Handbook of Research on K-12 Online and Blended Learning

(Second Edition)

EDITED BY KATHRYN KENNEDY & RICHARD E. FERDIG

HANDBOOK OF RESEARCH ON K-12 ONLINE AND BLENDING LEARNING (SECOND EDITION)

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Dedication

"Let a wise person listen and increase learning, and let a discerning person obtain guidance." (Proverbs 1:5, CSB)

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Preface

Richard E. Ferdig & Kathryn Kennedy

Introduction and Update from 2014

The idea for this Handbook originated in a New Orleans hotel lobby while we were waiting to present at a 2013 technology and education conference. Our conversation revolved around the need for a foundational set of literature to help researchers in K-12 online and blended learning. We wanted to help researchers —particularly those new to the field—have the opportunity to learn from others and proverbially 'stand on the shoulders of giants.' We believed a handbook would act as a key resource for existing and new researchers, practitioners, and policymakers in the field.

One year later, and with the support of Carnegie Mellon's ETC Press, we published the first edition of the *Handbook of Research on K-12 Online and Blended Learning* (2014). One of the many benefits of publishing with ETC Press was their willingness to make texts available electronically and openly with Creative Commons licenses. Readers of the first handbook (and this one) had the ability to download the materials, thus making them more widely available (or they could also pay to have a print version sent to them). Authors also retained the rights to their work.

The handbook was always meant to be an iterative publication (e.g. with multiple future editions). In other words, we knew that research and publications would continue to inform the field. However, for full disclosure, we were not necessarily sure when a second edition would happen or if readers were interested in even having that happen. We touched base with ETC Press in 2016; we were a little concerned that we only had 23 "sales" from the book. However, we were incredibly encouraged to find out that it had been downloaded over 35,000 times. We also paid close attention to research publications and conference presentations. We knew the research literature was growing, arguably exponentially since 2014.

With that in mind, we set forward the process of producing the second edition of this Handbook. What follows in the preface are minor edits from our 2014 preface as most of the background material is the same. There are three major changes from 2014. First, there are more chapters representing the increased amount of research. Second, we added section editors to help with the authoring, reviewing, and editing processes. Each section editor was also asked to write an introduction to their section. Finally, we updated section headings and added three new sections based on research in the field.

What this book is…and what it is not

This handbook is meant to be a resource for anyone interested in research, practice, or policy in the field of K-12 online and blended learning. This book is not intended to be a collection of opinions on the field. Nor is it meant to be a compendium of the top research articles for this past year. It is not a list of what is currently trending in K-12 online and blended schools. And, it is not a list of 'best pieces' from leading researchers in the field. Rather, this handbook is a collection of what we currently know about research in the field.

There are at least three main goals for publishing this work:

1. To continue to strengthen our field by providing clear evidence of what is known and what is yet to be known;
2. To provide an empirical resource for researchers (new and experienced) as well as parents, media, administrators, and policy officials; and
3. To set in motion repeated syntheses of the work in our field, with proposed frequent edition updates.

The Book's Outline

Our first step in creating the layout for this handbook was to discern the major topics in the field. There were three key ways we addressed this task. First, we examined the existing research in the field. We used that research to create categories. If we found an article that did not fit within a category or one that challenged our existing structure, we revised our framework. We continued with that process until we felt like we could comfortably fit existing research articles into the broad headings.

The second step was to compare that framework with existing handbooks of research. Obviously K-12 online and blended learning is a unique research area. However, other handbooks—particularly those in education—contain frameworks that are useful in helping to frame our work. We used those handbooks to determine areas of overlap as well as components that were missing from our framework.

The final step was to talk to experts in the field. We shared our framework with researchers and practitioners in the field. We asked them to evaluate the framework to see what we had gotten right and what we were missing. The outcome of the entire process was a nine section framework that included the following broad headings for the 2018 edition:

1. <u>A Background and Historical Perspective</u> – *What are the important background and historical markers that help contextualize research in K-12 online and blended environments?*
2. <u>Research on Learning and Learners</u> – *What does the research say about learning in K-12 online and blended environments?*
3. <u>Research on Teaching</u> – *What does the research say about preparing and mentoring current and future teachers?*
4. <u>K-12 Online & Blended Learning in the Content Domains</u> – *What does the research say about similarities and differences within content areas?*
5. <u>Research on Student Support Structure</u>s – *What does the research say about the role of the preparing and mentoring others who support K-12 online and blended environments?*
6. <u>Research on Instructional Design</u> – *What does the research say about effective design for K-12 online and blended learning?*
7. <u>Research on Learning Environments</u> – *What does the research suggest about new learning environments that will transform how we conduct and think about teaching and learning in K-12 online and blended learning?*
8. <u>K-12 Online Learning Around the World</u> – *What does the research say about how K-12 online learning is implemented around the world?*
9. <u>Emerging Issues</u> – *What are some of the emerging issues in K-12 online and blended learning research, policy, and practice?*

The General Outline of Chapters

After creating the framework, we went back to the researchers in the field to ask them to consider writing under each of the broad topics. We made suggestions as to when and where the authors' work might fit; however, we left it up to the authors to choose topics they felt most comfortable with. We asked authors in the "Background and Historical Perspective" to help set the stage for a deeper understanding of the research by providing a background and contextual information about K-12 online and blended instruction. We suggested to the authors that after consuming these chapters, the reader should have a context by which to understand the specific areas of research in the other chapters in the book. This would include an introduction, a discussion, and then a conclusion that set the stage for both where we are now and understanding what might come next.

Authors for the remaining sections received more explicit instructions as we wanted consistency between chapters. We asked authors to ensure that each chapter would include:

- Introduction – explain purpose and objectives of chapter. Include a layperson's description of the topic in a short overview including relevant definitions.
- Research Synthesis – categorize and present the research, preferably in themes, such that the chapter does not become a laundry list of everything published in that area but rather a synthesis of what we understand.
- Implications for Policy and Practice– given the research synthesis, what are the direct implications for policy, instruction, and preparation of teachers, students, and administrators?
- Implications for Research – given the research synthesis, this section sets the stage for what we have yet to learn that is a research gap in this specific context.
- Conclusion – What are the top highlights in terms of what we know about research, policy, and practice, and where we need to go next?
- References – this should be a section that highlights further reading as presented in the article.

Conclusion and Next Steps for Readers

The purpose of this handbook is to present a compendium of research devoted to K-12 online and blended learning. The goal is that any researcher or practitioner would be able to return to this Handbook and seek relevant and current information. There is value in having clearinghouses that attempt a similar purpose by linking to all the existing evidence. The value of this exercise is to move beyond collecting the research to also providing syntheses of those studies. The goal is to offer an understanding of where we have been and what research still needs to be conducted.

In order to continue to be relevant, our goal is to reproduce this Handbook frequently, updating chapters to reflect current research. Readers will undoubtedly see gaps in the chapters and in the topics that are present—or missing—in this book. In some cases, these gaps were related to researchers who weren't able to contribute to this iteration of the book. In other instances, gaps in chapters or missing topics in the book were related to a lack of literature in the field.

It is worth noting that we attempted to collect chapters even if there was limited research in the field. We wanted existing and new researchers and practitioners to see where we had gaps. We often had conversations with authors where we told them that it was ok to have a short research synthesis section of their chapter. We encouraged them to focus instead on what we knew outside of the literature to point to promising new areas of research and practice. Thus, in one year a chapter might have a small research synthesis section and a large section on research needs. A few years later and the ratio of text may have drastically flipped.

In conclusion, we are pleased to be able to present this *Handbook of Research on K-12 Online and Blended Learning* in its second edition. Our authors have produced thoughtful and well-written pieces that researchers, practitioners, and policy-makers can use to conduct studies or to improve practice. We ask readers to think of this work not as a completed product but rather a flowing conversation. We have attempted to get authors to note areas for future research. And, we ourselves have pointed at chapters we would like to have in future iterations. We encourage authors to contact us to propose missing research studies for certain chapters or for proposals on new chapters for future iterations.

Respectfully,

Richard E. Ferdig, Research Center for Educational Technology, Kent State University
Kathryn Kennedy, Michigan Virtual University

Acknowledgements

An edited book would not be possible without the contributions of authors. We would like to thank our authors for their hard work and dedication to the book in both authoring their chapters and supporting the revision process. This is the second edition of this book; the first was published in 2014. With this second edition, we introduced the concept of section editors. The section editors supported chapter development, review, and revision. They also wrote the introductions for their sections. Again, we are grateful for their service!

We would also like to thank Drew Davidson, Brad King, and the review board from ETC Press (Carnegie Mellon) for taking on this project. Drew and Brad were always supportive of us and our work. They were willing to answer questions even when our deadlines were pushed back, due, in part, to the size of this volume. We look forward to working with all of our authors (current and those who are already planning for the next edition) and ETC Press again in a few years' time.

In closing, we wish to thank our families for their support of our professional efforts, allowing us to give up personal time to complete this task.

Foreword

Joseph R. Freidhoff

Many publications on K-12 online learning emphasize how the number of online students and enrollments continue to grow rapidly and are at an all-time high. Such "high-water" sentiment is not often carried over to the summaries of existing research from which those publications build. The reality is that we have never known as much about K-12 online learning as we do today, and just like the number of students and enrollments, what we know is sizable and growing. What we know could fill a book!

Also true is that despite what we currently know, the performance of K-12 students in online settings is all too frequently underwhelming. To use Michigan as an example, state-level data have consistently demonstrated that K-12 students pass their online courses at a lower rate than they pass their face-to-face courses. The pass rate for online students in poverty trails the rate of those who are not in poverty, and students who are more successful in their face-to-face courses tend to also be successful in their online courses. Those who are not successful in face-to-face courses frequently continue to struggle when taking online courses.

Central to addressing this problem is designing online programs that align with proven practices from the field. That starts with introducing more people to the research evidence followed by rectifying the numerous instances of online programs that run contrary to this evidence. Hence, this book edited by Ferdig and Kennedy, and authored by so many leading scholars in our field, is a significant opportunity. At the same time, that opportunity must be paired with substantial effort to pursue new research initiatives, many of which are identified across the chapters of this book. As a novel framework for pairing the consumption and the creation of knowledge, I ask readers to consider some of the tenants of Amazon, one the most successful companies on the planet.

Even though Amazon has existed for more than 20 years, founder Jeff Bezos remains focused on maintaining a "Day 1" philosophy. In his 2016 Letter to Shareholders[1], Bezos elaborated on why every day has to be Day 1. He states, "[d]ay 2 is stasis. Followed by irrelevance. Followed by excruciating, painful decline. Followed by death. And that is why it is *always* Day 1." To remain in Day 1, Bezos identifies several defenses a few of which include obsessing over customers, resisting proxies, and utilizing high-velocity decision making.

The obsession with customers, Bezos argues, is the most productive strategy.

> Customers are *always* beautifully, wonderfully dissatisfied . . . want something better, and your desire to delight customers will drive you to invent on their behalf…Staying in Day 1 requires you to experiment patiently, accept failures, plant seeds, protect saplings, and double down when you see customer delight. A customer-obsessed culture best creates the conditions where all of that can happen.

Bezos is also wary of proxies. His thinking is that as companies grow, the tendency is to focus more and more on things other than the desired result, for instance, on process. In his words, "[t]he process is not the thing. It is always worth asking, do we own the process or does the process own us?"

Finally, Bezos warns against waiting to take action. High-quality decision making, Bezos proclaims, is Day 2 thinking. In Day 1, decisions must be both high-quality and high-velocity. To increase velocity, Bezos recommends that, in most cases, it is better to make decisions with 70% of the desired information rather than waiting until more is known.

So how might these tenants relate to the field of K-12 online learning? I submit that learners should be the objects of our obsession. I use the term "learners" (rather than "students") to encompass both K-12 students as well as the adults working

1. https://www.amazon.com/p/feature/z6o9g6sysxur57t

to implement solutions for K-12 students. We need to ask ourselves if the work we are engaging in is going to delight these two populations or if our primary audience is someone else.

Similarly, when it comes to resisting proxies and focusing on results, we need to ask if we able to distinguish between the two. Again, I offer that we must focus on learner results—results that directly (as possible) and positively impact the performance of K-12 students. It is worth examining, for each of us, how often we are painstakingly focused on impacting K-12 student performance and how that compares to the amount of time we spend honoring our plethora of proxies (e.g. tenure and promotion expectations or adhering to publication standards and methodologies). We need to consider what proxies are holding us back from making a bigger impact on student results.

I think it is safe to say that we all want our research findings to lead to higher quality decision making. This drives many of us in the field. As tempting as it may be to make recommendations to slow down until we know more, a Day 1 mindset would advocate for speeding up. Every day, educators across the globe are making important decisions that impact the lives of students; out of necessity they are making these decisions with less than optimal levels of information and understanding. How is our work keeping up with the current questions being asked, and how are our recommendations, and where we share them, assisting K-12 educators to make higher-quality, higher-velocity decisions?

Let me end by encouraging the cross-pollination of the ideas and issues laid forth in this handbook with the Day 1 principles introduced above. As an illustration, consider the challenging discussion that is taking place in states across the U.S. when it comes to appropriate levels of funding for cyber schools. At the risk of oversimplification, a frequent logic offered for why cyber schools should operate at a lower funding level than traditional schools is due to the fact that these schools do not provide busing or food services to their students. Proponents of equal funding cite heightened expenses in other areas that offset the lack of expenses for transportation or food programs.

Through a Day 1 lens, both of these arguments are borne out of obsession with money (how much, who is paying and who it goes to) rather than out of an obsession with K-12 students. By refocusing on students and what would delight them, we might perceive the problem differently. For instance, cyber school students, and likely their parents, might be delighted if their schools had food programs available to them. After all, the food program benefits that students who attend traditional public schools reap would similarly apply to cyber school students who currently are not afforded the same assistance.

Thus to date, process (or in this case, the lack of a process) has been the priority rather than results. The assumption that a school without a physical building cannot provide (or cannot be expected to provide) food to its students is treated as fact. If we resist that proxy argument and instead conclude that as public school students, cyber school students would benefit from and have a right to food services through their public cyber school, then we are left to confront a significant challenge: We don't know how to deliver school food programs to students who are geographically-dispersed, and even if we knew how, we don't know how to do it in a financially-viable manner.

From a high-velocity mindset, this would not be seen as an insurmountable task, but rather a golden opportunity. Possible solutions also seem less far-fetched as multiple companies have figured out affordable ways to ship pre-packaged meals to one's doorstep, and major grocery chains deliver entire shopping lists of food to customers' homes. The lessons learned from these adjacent activities may inform solutions for education, and the companies involved may contain eager partners willing to work with cyber school providers to create solutions for their students. Clearly, there is much that is unknown, but a high-velocity mindset tamps down the anxiety that quells from such deficit thinking and elevates the belief that the result is more likely to be achieved by moving ahead before we have all the answers.

What the application of the Day 1 principles in this scenario illuminates is that the typical arguments that surround cyber school funding are not the only arguments that could be made. For instance, those arguing for reduced funding for cyber schools could argue that cyber schools should be required to provide additional services commonly required of traditional schools. On the flip-side, cyber schools might accept this new expense in order to retain their current levels of funding or perhaps use these new expenses to advocate for additional funding.

As you read through the chapters of this handbook and engage with the ideas contained within, consider leveraging the Day 1 principles. They just may help you take on additional perspectives from the book.

PART I

Background and Historical Perspective

1

Introduction

Anissa Lokey-Vega

The field of K-12 online and blended learning is a relatively young field that is just now maturing away from the precursory studies involving distance learning that depended on mail and, later, satellite services. The field was really born as K-12 distance education switched away from mail and satellite TV to internet-based courses in the mid and late 1990s. Initially terminology in the field varied and included now-unrecognized terms like "netcourses" "callbacks" or "groupware" (Litke, 1998; Isenour et.al., 2000; and Kozma et.al 2000), and over the past 20 years a common vernacular has emerged improving communication among stakeholders and further distinguishing phenomena within the field. This section will introduce readers to a broad understanding of the field of K-12 blended and online learning. The contributing authors have a strong history of work within the field, and have consulted with the body of literature evident in the field, selecting the most useful and trusted sources. This section will take you across the globe and into the virtual classrooms, through methodological debates, and into a call for field-specific theory, all while providing a wealth of exemplars to help the reader accurately conceptualize this dynamic field in his/her mind.

To leap into a history of the field, read Schwirzke, Vashaw, and Watson's chapter titled *A History of K-12 Online and Blended Instruction in the United States*. This chapter not only provides the reader with a clear timeline of how K-12 virtual schools developed and spread across the United States, but they also give us a survey of key policy issues that have affected that development and spread. Finally, critical to the scholarly conversation and further reading, the authors provide us with a set of established definitions within the field that can be referenced as a set of community-constructed key terms.

This book, however, seeks to be broad enough to serve scholars across the globe, while broadening the perspective of scholars in the United States. This effort would be incomplete without input on the global expansion of K-12 online and blended learning. Barbour tackles this in our third chapter, *Exploring K-12 Distance, Online, and Blended Learning Worldwide*, where he reports on models found in Australia, Europe, Central America, the Middle East, and Asia. Not only does he report on international successes and research, but he also reveals key differences between models in the United States and those found internationally, many of these differences including or related to policy.

The fourth chapter, *History of Policies in K-12 Online and Blended Learning*, by Rice and Skelcher dives deeper into the dynamic history of how various policies or legislation have influenced virtual schools and practice in the United States. To provide structure for the reader, Rice and Skelcher approach the policies using four themes: Online and Distance Learning, Accountability, Innovation and Reform, and Teacher Education. These authors bring the history forward to present day by including the reauthorization of the Every Student Succeeds Act (ESSA) and the current National Educational Technology Plan.

Following policy, Lokey-Vega, Jorrín Abellán, and Pourreau discuss the current state of theory in the field of K-12 online and blended learning. First, they offer a collection of common definitions and belief systems that surround theory and are influential on research and teaching practice. Then, they make a case that the field currently has an inadequate use of theory, and is ready for researchers and theorists to borrow and build upon theory from tangential fields of study. Finally, they offer a conceptualization of how Connectivism might be a means to launch the field into its next phase of maturation.

Lowes and Lin's chapter six, *A Brief Look at the Methods Used in the Research on K-12 Online Teaching and Learning*, displays exemplars of key research traditions demonstrated in the field within the past fifteen years. The authors organize the chapter according to three main themes: quantitative, qualitative, and mixed methods studies. Within each theme, the authors provide a description of both data collection and analysis methods in efforts to reveal methods best suited to the unique context of K-12 online learning.

Related to research, but applied to specific events and contexts is program evaluation. In chapter seven, Clark gives us an overview of evaluation's relationship to research and the typical approaches used by evaluators. He also provides us with a collection of program evaluation exemplars and engages us in the trends evident within program evaluation of K-12 blended and online learning programs.

In the first chapters, the authors make wide sweeping strokes to paint a picture of blended and online learning in the K-12 setting, glimpses at the international and national trends or patterns. While still broadly speaking, Davis, Dabner, and Mackey's chapter, *Changes in School Culture with the Emergence of Virtual Schooling*, provides us a look at what impacts online learning programs have on local school and classroom cultures. In this chapter, the authors present us with a description of K-12 school cultures and how they are generally being influenced by blended and online learning. To further paint a picture for the reader, they provide us with an illustrative example of how Iowa high school cultures were influenced by the inclusion of an online learning program, the Iowa Learning Online.

Mohammed closes section one with her chapter, *Measurement in Emerging Learning Environments*, which offers insight into traditions and newer more-responsive investigations of causal relationships in new learning environments. Maintaining that understanding causal relationships through measurement helps build knowledge of best practice in educational settings, Mohammed presents methods beyond randomized controlled trials that better suit the context and ethics aligned with K-12 teaching and learning.

Conclusion

The purpose of this handbook section is to zoom out and see the field as a whole, a broad understanding of where it came from and the directions in which it is currently going. It is a must-read for all doctoral students and emerging scholars being initiated into the field, and who seek a synthesis of the big picture spanning roughly 20 years of research. In this time, scholarly leaders have established critical community infrastructure for networking and knowledge building that would benefit any current or new scholar in the field. Today this infrastructure includes special interest groups (SIG) and social media collaborations like that of the K-12 Online Learning SIG, a group founded at the Society for Information Technology and Teacher Education (SITE) conference. Just 3 years ago, leaders established the first K-12 online learning focused peer-reviewed research publication, Journal of Online Learning Research. Only four years ago, the first edition of this handbook set a notable stake in the timeline of the field (Ferdig & Kennedy, 2014), and this second edition further perpetuates the momentum of the work that is taking place among this community of scholars. This field has made great strides in growth attributable to a common sense of responsibility to the future generations of K-12 learners and educators who deserve and need high-quality online learning experiences.

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2

A History of K-12 Online and Blended Instruction in the United States

Kelly Schwirzke, Lauren Vashaw, & John Watson

Abstract

This chapter reviews the history and progression of online and blended learning in K-12 education in the United States. Program categories discussed include state virtual schools, fully online schools, blended learning, and digital learning activity in traditional school districts. Key policy issues affecting the development of online and blended learning are also addressed, including course choice, online learning requirements, student achievement, and school accountability.

Introduction

The earliest examples of K-12 schools in the United States using the World Wide Web to deliver instruction date to the mid-1990s. As of late 2017, online learning is entering its third decade, and the trajectory of online learning development over that time helps explain the status, benefits, and challenges of online, blended, and digital learning today.

Some of the earliest online programs provided supplemental online courses to students in traditional schools. Two examples, which are still in operation, are the Virtual High School (VHS) and Florida Virtual School (FLVS).

- VHS is a nonprofit collaborative of schools founded in 1995 that began offering online classes in fall 1997. The VHS structure allows members to share online instruction and content. In addition, members benefit from online course development, a technology platform, teacher professional development, and other online learning services. VHS partners with nearly 200 middle and high schools in Massachusetts and has more than 6,800 enrollments in the state. It has additional members in 40 states and territories and an international presence with students in 33 countries. VHS had 18,455 course enrollments and about 12,000 students in FY 2015–16 (Evergreen Education Group, 2016).
- FLVS began as the "Web School" in Orange County, Florida, during the 1996 school year. Encouraged by the Florida Department of Education (DOE), it then partnered with Alachua County and received a $200,000 grant from the DOE in November 1996 intended to develop the Florida High School (FHS) project. FHS officially launched with seven staff members in August of 1997. In 2000, legislation established FLVS as an independent education entity. Legislation enacted in 2002 and 2003 granted parental rights for public school choice, listed FLVS as an option, and defined full-time equivalent (FTE) students for FLVS based on "course completion and performance" rather than on seat time. FLVS is one of the few state virtual schools in the country that is funded based on successful course completions. Florida students retain the right to choose FLVS courses to satisfy their educational goals. FLVS successfully served 290,000 students collectively through FLVS Flex and FLVS Full-Time programs in FY 2015–16 (Evergreen Education Group, 2016).

The first fully online schools, serving students taking their entire course load online, also date back to the mid-1990s. Some of these were private schools, such as Laurel Springs in California, and traditional school districts, such as Monte Vista School District in Colorado, which began opening online schools as well. Soon after, the major online school service providers K12 Inc. and Connections Academy began working with schools in multiple states.

Other early adopters of K-12 online learning were programs that evolved from correspondence schools or distance education programs (Watson, 2012). This includes, for example, the North Dakota Center for Distance Education, which began delivering correspondence classes in 1935 and evolved to offer classes through many different delivery methods, including online. Another example is the University of Nebraska High School which began delivering paper-based correspondence courses in 1929, launched its first "Tele Learning courses" where students submitted work by email in 1985, and offered its first full diploma sequence online in 2001.

Fifteen to twenty years ago, the K-12 online learning world was mostly contained within a few well-defined dimensions: there were state virtual schools and fully online schools, but there was essentially no blended learning as currently defined and very little district-level activity. In the years soon after the turn of the century, the online learning landscape was dominated by the cyber charters offering a fully online education to students in Pennsylvania, Ohio, and elsewhere, and the state virtual schools offering supplemental online classes to students in states, such as Florida, Illinois, and Kentucky.

The landscape is not nearly as simple now. While some challenges from years ago continue today—including a constant tension between Pennsylvania's cyber charters and district schools, and the persistent question about how state policymakers choose to fund supplemental online courses—nearly every aspect of the online and blended landscape has become more complex, more interconnected, and more volatile. Providers have multiplied and diversified: yesterday's virtual charter school operator is also today's course vendor and blended learning consultant, while the leading state virtual schools now serve fully online students, blended students, and teachers with professional development. As customers, schools are aiming for a wide range of virtual, blended, part-time, full-time, and mobile offerings. Multiply this by thousands of districts, charter schools, private schools, education agencies, and all 50 states, and the source of the proliferation becomes clear (Evergreen Education Group, 2013).

State legislatures have moved in uneven bursts to create statewide supplemental course options, build online schools into charter laws, and incentivize districts to create opportunities for their own students. The emerging results for students still tend to be a varying set of options that are often dependent upon zip code. In some states, students in all districts have access to a variety of providers of full-time and supplemental options, whereas in other states the only options are those made available to a handful of students by their own districts (Evergreen Education Group, 2013). (Because this chapter is mostly focused on public education, this analysis does not consider that many families augment their children's publicly-funded education by purchasing online courses and content from private providers.)

Identifying Online and Blended Learning Options

As the field has evolved, researchers and practitioners have identified several categories of online and blended learning that allow for data collection and sharing of best practices of similar teaching methodologies. These strands developed on related but independent paths and include full-time online programs/schools; programs that provide supplemental online courses; and schools implementing a wide variety of blended learning models in individual classrooms, across grade levels, or school-wide.

Supplemental Online Courses

Supplemental online programs provide a small number of courses to students who are enrolled in a school separate from the online program. Some states call these programs part-time programs. The first statewide supplemental online programs were state virtual schools, which sought to level the playing field for all students statewide by making robust course catalogs available to all students. The first state virtual schools were groundbreaking, opening the door for dozens of states to offer similar opportunities to their students over the last 20 years:

- Utah Electronic High School began serving students in 1994.
- Hawaii Department of Education e-School was formed in 1996.
- Florida Virtual School (FLVS), as mentioned above, began serving students with supplemental courses in January 1998.

Other programs followed closely on the heels of these early adopters. Michigan Virtual School was funded by the Michigan Legislature in 2000 to be operated by the Michigan Virtual University, a private, nonprofit corporation. It has grown to become one of the larger state virtual schools in the country, serving 24,397course enrollments in school year 2015-16. The Idaho Digital Learning Academy was created by the state legislature in 2002 and served 25,488 course

Definitions

Online learning

Online learning is where instruction and content delivered primarily over the Internet. This term is used interchangeably with virtual learning, cyber learning, and eLearning. Students can participate in online learning through one course (supplemental), or a fully-online school or program.

Blended learning

Blended learning is defined by the Clayton Christensen Institute as a formal education program in which a student learns at least in part through online learning, with some element of student control over time, place, path, and/or pace; at least in part in a supervised brick-and-mortar location away from home; and the modalities along each student's learning path within a course or subject are connected to provide an integrated learning experience.

These modalities could include small group instruction, online learning, individual instruction, group projects, and pencil and paper assignments.

Supplemental online programs

Supplemental online programs provide a small number of courses to students who are enrolled in a school separate from the online program. Sometimes referred to as part-time.

Digital learning

Digital learning is an umbrella term that may include online learning, blended learning, and other uses of educational technology.

Table 1: Online learning research

enrollments in school year 2015–16. The Illinois Virtual School has been serving students since 2001, originally focusing on high school courses but expanding in recent years to include middle school courses and professional development. Georgia, Kentucky, North Carolina, and Arkansas are among the other states that made supplemental courses available to students statewide by creating some of the first state virtual schools.

The number of state virtual schools peaked in school year 2009–2010. Since then the number of state virtual schools has dropped slightly from its peak of 31, but the number of course enrollments has continued to grow, to almost 950,000 in school year 2015–16 (Evergreen Education Group 2016). While total enrollments nationwide have continued to grow year after year, not all of these schools are able to serve students in their states equally, resulting in steady growth in some programs and enrollments staying steady or even shrinking in other states.

There are two likely causes for this shift. First, in most states, individual districts, consortia, and private providers have grown to play an increasingly larger role in providing supplemental online courses to students. Second, in many states, state virtual school funding has been restricted or reduced in recent years, resulting in inadequate funding to meet demand.

The state virtual schools that continue to grow are either funded based on a formula that taps into the public education funding formula (e.g., Florida and North Carolina), or are well-funded via state appropriations relative to the size of the state (e.g., Idaho and Michigan).

FLVS remains by far the largest state virtual school, growing to 471,576 course completions in school year 2015-16. The growth of FLVS reflects a straightforward set of policy and funding choices. FLVS was first supported with state appropriations totaling more than $20 million in the late 1990s and early 2000s; subsequently Florida passed a law that allows any student in Florida to choose an FLVS course, and that student's funding follows the student to pay for the FLVS course.

State virtual schools that have remained small or are now shrinking have been created relatively recently (e.g., Vermont), have not grown over time (e.g., Colorado, Hawaii), or have dropped in size in recent years due to funding cuts (e.g., Iowa, Missouri). Most of the small state virtual schools have not received annual appropriations of more than a few hundred thousand dollars and sell courses to districts at rates similar to the fees charged by private providers.

In recent years, some states have shut down state virtual schools. Kentucky Virtual School, one of the oldest state virtual schools but one that never grew much, closed in 2012. Tennessee's state virtual school, e4TN, had been funded via Enhancing Education through Technology grant money, and with the loss of the funds, it closed prior to school year 2011-12. Connecticut closed its state virtual school at the end of school year 2012-13 due to lost funding and lack of enrollments. Louisiana redirected state funds from the state virtual school, Louisiana Virtual School, to a new state course choice beginning in school year 2013-14.

Course Choice and Access

This shift away from support of state virtual schools, in some states, has created opportunities for different types of providers and policies. One way in which states are offering supplemental options to students statewide is through state-supported course choice programs, which are designed to allow students to choose the course and provider that best meets their needs. A course choice program is one in which:

- The student chooses online courses from one or more providers.
- The student retains control over the choice. In much the same way that open enrollment laws allow students to choose schools other than those in their districts of residence, course choice allows students to choose a single academically appropriate course from outside their districts of enrollment.
- A significant portion of the student's public education funding flows to the provider of the online course.

Fourteen states had some type of course choice programs or policy in school year 2014-15, although some of these operate with some restrictions. Most of these programs are still in early stages and are experiencing mixed success in achieving the goal of giving students choice in their course providers.

Course choice programs have restrictions in place that stretch along a continuum that relate to available grade levels, number of funded courses, whether the course is core or elective, whether multiple providers are authorized, and the funding method. In some states, districts have a variety of reasons in policy that they can deny students their online course preferences. Some of these are related to funding or educational goals (e.g., students cannot retake a course that they already passed, students cannot take an out-of-district course if the district offers that course, or students can take online courses only if the courses are consistent with the students' educational plans), but they may be used to restrict options through students not being given a method of appealing if their online course choice is denied. The programs in Utah and Louisiana have received considerable attention in the media and among policymakers as examples of course choice and are explained in more detail below.

The Statewide Online Education Program (SOEP) in Utah is among the first and best-known course access programs in the country. The program is small, although growing, serving 4,220 course enrollments in school year 2014–15. This was an increase of 33% over school year 2013–14. Students advance based on competency. SOEP opened to private and homeschooled students in school year 2013, and as of August 2015, these made up 44% of student enrollments. The state maintains a list of approved district and charter providers. Any LEA—charter or district—can apply to be an online provider. Providers receive 50% of course fees after the withdrawal period, and 50% when the credit is earned on time; they may also receive a reduced final payment if the student eventually completes the course. There are different funding levels for core and elective courses ranging from $218–$381.

As of school year 2016-17, the program allows students to enjoy online access to all credits necessary to meet state graduation requirements, while they remain fully enrolled in a school district or charter school that offers additional services and activities supportive of their success, including graduation, counseling, IEP management, sports, and extracurricular activities. Students may sample from a range of options and providers while immersed in a traditional school community in which they can access the array of services associated with their boundary school or other school of choice. In recent years, state public institutions of higher education (including Community Colleges and Utah Colleges of Applied Technology) were integrated as providers, with the intent that this will allow SOEP to expand career, vocational, and concurrent enrollment options. Utah's extensive course access program is facilitated by the state's "Student Achievement Backpack," and robust system of student identifiers.

In Louisiana, the course choice program, called the Supplemental Course Academy (SCA), replaced the Louisiana Virtual School, which was defunded at the end of school year 2012–13. The Louisiana Supreme Court found the original Course Choice funding model unconstitutional after initial enrollments had begun in school year 2012–13. To keep the program operational during its first year, the Department of Education reallocated $2 million in one-time funding for the school year 2013–14 pilot program. SCA funding is now a component of Louisiana's public education funding, which is called the Minimum Foundation Program (MFP). All districts and charter schools received a dedicated SCA funding stream equal to $26 per student in grades 7–12 in school year 2014–15 (about $7.5 million in total), in addition to the regular public education funding formula. These funds must be spent on tuition for course offerings from state-approved course providers. In 2015 the Louisiana legislature approved an additional one-time SCA allocation of $9 per student in grades 7–12—an increase of 35% in the base SCA—creating over $10 million in course access funding for school year 2015–16. K–12 course providers receive 50% of course fees upon enrollment and 50% upon completion, or 40% upon eventual completion if the student's time in the course is extended. Dual enrollment/postsecondary course providers receive their entire tuition up front but are required to issue refunds to students who withdraw from courses before stated deadlines. School districts work with students to select their online, hybrid, and face-to-face course offerings. All course registrations require local school counselor approval to ensure that each course is academically appropriate, and logistically feasible, and keeps the student on track for an on-time graduation.

Full-time Online Schools

Full-time online schools, also called cyberschools, work with students who are enrolled primarily (often only) in the online school. Cyberschools typically are responsible for their students' scores on state assessments. In full-time online schools, students enroll and earn credit and diplomas issued by the online school.

Online schools typically have served students full-time from across multiple districts and often an entire state. Historically these schools were primarily charter schools; however, there has been a rise in the number of districts offering full-time online programs for students within their district and to district programs authorized to serve out-of-district students (also called multi-district online programs). These programs can issue a diploma from that district. States differ on whether these schools can serve out-of-district students, whether they must seek specific authorization to serve students entirely online, and whether they must report online enrollments to the state department of education. As a result, the amount of information available about full-time online schools varies widely.

Total enrollment in multi-district, fully online schools continues to grow nationwide, although that pace has slowed in recent years. In school year 2013–14, the latest year for which numbers are available, thirty states had fully online schools serving a total of about 315,000 students, with a year-over-year increase of 6.2%. Policies and practices vary by state; two illustrative examples are Pennsylvania and Colorado.

Pennsylvania was not the first state to allow full-time online schools, but it was among the first to see rapid growth in both the number of schools and students. Cyber charters have dominated K-12 online options in Pennsylvania since SusQ-Cyber Charter School first opened in 1998. In response, districts have been opening their own cyber academies in order to keep students—and their per pupil funding—in the district. While legislation has been proposed many times over the years to remedy this situation, it has yet to change.

Colorado's current online learning policy framework dates to December 2006 when the Office of the State Auditor released an audit reviewing full-time online programs and the performance of the Colorado Department of Education (CDE) in overseeing online programs (Colorado Legislative Audit Committee, 2006). The Trujillo Commission, formed in response to the audit, and a task force formed by the State Board of Education, suggested recommendations for legislators and expressed concerns about the lack of oversight of full-time online programs (Donnell-Kay Foundation, 2007). In response, the legislature passed SB215 in May 2007, which made numerous changes to online education regulations. The bill made many changes to online programs, the most significant of which was creating a distinction between multi-district online programs and single-district programs; while both types of programs were required to submit an annual report to the CDE, the multi-district online programs were subject to greater oversight because the authorizers of multi-district programs had to be state certified as demonstrating capacity to run an online program. Although further changes have been made to the regulations since then, the basic framework in which districts and BOCES can create online schools serving students statewide, under regulations and reporting created by the state, remains.

Some states, including Michigan, Wisconsin, and Indiana, have all lifted various online school caps in recent years, allowing for easier student access and significant increases in student enrollment. However, in states where a fully online option has been readily available to students, the pace of growth tends to be slower, and total enrollment has never exceeded 3% of the state's K-12 student population.

Full-time online schools are responsible for requirements that pertain to all schools, as determined by state and federal regulations. The federal regulatory framework under which schools operated for about 15 years was No Child Left Behind (NCLB), which was enacted in 2002. The Every Student Succeeds Act (ESSA) was signed into law in late 2015 to replace NCLB. Regulations under ESSA have not yet been finalized but continue to require the use of state assessments along with other measures such as graduation rate.

District Online and Blended Programs

While state virtual schools and online charter schools were responsible for most online learning activity in the early years, some traditional school districts began offering online options to their own students in the late 1990s, and the trend has accelerated since then. This has been driven by a variety of factors:

- The increased acceptance of online learning, and the effectiveness demonstrated by early online programs;
- Perceived or real competition from state virtual schools and online charter schools;
- The increase in available content, software, and professional development, which allows more districts to start and grow their own online schools by mixing and matching elements that they outsource and develop in-house; and
- A recognition that blended learning can be a transformative factor that personalizes learning for students.

Many district online and blended programs have a few common characteristics, although with exceptions. Most have an onsite component and therefore are blended and not purely online. Of those that are fully online, many serve students for a short period of time, from a few weeks to several semesters. The blended programs generally fall into two categories, although with exceptions. One category is made up of blended learning based in traditional schools, operating within existing school buildings and on usual semester schedules. These programs are most common at the elementary school level and are used primarily to bolster and differentiate instruction among students by using online content that focuses on skills in math (most often), ELA, and sometimes other subject areas including English language acquisition. A second category, which is more common at the high school level, is made up of new schools and programs that are using online courses and content to create an alternative to traditional schools. These innovative programs typically have some method of accounting for student attendance in ways other than seat time, and may combine high school course work with college courses, jobs, internships, and other activities.

Some districts combine both categories of online and blended learning. One example is the blended learning program in the Washington County School District in St. George, Utah. The district started its blended learning programs in 2013 after accumulating years of experience operating the Utah Online School, a virtual school enrolling students in the district and across Utah. The Utah Online School opened with elementary grades in 2004 and added high school in 2011. The district learned from the experience of operating the online school and developed blended courses combining online and onsite content and student support. The courses are offered both for original credit and what the district terms "recovery-content." The district uses this term because it focuses on helping students master content, as opposed to earning credits, to ensure that students graduate college and career ready. The district has demonstrated success with its blended learning programs, as its graduation rate improved from 80% in 2012 to 88% in 2014, and the high schools that implemented the most recovery-content courses had the largest increases in graduation rate (Evergreen Education Group and Clayton Christensen Institute, 2015). Numerous additional district examples exist as well. For example:

- Gwinnett County Public Schools (GCPS), a large suburban district outside of Atlanta, Georgia, with approximately 178,000 students, runs the Gwinnett Online Campus (GOC). GOC offers both supplemental online courses and a full-time online option for students. It had 5,124 course enrollments during the 2015–16 school year and also enrolled over 500 full-time students in grades 4–12. The instructional program for students in grades 4–9 offers a blended approach in which full-time online students can attend learning labs on campus two mornings per week or log in from home to join the live class sessions. These students meet face-to-face with their online teacher once per week. High school students taking online courses are able to come to campus once per week and meet with the Department Chair or their online teacher to receive additional curricular support. Students enrolled in science courses also attend live science labs.
- Clark County School District (CCSD), the fifth largest school district in the U.S. with about 320,000 students, created the Nevada Learning Academy at Clark County School District (NVLA) as the primary provider of both supplemental and full-time online learning opportunities for students in grades 6–12. NVLA provides a variety of online options including a blended middle school, in which students come to campus two days a week for teacher-led instruction and project-based learning. NVLA was started in fall 2004 as Clark County Virtual High School. In subsequent years, the virtual high school joined with the Academy of Individualized Studies, expanded online courses for middle schools in the district, and became NVLA. NVLA had 11,439 students take 23,513 online courses in fiscal year 2015–16. In addition to NVLA, CCSD has focused on providing blended learning opportunities across the district, using teacher-developed courses and vendor-provided courses. The district had 93,240 course enrollments in vendor courses in the 2015–16 fiscal year.
- Ephrata Area School District (EASD), a small district with about 4,000 students in eastern Pennsylvania, runs the Ephrata Virtual Academy (EVA). Like other districts in the state, part of the reason for starting the online school was to compete with the online charter schools that enroll students from many districts. EVA leadership has also begun to provide professional development to teachers across traditional schools in the district, using its knowledge and experience with online learning to help teachers adopt digital content and individualize learning. During school year 2014–15, EVA served 103 unique students with 226 supplemental course enrollments. Most of these were core courses in math, ELA, social studies, and science. The district also offers summer school credit recovery using EVA online courses (Evergreen Education Group, 2016).

Although many anecdotes like these exist, the overall use of digital learning in traditional school districts remains murky because most states have little or no required reporting to note whether students are in online, blended, or traditional courses. Over a few years starting around 2010, several studies were released that provided a limited snapshot of the field, including reports published by the National Center for Education Statistics (NCES) in 2011 (Queen and Lewis, 2011), the California Learning Resource Network (CLRN) in 2012 and 2013 (Schwirzke et al., 2012), the Southern Regional Education Board (SREB) in 2012 (Lynde, 2012), and the Evergreen Education Group for rural Colorado in 2012 (Watson and Murin, 2012). More recently, reporting from Michigan Virtual Learning Research Institute paints a picture of online course enrollments across the state, but this reporting is an exception among states (Freidhoff, 2017).

Transformational Potential of Blended Learning

Blended learning evolved from traditional classrooms seeking to use technology to improve student outcomes and fully online schools that recognized the need to provide some students with face-to-face support. The Clayton Christensen Institute for Disruptive Innovation defines blended learning as, "a formal education program in which a student learns at least in part through online learning, with some element of student control over time, place, path, and/or pace; at least in part in a supervised brick-and-mortar location away from home; and the modalities along each student's learning path within a course or subject are connected to provide an integrated learning experience" (Clayton Christensen Institute, 2013). However, the term "blended learning" is used to describe many situations that do not conform to the definition.

The Christensen Institute's May 2013 report—*Is K-12 Blended Learning Disruptive?*—looked at whether blended learning, as conceived and implemented in many schools, will be transformative in producing significant improvements in student outcomes. The Christensen Institute provides a valuable theoretical grounding to this question.

> Often industries experience a hybrid stage when they are in the middle of a disruptive transformation. A hybrid is a combination of the new, disruptive technology with the old technology and represents a sustaining innovation relative to the old technology… In many schools, blended learning is emerging as a hybrid innovation that is a sustaining innovation relative to the traditional classroom. This hybrid form is an attempt to deliver "the best of both worlds"—that is, the advantages of online learning combined with all the benefits of the traditional classroom. In contrast, other models of blended learning appear disruptive relative to the traditional classroom. They do not include the traditional classroom in its full form; they often get their start among nonconsumers; they offer benefits that accord to a new definition of what's good; and they tend to be more foolproof to purchase and operate. (Christensen, Horn, & Staker, 2013, p. 4)

Four years after that report was published, and about a decade after blended learning first gained widespread recognition, the answer that appears to be developing is this: schools that combine technology with excellent planning, teacher professional development and support, and the patience to wait several years to see results, are showing positive outcomes. Many of these schools were started and operate outside the mainstream of traditional public education structures. Examples include Innovations Early College High School in Utah, Poudre Global Academy in Colorado, Brilla College Prep Public Charter School in New York, and Oasis High School in California. In addition, several outstanding examples exist within traditional public school districts as well, including Horry County in South Carolina, and Washington, DC.

Counter-examples exist as well, however. Many cases exist in which schools and districts made major investments into acquiring computers and software, with few or no results to show. In most of these cases, a lack of planning or sufficient teacher support caused, or at least contributed to, the lack of success. The case of Los Angeles Unified School District investing in iPads is among the most commonly cited, but many other districts have had experiences similar to LAUSD, although most have received less media attention (American Institutes for Research, 2015).

Key Policy Issues

Online Course Requirements

Over several years in the mid-2000s, several states passed laws or regulations requiring students to complete an online course in order to graduate from high school. Many other states considered similar requirements, and it seemed that online course graduation requirements might become common. In recent years, however, no state has created a new online learning requirement, and five states now require students to complete an online course to graduate:

- Alabama's began with the graduating class of 2013.
- Arkansas' began with the graduating class of 2018.
- Florida's began with students entering 9th grade in school year 2011-12.

- Michigan's began with students entering 8th grade in 2006, making it the first such requirement in the country.
- Virginia's launched with students entering 9th grade in school year 2013-14. (Evergreen Education Group, 2014)

Other states, including Georgia, New Mexico, Massachusetts, and West Virginia, have passed rules or legislation encouraging but not requiring online learning.

The extent to which online learning graduation requirements have had an impact on the adoption of online or blended learning is unclear. Some states (e.g., Michigan) allow students to have an online learning "experience" in place of a fully-online course. Other states have little or no enforcement of the online learning requirement provisions. Michigan, Florida, and Alabama have certainly been among the states with the most K-12 online and blended learning activity overall, but it is unclear how much of that activity would have occurred in the absence of the online learning graduation requirement, as those states have funded state virtual schools and supported online and blended learning in other ways as well.

Student Achievement

Educators and policymakers often ask the same question about any technology integrated in teaching and learning: does this technology work? Results from research on K-12 online and blended courses and schools have provided two decades' worth of evidence to suggest that teaching and learning online can work. Studies that have shown positive outcomes include the 2009 U.S. Department of Education meta-analysis (Means, 2009) (which included a large proportion of studies looking at post-secondary students) and the meta-analysis done by NCREL in 2004 (Cavanaugh et al.). In addition, data from and studies of specific schools have shown positive outcomes. For example, Florida Virtual School received a positive review of its performance by the Florida TaxWatch Center in 2008. The rating was based on extensive research into student achievement, demographics, AP scores, and enrollment information (Florida TaxWatch, 2008).

However, just because online learning **can** work does not mean online learning **will** work in all cases. As with traditional brick-and-mortar education, there are many high-quality schools, and many that fall short. This finding is not unique to K-12 online and blended learning but extends to other types of educational technology as well. Researchers studying technologies ranging from educational radio and television (Salomon & Gardner, 1986) to a wide range of uses of computers in education across many countries (Organisation for Economic Co-operation and Development Publishing, 2015), have all found evidence of relevant studies that have collectively shown both positive and negative outcomes, or no significant difference. In some cases, the studies might essentially be comparing apples and oranges; in other cases, there are both good and bad examples of the actual implementation. In the United States, recent media attention has focused in particular on the performance of fully online schools, and reports such as CREDO's 2015 Online Charter School Study, as well as findings from some state agencies based on their accountability frameworks, suggest that online schools are not serving students well. Online school advocates counter that these studies do not fully consider high rates of student mobility in online schools, and that a high percentage of students entering online schools do so after falling behind in their academic performance. (These issues are discussed in more detail below.)

Given that examples of positive, negative, and neutral uses of online and blended learning have been documented, the challenge accepted by many researchers is to change the question from "does online work?" to "under what conditions does online learning, or other educational technology, work?" (Ferdig, 2010). Several notable studies that attempt to answer this question are listed in Table 1.

Challenges in Accountability Systems

Public schools in the United States operate under state accountability systems that vary by state and are meant to measure individual school performance against criteria determined by state policymakers. State accountability systems operate within the requirements of the federal Elementary and Secondary Education Act, which was most recently reauthorized as the Every Student Succeeds Act (ESSA). As of July 2017, individual states are providing their revised accountability

Finding	Citation
The impact of technology on student performance is mixed. Test results "show no appreciable improvements in student achievement in reading, mathematics or science in the countries that had invested heavily in ICT for education." (p. 3) In addition, "The real contributions ICT can make to teaching and learning have yet to be fully realised and exploited" (p. 15).	Programme for International Student Assessment and Organisation for Economic Co-operation and Development (2015). *Students, computers and learning: Making the connection*.
Researchers studied outcomes of more than 25,000 students using the "technology-based algebra curriculum" of Carnegie Learning across 147 middle and high schools in 52 school districts in seven states. It found a positive effect in the second year of implementation in high school, no effect in the first year of implementation in high school, and no effect in middle school.	Pane, John F., Beth Ann Griffin, Daniel F. McCaffrey and Rita Karam (2013). *Effectiveness of cognitive tutor algebra I at scale*. RAND Education.
K-12 online learning can act as a successful path for graduation of students who were expelled or who had dropped out.	Ferdig, R.E. (2010). *Understanding the role and applicability of K-12 online learning to support student dropout recovery efforts.* Lansing, MI: Michigan Virtual University.
K-12 online instructors practice skills that are: a) similar to those practiced by K-12 face-to face instructors; and b) similar to those practiced by post-secondary online instructors; but c) also practice skillsets that are unique to teaching and learning online at the K-12 level.	DiPietro, M., Ferdig, R. E., Black, E.W. & Pres-ton, M. (2008). Best practices in teaching K-12 online: Lessons learned from Michigan Virtual School teachers. *Journal of Interactive Online Learning*, *7*(1), 10-35.
Many K-12 online and blended schools/pro- grams are woefully unprepared for the collection and analyses of data that is required to truly inform and transform practice.	Ferdig, R.E. & Cavanaugh, C. (Eds.) (2011). *Lessons learned from virtual schools: Experi-ences and recommendations from the field.* Vienna, VA: International Association for K-12 Online Learning.
Professional development (PD) for K-12 online instructors has shown promise when instruction is not just focused on pedagogical content knowledge, but also on building a community of learners who can examine their practice in process.	Ferdig, R.E. (2010). *Continuous quality improvement through professional development for online K-12 instructors.* Lansing, MI: Michigan Virtual University.

Table 1: Online learning research

plans under ESSA to the federal Department of Education for review and approval. These plans are based on multiple measures, including scores on state assessments and high school graduation rates.

Online schools often have not performed well under state accountability systems that were implemented under the previous federal education law, No Child Left Behind. Online school proponents argue that state accountability systems are not designed to measure online schools for two main reasons. First, online schools' student populations exhibit unusually high rates of mobility, which has been linked to lower rates of student achievement. Second, at the high school level many students enter online schools behind on credit accumulation for their grade level or age, which reduces graduation rates. Online schools commonly face these issues, which also relate to blended schools and many traditional physical schools as well that have similar issues with student mobility and credit deficiency.

Some states have documented these challenges. For example, the Final Report of the Illinois Charter School Commission Report on Virtual Schools found that “characteristics of virtual schools also complicate student assessment. The existing schedule and protocols of state and school district assessments do not match up with the more fluid virtual school environment where students enroll throughout the year and complete courses at their own pace. Annual state tests administered on specific days in the spring are not an effective way to measure growth for students who may be studying material that doesn’t match what is being tested” (Richmond, 2014). In addition, some states are beginning to change accountability mechanisms to base them on the educational trajectory of each individual student.

Arizona, for example, created a new set of accountability rules for its Arizona Online Instruction (AOI) schools. The changes were recommended by the Arizona Department of Education (ADE) and approved by the State Board of Education in March 2015 (Evergreen Education Group, 2015). Iowa passed a law in 2015, *SF 510*, which adopts a wide-ranging set of performance metrics for online schools, and requires schools and the state education agency to report on them. The multiple measures include student proficiency, growth, progress towards graduation, entry and exit exams in certain subject areas, and reasons for enrolling in online schools and leaving them.

This attention to accountability issues by a few state agencies, and by charter school authorizers, is important to ensure that online schools operate under appropriate oversight. But as an ever-increasing portion of digital learning activity moves to traditional schools and districts, digital learning will more often be evaluated within the context of overall school accountability frameworks. The advantage to this is that digital learning will be evaluated in the same ways that public schools are broadly held accountable. The disadvantage is that with blended programs often measured as part of traditional schools, the blended component will not be broken out under a separate and identifiable measure.

Funding

Online schools and programs are funded in a variety of ways. Some are linked to the funding for physical schools and some are not. Funding methods include:

- Appropriation from the state legislature, which is often used for state virtual schools.
- Standard average daily attendance (ADA) or average daily membership (ADM), which is often used by district programs.
- Online student funding, which sets a funding level or calculation for fully online schools.
- Charter school funding, which sets a funding level or calculation for all charter schools, including online charter schools.
- Independent study or other alternative programs, whose funding levels and calculation methods vary by state.

Course-level funding, especially funding that follows the student, is relatively new. It is a subset of ADM/ADA funding, with the funding going to the course provider instead of to the student’s enrolling district.

A further subset of funding, most often applied at the course level, is performance-based funding. Several states have begun funding individual online courses partly based on demonstrated student success. In Utah, the provider receives 50% after the withdrawal period and the remaining 50% upon credit earned. In Louisiana, online course providers will receive 50% upon the student’s beginning of the course and 50% upon successful completion. Other states are considering similar course-level funding, especially linked to course access programs.

Conclusion

K-12 online and blended learning continue to evolve in new directions. Familiar segments of the field, such as online charter schools and state virtual schools, have continued to grow, although at a slowing pace. Relatively new forms such as single-district programs are expanding even more rapidly, as is the range of private providers competing to work with districts. Ten years ago, statewide schools and programs were driving most online learning activity. That is no longer the case; now the bulk of activity is at the district level. As districts that began with single course providers are improving their operational systems, they are expanding offerings through multiple providers for licensed curricula and locally-developed courses to more effectively personalize learning and meet student needs.

A corollary to the growth of district programs is that many of these options blend online and face-to-face learning, instead of being entirely online as many state-level schools were. One reason for this is simple: districts are often serving their own students, who live nearby, so there is limited need to bridge large distances. Even when the district is providing an online course with a remote teacher, the local school often provides a computer lab, facilitator, or other on-site resources that may define the course as blended instead of fully online.

In addition to district activity, intermediate units, BOCES, county offices, and other education service agencies are taking on important roles. Many states are devoting less funding to develop state virtual schools and other state-level efforts, but districts often recognize that creating online schools requires high investment and expertise, which is more than small districts can often provide. In states as diverse as New York, Wisconsin, Colorado, and California, educational service agencies are forming consortia to help districts gain expertise and provide economies of scale.

A long history of research exists showing that online learning can work, but whether it will work depends on implementation conditions. The most valuable research therefore will be in determining the conditions that produce successful outcomes. As more online programs are created and grow, and as state data collection increasingly—albeit slowly—includes markers for online courses and schools, much of this research can be done by mining existing data. Although there will always be a role for large-scale longitudinal assessments of what works under various specific conditions, research funders should put more emphasis on reviewing outcomes from online schools and courses and determining what factors from within those schools appear to correlate with student success based on existing data.

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3

A History of K-12 Distance, Online, and Blended Learning Worldwide

Michael Barbour

Abstract

Many involved with the practice or study of K-12 online and blended learning are familiar with the American context. It surrounds us in the media and published research. However, online and blended learning is occurring in meaningful ways to address specific K-12 student needs all around the globe. There are several areas where the international practice is consistent with what we know about the United States (e.g., similar evolutions, early initiatives were government-funded, many of the labels are similar). At the same time, there are some key differences internationally. While far less is known about K-12 online and blended learning in international contexts, programs in these jurisdictions are just as keen to tell their own success stories and undertake cyclic research to improve the design, delivery, and facilitation of their programs. As American-based researchers, it is incumbent upon us to ensure that these research-based lessons are known to our various stakeholders.

Introduction

Many of us who have been involved in K-12 online and blended learning, both practitioners and researchers, are familiar with the development of the field within the United States. Unfortunately, many who are involved in the field cannot say they have the same level of familiarity of the history, development, and/or current status of K-12 online and blended learning outside of the United States. Even those that do have some level of understanding of the K-12 online and blended learning worldwide context often see that information solely through an American lens (e.g., Barbour, Brown, Hasler Waters, Hoey, Hunt, Kennedy, Ounsworth, Powell, & Trimm, 2011; Barbour, Hasler Waters, & Hunt, 2011; Powell, & Patrick, 2006).

The fact that the practice and research into K-12 online and blended learning being viewed through a United States lens – or to a lesser extent a North American lens – is quite understandable when the scholarship in the field is examined. For example, in 2015, the *Journal of Online Learning Research* (JOLR) was established as a journal of the Association for the Advancement of Computing in Education, and managed by the leadership of the K-12 Online Learning special interest group of the Society for Information Technology and Teacher Education. In its inaugural issue, the editors wrote:

> JOLR is focused on publishing manuscripts that address online learning, catering particularly to the educators who research, practice, design, and/or administer in primary and secondary schooling in online settings. The journal also serves those educators who have chosen to blend online learning tools and strategies in their face-to-face classroom. JOLR is both international and interdisciplinary, publishing qualitative, quantitative, and mixed methods research from multiple fields and disciplines that have a shared goal of improving primary and secondary education **worldwide**. Most importantly, JOLR is theoretical and practical. (emphasis added – Kennedy & Archambault, 2015, p. 6)

As of December 2017, the journal has published nine issues comprised of 38 articles. Below is the geographic breakdown of those articles.

Table 1.
Geographic analysis of K-12 focused articles in JOLR

Volume, Issue	# of articles	No focus	Global	Turkey	Brazil	United States
1,1*	5	1				4
1,2	4			1		3
1,3	4					4
2,1	3		1			2
2,2**	5					5
2,3	5					5
2,4**	5					5
3,1**	4				1	3
3,2	3					3
Total		*1*	*1*	*1*	*1*	*34*

* By invitation only / ** Special issue

During its first three years of publication, approximately 90% of the articles that JOLR has published have focused on the United States. Essentially, there has been one article per year that has focused on international contexts, and five of the nine issues were solely focused on the United States.

This commentary is not to suggest the *Journal of Online Learning Research* intentionally ignores international work. Rather, it is simply an observation about the foci of currently published articles related to K-12 distance and online learning. The observation is also true of other journals in the field. As an example, Barbour (2011a) examined the five years of articles published by four of the leading distance learning journals – three of which were published internationally (i.e., in Australia, Canada, and New Zealand). Barbour's analysis revealed that there were 24 articles focused on the K-12 setting, and Table 2 provides the geographic focus of the article itself and/or the data collection for study described.

Table 2.
Geographic analysis of K-12 focused articles in main distance education journals from 2006-2010

	Australia	Canada	New Zealand	South Africa	United States
American Journal of Distance Education (United States)					8
Distance Education (Australia)	2			2	4
Journal of Distance Education (Canada)	1	4			
Journal of Distance Learning (New Zealand)		1.5*	1		.5*
Total	3	5.5	1	2	12.5

* One article had a focus on both Canada and the United States

Essentially, half of all of the articles focused on K-12 distance and online learning that were published in these four major distance learning journals during this five year period were focused on the United States; and all but four focused on North American countries.

The reality is that the vast majority of the scholarship that is being published focuses on the United States (and to a lesser extent North America), even though there is a great deal of K-12 online and blended learning occurring outside of the United States; which may explain why what we know about K-12 online and blended learning is generally based on a US-defined understanding. Given the level of familiarity of the American context, it may be useful to leverage this knowledge in our discussion of the international context by examining how the history, development, and current state of K-12 online and blended learning internationally is similar and different to the United States.

In the following sections, I will discuss how the evolution, the use of government funding to instigate initiatives, and the descriptive labels are similar in both the international and American contexts. I will also discuss how internationally there is a reliance on legacy delivery models, an absence of free market advocates, a lack of proliferation beyond the secondary environment, and blended learning is seen as an effective information communications technologies (ICT) or e-learning is quite different. Unlike the "International" section that appears in a different section of this handbook (which describes the state of K-12 distance and online learning practice and research in a series of different countries); this chapter is designed to re-enforce the worldwide similarities based on the American perception of the field and to highlight ways in which K-12 distance and online learning is perceived or operates differently outside of the United States.

Consistencies Between the International and American Contexts

There are three main areas of consistency between what most readers are familiar with in the United States and what occurs in the international context. First, the evolution of K-12 distance education from correspondence education to various media (e.g., radio, instructional television, telematics, videoconferencing, etc.) to online learning, and then blended learning, is quite consistent. Second, many of the early K-12 online learning programs in the United States were created through grants provided by the federal or individual state governments, which is consistent with the experience of K-12 distance education programs in many international jurisdictions. Third, terms such as supplemental and full-time, as well as district-based and state-wide (possibly nation-wide or province-wide, depending on the international jurisdiction) are all consistently used to describe K-12 online and blended programs in both the United States and internationally.

Evolution of Delivery Models

Clark (2013) provided one of the most detailed descriptions of the evolution of K-12 distance education in the United States. According to Clark, this evolution began with the use of print-based materials – also known as correspondence education – at the University of Nebraska-Lincoln. As Clark noted, this medium was a mainstay in K-12 distance education until the 1990s, with rural students who were otherwise unable to access these courses being the primary audience. Clark also described early initiatives using audio distance education (e.g., the Ohio School of the Air and the Wisconsin School of the Air), instructional television (e.g., Midwest Program on Airborne Television Instruction), and early computer-based systems (e.g., Plato III). This evolution of mediums is quite consistent in many other jurisdictions outside of the United States.

Correspondence education was the first form of K-12 distance education used in many international jurisdictions. For example, the first correspondence school in Canada was Elementary Correspondence School in British Columbia, which officially opened in 1919 with 86 students (Dunae, 2006). Thirteen of these students were the children of lighthouse keepers who lived too remote to any other school; thus, correspondence was the only education that could be provided to them. Similarly, The Correspondence School in New Zealand, now known as *Te Aho o Te Kura Pounamu*, began around 1922 to provide educational opportunities to those living in rural areas (Rumble, 1989). Further, a correspondence school was established around 1922 in Australia (Stevens, 1994), primarily as a way to provide "support for isolated schools and isolated students" (Crump, 2006, p. 4). As within the American experience, correspondence education was the only educational opportunity that many of these students were able to avail themselves of (beyond homeschooling).

As other technologies became available, international jurisdictions also began to adopt these technologies for distance education. Following the use of correspondence education, K-12 distance education programs in Australia became extensive users of educational radio (Stacey & Visser, 2005). Moore and Kearsley (1996) indicated that the first School of the Air was established in 1948 on the Alice Springs Royal Flying Doctor Service base. In the 1980s, several rural jurisdictions in Australia began to experiment with telematics, also known as audiographics (Oliver & Reeves, 1994). Telematics makes use of an audio-conferencing telephone link, an interactive blackboard that is networked using computers, and facsimile to transmit print materials. The Canadian province of Newfoundland and Labrador were also heavy users of the telematics technology to deliver distance education. This program operated by the provincial government began in 1988-89 with a single course that enrolled 36 students from 13 rural schools (Brown, Sheppard & Stevens, 2000) and grew it to eleven courses by1999–2000 that had 898 enrollments from 703 students representing 77 different rural schools.

In the late 1990s and early 2000s, there were several initiatives in New Zealand that began to explore the use of video-conferencing to provide distance education to students attending rural schools (Roberts, 2009; Treadwell, 2010; Wenmoth, 1996). Further, Barbour and Wenmoth (2013) described the evolution of correspondence and video-conferencing technologies to provide distance education in that country in the section entitled "Background and History of Primary and Secondary Distance Learning in New Zealand." Finally, there have been several articles that provide comprehensive discussions of the evolution of Canadian K-12 distance education in various jurisdictions from correspondence education, through to other mediums, concluding with the current online learning model (Haughey & Muirhead, 2004), for example, the development of K-12 distance education in the province of Newfoundland and Labrador (Barbour, 2005) and a more detailed account of a similar development in the province of British Columbia (Winkelmans, Anderson, & Barbour, 2010).

Use of Government Grants to Fund Initiatives

In their earlier chapter in this handbook, Schwirzke, Vashaw, and Watson described two early K-12 online learning initiatives that had been created using government grants (i.e., Virtual High School and Florida Virtual School). The Virtual High School was created using a five-year, $7.4 million Stars Initiative federal grant (Pape, Adams, & Ribeiro, 2005), while the Florida Virtual School was created through a Florida Department of Education allocation of $200,000 (Friend & Johnston, 2005). In fact, many of the early K-12 online learning programs in the United States were created through grants provided by the federal or individual state governments.

This is consistent with the experience of K-12 distance education programs in many international jurisdictions. For example, the Ministry of National Education in Turkey funded the creation of an open high school (Demiray & Adiyaman, 2002; Sakar & Ozturk, 2011). By the end of its first decade, the open high school had grown from serving approximately 45,000 students to over 1.3 million students. More recently, the government has funded a project to develop asynchronous online learning content, as well as equip schools with the necessary infrastructure to leverage that content (Barbour, Brown, et al., 2011). Further, Gedik and Goktas (2011) outlined the role of the Ministry of National Education, along with the Council of Higher Education (an agency of the national government), in the development of K-12 online and blended learning – including several individual programs to develop online content, teacher expertise, and technological infrastructure.

Similarly, one of the more extensive examples of an international government-funded K-12 online learning initiative is the Cyber Home Learning System in South Korea. Based upon a series of "Master Plans," the national government sponsored the creation of a program that provided K-12 students access to the entire primary school and secondary school curriculum, including content-based tutors (Bae, Han, Lee, & Lee, 2008; Song & Kim, 2009). According to the Korea Education and Research Information Service (2011), this government-funded initiative was serving more than four million students. The South Korean experience is actually quite consistent with the role of the national governments of many other Asian and European nations (Barbour, Brown, et al., 2011; Powell, & Patrick, 2006). For example, a subsequent chapter entitled "A Case Study of E-Learning Initiatives in Singapore's Secondary Schools" by Powell and Barbour examines the role of the Singapore government in supporting numerous e-learning programs.

There are many other examples that could be used (e.g., ScienceNet in Singapore [Hin & Subramanian, 2004]; the Virtual Classroom Technology on EDUSAT for Rural Schools initiative in India [Centre for Civil Society, 2011]; *Ensino a Distância para a Itinerância* in Portugal or *Rīgas Tālmācibas Vidusskola* in Latvia [Bacsich, Pepler, et al., 2012]; or both the *Te Aho o Te Kura Pounamu* – The Correspondence School [Wenmoth, 2005], and Virtual Learning Network (VLN) in New Zealand [Barbour, 2011b; Roberts, 2010; Wenmoth, 2011]). Even later in this handbook Jakobsdóttir and Jóhannsdóttir describe several e-learning initiatives (e.g., *Íslenskuskólinn á Netinu*/IceKids, *Strandir*, *VestBarð*, *SnæVest*, and others) that were supported or managed by the Icelandic Government. Further, a later chapter by Biton, Fellus, and Fellus describe the environment that was created by the Israeli Ministry of Education that allowed for the creation of the Virtual High School through a funded partnership between the Ministry, the Trump Foundation, and the Center of Educational Technology. It is sufficed to say that the use of external funding initiatives to initiate or expand K-12 online and blended programs in the United States and internationally is increasingly common.

Terms to Describe K-12 Online and Blended Learning

In their chapter, Schwirzke, Vashaw, and Watson defined several terms used to describe the nature and medium of K-12 online and blended learning. These terms included supplemental online courses, full-time online schools, and district-led programs. Many of these same terms, as well as others that are commonly used in the United States, are also appropriate descriptors for K-12 online and blended learning programs internationally.

Supplemental online learning programs are ones where students are enrolled in a brick-and-mortar school but take one or more courses from an online provider to supplement their face-to-face learning (Barbour, 2013a). On the other hand, full-time online programs are ones where the students are not enrolled in a brick-and-mortar school but take all of their courses from an online provider. These two terms are quite applicable to the international context, although the majority of K-12 online and blended learning programs internationally are supplemental in nature. According to the *State of the Nation: K-12 Online Learning in Canada* reports, the majority of K-12 distance education programs in Canada are supplemental in nature (Barbour, 2013b). The same is true of programs in New Zealand (Roberts, 2010), South Korea (Cho, 2009; Jang, 2006), and most European nations (Bacsich, Bristow, Camilleri, de Beeck, Pepler, & Phillips, 2012; Bacsich, Pepler, Phillips, Öström, & Reynolds, 2012). This observation is not to suggest that there are no full-time online and blended learning programs outside of the United States. For example, there are some full-time K-12 distance education programs in Canada, primarily at the elementary level (Barbour, 2013b). There is also a full-time blended learning program, the Northern Beaches Christian School, in Australia (Harris, 2005, 2008).

In addition to the consistency in describing the nature of K-12 online and blended learning, there are also some similarities in the way in which the scope of the K-12 online and blended program is described. Watson, Gemin, Ryan, and Wicks (2009) described comprehensive reach and operational control as two of the dimensions for describing K-12 online learning programs. Variables such as district-level and local board controlled are typical of the vast majority of the K-12 distance education programs that exist in Canada (Barbour & Kennedy, 2014). Similarly, the geographic variable of state or, in the case of Canada, province is another accurate description. The geographic variable national is an accurate descriptor for many of the K-12 online programs in Asia (Barbour, Brown, et al., 2011). In addition to being geographic descriptions, these variables often describe the level of operational control.

One limitation of these American-based descriptors is in international jurisdictions where there are no states or provinces. For example, the vast majority of e-learning clusters in the VLN in New Zealand are regional in their primary focus, but these programs serve students from all over the country (Roberts, 2010). The same is true of many of the European K-12 online and blended learning programs – they are managed at a local or regional level but often enroll students from anywhere in the nation (Bacsich, Pepler, et al., 2012). For example, IVIO@school and Wereldschool in the Netherlands are managed at the local level, but they serve students throughout the country and in Dutch colonies abroad, respectively. Another limitation of these terms is when the operational control and the geographic reach conflict (e.g., the Canadian provinces of Ontario and British Columbia both have programs that are largely managed by local school districts but enroll students from all over the province) (Barbour, 2013b).

When it comes to blended learning, the dominant framework that is used in the United States are those supported by the Christensen Institute (see https://www.christenseninstitute.org). Horn and Staker (2011) defined blended learning as "any time a student learns at least in part at a supervised brick-and-mortar location away from home and at least in part through online delivery with some element of student control over time, place, path, and/or pace" (p. 3). A year later, Staker and Horn (2012) described four models of blended learning: rotation model (which actually has four versions: station-rotation model, lab-rotation model, flipped-classroom model, and individual-rotation model); flex model; self-blend model; and enriched virtual model. Major United States education organizations, such as the Florida Educational Technology Conference, International Association for K-12 Online Learning (iNACOL), International Society for Technology in Education, State Educational Technology Directors Association, etc., promote this definition and these models within the United States K-12 context.

While blended learning is often seen internationally as simply a form of technology integration (see discussion below in the inconsistencies section), those international programs that do use the term blended learning generally use the

American terminology. For example, in a study of blended learning at a public school in Vinhedo City, Brazil, the authors described the study as occurring in classes "designed based on Christensen, [Horn, & Staker]'s (2013) hybrid innovative blended learning models: flipped classrooms and station rotation" (Magalhães de Barros, Simmt, & Maltempi, 2017, p. 82). Similarly, Barbour and LaBonte (2016) described how the Yukon territory in Canada had a robust blended learning program supported by the territorial government that had participation from more than half of the schools and approximately 20% of the grades 5-12 students in the territory. Yukon Education, the territorial department responsible for the program, describes this blended learning program as a flexible rotation model (Bennett, 2016; Stacey, 2015). Further, in his description of the Northern Beaches Christian School in Australia, Harris (2015) describes their blended learning program as following Staker and Horn's (2012) rotational model. So, while the use of terminology related to blended learning is often rare or foreign to many international contexts, the pervasiveness of American-based literature has resulted in adoption of United States conceptions when it is used.

Inconsistencies Between the International and American Contexts

There are four main areas of inconsistency between what most readers are familiar with in the United States and what occurs in the international context. First, in many international jurisdictions there is still a significant use of correspondence education, audio distance education, and video conferencing. Second, internationally the primary driver of K-12 online and blended learning are government forces, and corporations are largely contractors that provide content, learning technologies, and other services to these government-run programs. There are few, if any, proponents of the application of free market principles to public education through K-12 online and blended learning. Third, in most countries K-12 online and blended learning is primarily used at the secondary level. Even the use of K-12 distance education in general is largely focused on the secondary grades. Fourth, as corporations and free market proponents are largely absent, blended learning – and even online learning – is generally regarded as the next evolution of effective technology integration.

Continued Reliance Upon Legacy Delivery Models

While the evolution of K-12 distance education from correspondence education to audio, telematics, and video technologies to online learning was one of the similarities between the American experience and international jurisdictions, the continued reliance of many of these jurisdictions on these pre-cursor K-12 distance education technologies is one of the main differences with the international experience. Simply put, in many jurisdictions, there is still a significant use of correspondence education, audio distance education, and video conferencing.

New Zealand is one of the better examples of this reliance on legacy delivery models. While *Te Aho o Te Kura Pounamu* – the Correspondence School was first established in 1922, according to their *2016 Annual Report* there were 12,000 students that were enrolled in one or more courses through this primarily correspondence education model (*Te Aho o Te Kura Pounamu*, 2017). Over the past two decades, there has been a significant development of regional e-learning clusters that utilized video-conferencing as the primary means of instructional delivery – such as CANTANet (Wenmoth, 1996), *Kaupapa Ara Whakawhiti Mätauranga* (Waiti, 2005), OtagoNet (Lai & Pratt, 2009; Pullar & Brennan, 2008), and FarNet (Barbour & Bennett, 2013; Bennett & Barbour, 2012; Rivers & Rivers, 2004; Stevens & Moffatt, 2003). At one point there were upwards of 20 of these regional clusters operating (Compton, Davis, & Mackey, 2009), but it appears now that through amalgamation and dissolution there may be as few as eight (Virtual Learning Network Community, n.d.). However, even the largest of these e-learning clusters only reported 809 student enrolments for 2016 (Higgs, 2017). The vast majority of K-12 distance education being provided in New Zealand was still using correspondence education, and the distance education that is not delivered via correspondence education has historically been offered through video-conferencing (although this has been steadily transitioning to online synchronous tools such as *Google Hangouts* and *Zoom* [Tolosa, East, Barbour, & Owens, 2017]). The primary use of online learning is generally to support the synchronous instruction by providing students with access to asynchronous course content.

New Zealand is not the only international jurisdiction where correspondence education is still used extensively. According to the annual *State of the Nation: K-12 e-Learning in Canada*, K-12 distance education programs in Canada still use a more traditional, print-based correspondence education delivery model on a frequent basis compared to the US context (Barbour, 2012). This is particularly true of elementary level offerings, which are almost exclusively full-time, correspondence-based programs. In a more recent report, Barbour and LaBonte (2016) described how of the students taking high school distance education courses almost half in Nova Scotia, approximately three quarters in Quebec, and approximately a quarter in Ontario and Manitoba, were using correspondence education. These figures do not include all of the elementary school students in British Columbia, which has historically been the jurisdiction that has the largest proliferation of K-12 distance education in Canada based on proportion of the population.

Similar to the New Zealand example, while online learning is present within the Mexican context, there are still programs that provide a significant portion of their K-12 distance education through compact discs that are mailed to the student or school (Secretaría de Educación Básica, 2010). As was mentioned earlier, Australia has a long history of K-12 distance education. While there are at least five identified K-12 online or blended learning programs in the country (Barbour & Kennedy, 2014), there are three times as many School of the Air distance education programs that are still operating in Australia[1] These are just some of the examples where online learning technology is available for use within the K-12 education system, but these legacy delivery models of distance education persist. This brief discussion does not include the large number of jurisdictions where access to online learning technology is simply not available (Barbour, Brown, et al., 2011), and legacy delivery models are the only K-12 distance education options.

Absence of Free Market Advocates

One of the main differences between the American and international experiences is what is driving the use of K-12 online and blended learning. Within the United States, there has been a strong push to expand access to K-12 online and blended learning based on the belief that by providing students with choice it will improve the quality of education – as students will select those opportunities that are high quality, forcing the low quality opportunities to either improve or close due to a lack of interest (Apple, 2001, 2005; Fiske & Ladd, 2000). K-12 online and blended learning programs – many of which are directly or indirectly managed by for profit corporations – can provide students with choice regardless of geographical location, in a medium that may provide a higher quality opportunity for students (Moe & Chubb, 2009; Petersen, 2010; Vander Ark, 2012). Others have argued that the use of technology-based innovations, such as online and blended learning, presents opportunities for students to personalize or customize their education – and thus provide a more meaningful, higher quality educational experience (Christensen, Horn, & Johnson, 2011; Packard, 2013; Vander Ark, 2012). Within this American context, some have argued that these claims may be exaggerated and the motives of the proponents may also be questionable (Ravitch, 2010, 2013). Internationally, these kinds of proponents and this kind of push towards K-12 online and blended learning are largely absent.

The phrase 'largely absent' is purposefully used, as there are some free markets proponents of K-12 online and blended learning outside of the United States. For example, there are proponents of free market principles within K-12 online and blended learning in the Canadian context. In 2012 the Society for Quality Education published *The Sky Has Limits: Online Learning in Canadian K-12 Public Education*, which argued that "school choice [was] rationed or channeled, learning conditions [were] carefully state regulated, and the delivery of education limited by teacher union contracts" – particularly when it came to K-12 online and blended learning (Bennett, 2012, p. 3). Bennett cited British Columbia, which has a regulatory regime where the funding follows the student based on what body delivered the individual course, as the only jurisdiction where true choice existed. Interesting, in the *State of the Nation: K-12 Online Learning in Canada* reports, British Columbia has been described as the most regulated province or territory in Canada (Barbour, 2009, 2010, 2011c, 2012, 2013b; Barbour & Stewart, 2008), and the British Columbia Teachers Federation (i.e., the provincial teachers' union) has been described as having conducted more research into K-12 distance education than any other Canadian organization (Barbour & Adelstein, 2013).

Further, at present there is only one Canadian province that permits charter schools – Alberta, which first enabled charter schools in 1994. In response to the Government's *Inspiring Action on Education* initiative (see

1. See http://bit.ly/2GzmQZG for a listing of existing programs as of February 2014.

https://inspiring.education.alberta.ca/), which promoted personalized, innovative, and technology-based learning, the Parkland Institute released *Delivery Matters: Cyber Charter Schools and K-12 Education in Alberta*. In this report, Clements and Gibson (2013) argued that the evidence from cyber charter schools – and full-time K-12 online learning in general – from the United States did not support the creation or pursuit of cyber charter schools within the province. This attention to research-based, measured growth – along with the teachers' union that is supportive of K-12 online learning (McRae, 2013) and lack of direct corporate involvement in charter schooling – may explain why Alberta has not developed any online charter schools over the past decade. Essentially, the proliferation of K-12 distance education has not been due to advocates of free market principles; instead, it has been almost solely due to the fact that online and blended learning offers opportunities for K-12 students that are not available in the brick-and-mortar environment (Barbour, 2012, 2013b).

New Zealand is another jurisdiction that has a system of education based on free market principles. Beginning in 1989, the Government of New Zealand introduced an initiative known as "Tomorrow's Schools," which transferred the governance of every public school in the country to an elected board (Fiske & Ladd, 2000). These self-governing schools, which were free from geographic enrollment restrictions and/or boundaries, created a system where each school was in competition with each other for students. However, even in this competitive environment the individual e-learning clusters of the VLN have been able to partner with individual schools where the brick-and-mortar schools provide the equivalent of one teacher who teaches one class in order to enroll students in courses offered through the VLN (Barbour, 2011d; Roberts, 2010). Essentially, proponents of online and blended learning tout its ability to operate in a co-operative fashion with these competitive brick-and-mortar schools. Further, the use of K-12 distance education in New Zealand is also seen as an agent of change in transitioning school from traditional to networked to connected schools (21st Century Learning Reference Group, 2014). A connected learning environment is one "where the integration of face-to-face learning and virtual learning has become seamless and an onlooker would have difficulty in determining if students were learning in a face-to-face or online context" (Barbour & Wenmoth, 2013, p. 7). The description of 'connected schools' is similar to what many in the United States would consider a blended instructional environment.

It should be noted that the previous New Zealand Government passed the *Education (Update) Amendment Act 2017* shortly before being defeated in national elections (Ministry of Education, 2017). The *Act* intended, among other things, "to enable new partnerships between schools and online learning providers, and enable children and young people to access their education through online delivery" (Ministry of Education, 2016, ¶ 2). However, the legislative language to create these online schools read:

> 35T Provisional accreditation of communities of online learning
>
> (1) Any of the following bodies may apply to the Minister for provisional accreditation as a full community of online learning or a supplementary community of online learning:
>
> (a) a registered school;
>
> (b) a body corporate; or
>
> (c) a tertiary education provider. (Ministry of Education, 2017, ¶ 1)

While a laudable intention, the inclusion of "a body corporate" as one of the potential groups that can operate a Community of Online Learning (CoOL) introduces the possibility that for-profit corporations could directly operate online schools in New Zealand. As Pratt and Williamson-Leadley (2017) noted, this possibility has created concern among those in the education sector that the government was trying to privatize public schools. This concern was summarized by the President of the Post-Primary Teachers' Association in a news article, when she was reported as saying, "there are two wildly incorrect assumptions that underpin this idea… One is that online learning can substitute for face-to-face, and the other is that a more competitive market in education is going to lead to better results. Both of these fly in the face of all the evidence" (Moir, 2016, ¶ 20-21). At present, the new Government is still engaged in the consultation process on how to implement CoOLs (Cognition Education, 2017).

While Canada and New Zealand are jurisdictions that have education systems with varying levels of free market principles, proponents of these principles are largely absent in advocating for increased proliferation of K-12 online and blended learning. It is interesting to note that in many other international jurisdictions there is even less involvement of the free market in advocating for the use of K-12 online and blended learning. Barbour and Kennedy (2013) described five additional jurisdictions (i.e., Mexico, Australia, Singapore, South Korea, and Turkey) where the primary driver of K-12 online and blended learning are national government forces, and corporations are largely contractors that provide content, learning technologies, and other services to these government-run programs.

Lack of Proliferation Beyond Secondary School

One of the trends that Schwirzke, Vashaw, and Watson reported in their chapter was the fact that full-time, multi-district online schools continue to grow. The authors estimated that there are approximately 315,000 students enrolled in these programs. These full-time, multi-district online schools serve students from kindergarten through to grade 12, and in many states the enrollment in these programs is skewed towards students in the elementary grades. While not unique in the field of K-12 online learning, this is a trend that is more common in the United States.

Internationally, the majority of K-12 distance education outside of the United States is focused on the secondary level. One of the best examples of this focus is the Lifelong Learning Programme of the European Commission funded VISCED Project, whose mission was focused on "a transnational appraisal of virtual schools and colleges with a systematic review at international and national levels of fully virtual schools and colleges" (Bacsich, Pepler, et al., 2012, p. 18). What is most telling about this European initiative is that the review focused on students aged 14 to 21. While the listing of virtual schools and colleges created by the VISCED Project[2] included online programs that served elementary and middle school students, the vast majority of programs outside of North America were primarily focused on secondary school students.

In keeping with the trend in Europe, the provision of distance education in New Zealand is also primarily focused on the secondary levels. The VLN in New Zealand was once comprised of approximately 20 geographic and thematic e-learning clusters (Barbour, 2011) but now includes an estimated seven clusters (Virtual Learning Network Community, n.d.). An eighth e-learning cluster is a nation-wide one that focuses upon primary level students (i.e., Years 1 to Year 8) – although the VLN Primary courses are mainly focused on Years 5-8. While some of the geographic clusters do offer courses for students in Year 7 and Year 8, the VLN-Primary is the major provider of non-secondary level enrollments. A review of the VLN indicated that only a small percentage of the enrollments in the network came from the VLN-Primary e-learning cluster (Barbour, 2011). To quantify this belief, one of the most comprehensive accounting of student enrollments in the VLN was conducted by the CISCO Corporation, who reported that there were 1,400 children engaged in distance education through one or more of the e-learning clusters (CISCO, 2011). Based on the most recent data available, the VLN-Primary only enrolled 375 students who were enrolled in one of more courses during the 2016 school year (Virtual Learning Network Primary Governance Group, 2017). This figure represented approximately 25% of the students engaged in distance education in New Zealand (assuming that the number of national enrollments have not increased in the past five or six years, which is an unlikely assumption).

The inclusion of younger students in K-12 distance education is not limited to New Zealand. For example, in Canada the majority of K-12 distance education occurred at the secondary level (Barbour, 2013b), and the majority of distance education at the elementary level was delivered using correspondence education – almost exclusively on a full-time basis. Similarly, while the majority of K-12 distance education in Australia is delivered to secondary school students (Pendergast & Kapitzke, 2004), the Schools of the Air in Australia generally provide distance education opportunities to younger students (Stacey & Visser, 2005). Further, in addition to their Open High School, Turkey also has an Open Elementary School (Gedik & Goktas, 2011). The only virtual school in Ireland, iScoil, is reserved for students ages 13-16 (Hallissy, 2009). Finally, the Cyber Home Learning System in South Korea is a K-12 online learning program that spans the realm of K-12 (June, Yoon, & Lee, 2013; Kang, Kim, Yoon, & Chung, 2017; Shin & Albers, 2015). So, there is K-12 distance

2. See the complete listing of K-12 distance education programs worldwide, organized by continent, on the VISCED Project Wiki at http://www.virtualschoolsandcolleges.eu/index.php/Main_Page

education occurring at the elementary level outside of the United States. However, it still only encompasses a small percentage of the activity internationally.

Blended Learning is Effective ICT or E-Learning

iNACOL originally defined blended learning as:

> …any time a student learns at least in part at a supervised brick-and-mortar location away from home and at least in part through online delivery with some element of student control over time, place, path, and/or pace; often used synonymously with Hybrid Learning. (iNACOL, 2011, p. 3)

This definition was subsequent from a more generalized understanding of online learning. For example, in their 2006 publication of the *International Perspective of K-12 Online Learning* iNACOL described online learning as including:

> a range of web-based resources, media, tools, interactivity, and curricular or instructional approaches. Internationally, a variety of terms are used to describe online learning–including distance education, virtual schools, virtual learning, e-learning, electronic learning. In general, the common theme is that this type of learning takes place over the Internet. (Powell & Patrick, 2006, p. 3)

This broader description of online learning contains many of the features that would be incorporated into the more recent definition of blended learning (e.g., a range of web-based resources being used in various instructional approaches). In fact, the variety of terms are one of the potential confounding issues.

The New Zealand Ministry of Education defined e-learning as "learning and teaching that is facilitated by or supported through the smart use of information and communication technologies" (Ministry of Education, 2006, p. 2). However, e-learning in New Zealand is not synonymous with online or virtual learning. In fact, Powell and Barbour (2011) wrote how the national government's vision for increased e-learning in the K-12 environment allowed for the development of online learning programs (i.e., the implication is that if one allows for the other to occur, then they cannot be the same). The confounding of online and blended learning with ICT or e-learning is consistent with countries like Australia, China, and South Korea (Barbour, Brown, et al., 2011; Barbour, Hasler Waters, & Hunt, 2011), as well as Singapore (see the subsequent chapter in this Handbook for a more detailed discussion).

Further, in his case study on online education in Finland, Kajander (2011) indicated that online and blended learning was a teaching method and content source as any other, and it had no special standing in evaluation, quality assurance, procurement, or otherwise. This perception, of online and blended learning as another arrow in any teacher's pedagogical quiver, is seen in many European nations. It is also likely one of the reasons why online and blended learning practices have often emerged from earlier SchoolNet initiatives (Bacsich, Bristow, et al., 2012; Bacsich, Pepler, et al, 2012).

This is not to suggest that blended learning does not occur internationally, only that it is generally not called blended learning or not seen as being connected with online learning. For example, in the 2012 *State of the Nation: K-12 Online Learning in Canada* report, it stated:

> while blended learning is occurring across Canada, practitioners do not always consider it part of the distance education or online learning movement. Within the Canadian context blended learning is largely considered an extension of effective ICT, or effective technology integration—to use more of an American phraseology. Many teachers not directly involved with K-12 distance education may not realize they are practicing blended learning according to the iNACOL definition. (Barbour, 2012, p. 15).

In fact, there are several Canadian provinces where any teacher or student can access the Ministry-operated K-12 online learning programs asynchronous course content to use in their own face-to-face teaching and learning (e.g., Newfoundland and Labrador, Nova Scotia, New Brunswick, and Ontario) (Barbour & LaBonte, 2016).

Summary

The goal of this chapter was to expose the reader to the international context of K-12 online and blended learning. As many readers will likely be familiar with the American context, I chose to compare and contrast that American experience with the international experience. In doing so, I have described three main similarities and four main differences between the two contexts. The international examples that I have used, as well as the amount of coverage that they have received, is representative of the availability of English-language literature about each of these jurisdictions.

In terms of the areas of consistency, the first was the fact that international K-12 distance education has had a similar evolution to the United States. Both contexts began with a traditional print-based correspondence education model and transitioned through several technological advances in the delivery medium to the present-day use of online and blended learning. The second consistency is that many of the early K-12 distance education programs – both legacy programs and current online and blended programs – were created through government grants or other investments. The third area of consistency is that many of the labels that we use to describe K-12 online learning in the United States (e.g., supplemental, full-time, statewide, district-based, multi-district, etc.) are applicable to many international jurisdictions.

In terms of the areas of inconsistency, the first was the prevalence of correspondence education, educational radio, telematics, video conferencing, and other legacy forms of distance education mediums that are still in use at the K-12 level internationally. The second was a lack of proponents of the application of free market principles within international K-12 education in general, and K-12 online and blended learning specifically, driving regulatory reform and growth within the field. The third was the lack of online learning occurring below the secondary school level in most international jurisdictions. Finally, the fourth was a lack of a connection between online learning and blended learning, with blended learning simply being seen as a form of technology integration.

It is important to underscore the fact that while K-12 online and blended learning may not be as prevalent or as expansive internationally than it is in the United States, it is occurring in meaningful ways to address specific student needs. However, it is worth adding that many international jurisdictions do not come to the positive conclusions regarding the research into online learning and student achievement. For example, Canadian researchers have found that students in online environments often perform at similar or lower levels than their classroom-based counterparts, and these researchers often comment about the selective nature of the online sample increasing that cohort's results (Ballas & Belyk, 2000; Barbour & Mulcahy, 2008, 2009; Barker & Wendel, 2001; Mulcahy & Barbour, 2010; Mulcahy, Dibbon, & Norberg, 2008). For example, the Parkland Institute report detailed the various government reports, investigative journalism, and independent researchers that have found consistently poor results for full-time online schools in the United States (Clements & Gibson, 2013). This alternate perception of the effectiveness of K-12 online and blended learning is one of the leading causes for many of the differences in both how K-12 online and blended learning is perceived and how it has been operationalized in international contexts.

Finally, before concluding this chapter it is important to once again underscore the general lack of English-language literature – particularly research – focused on international distance, online, and blended learning programs. The earlier analysis of the main distance education journals and of JOLR introduced this reality, but an examination of the international literature found in the *Research Clearinghouse for K-12 Blended and Online Research*[3] would yield a similar result. A review of the chapters in this very handbook, with the exception of the "K-12 Online Learning Around the World" section, there are probably few references to examples, illustrations, and/or literature from outside of the United States. Again, these statements are not made as criticisms of those involved in any of these projects. They are simply statements of fact about the current state of the field of K-12 online and blended learning. There is a general need for international stakeholders to explore ways to address this situation by further exploring the factors that have resulted in this deficit.

3. The *Research Clearinghouse for K-12 Blended and Online Research* is an initiative of the Michigan Virtual Learning Research Institute and iNACOL, and can be accessed at http://k12onlineresearch.org

It is worth noting that work is being undertaken to bring greater awareness to K-12 online and blended learning outside of the United States. For example, the *Research Clearinghouse for K-12 Blended and Online Research* has engaged in a partnership with the Canadian E-Learning Network to increase the number of Canadian submissions in the Clearinghouse. This handbook has added the "K-12 Online Learning Around the World" section as a part of the updates contained in this second edition (and as the editor for that section, I can personally report that we had solicited more than twice as many nations as we were actually able to secure submissions from). Additionally, the *JOLR* will be publishing a special issue focused on "K-12 distance, online, and blended learning in international contexts" in 2019; and this special issue will be followed by the creation of an "International Section" for the journal moving forward. However, there is still more work that needs to be done. In many instances, there is a great deal that is known about many of these international programs that is only written in the native language of the administrators, evaluators, and researchers. As one example, there has been a great deal written about South Korea's Cyber Home Learning System in Korean-language publications (see Lim & Kim, 2007 as one of many illustrations). The offer of English-language assistance by publishers and editors may be one solution – as many English-language publications often reject manuscripts from international scholars due to it being poorly written. At present there exist several examples of foreign language journals translating and publishing English-language research for their readership. For example, the Mexican-based *Revista Mexicana de Bachillerato a Distancia* has translated several of my own articles from English into Spanish (see Barbour and Plough [2014] or Hawkins, Barbour, and Graham [2012] as two examples). There is no reason why an English-language publication could not seek to do the same for research published in other languages (i.e., simply translate and re-publish some foreign language article). These are just two additional examples that could be added to the efforts that are already underway. While a somewhat general ignorance of international K-12 online and blended learning is the current reality, it can and is being changed. It can only be hoped that practitioners and researchers in the field will meaningfully engage with these international examples, illustrations, and/or literature from outside of the United States.

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4

History of Policies in K-12 Online and Blended Learning

Kerry Rice & Shannon Skelcher

Abstract
This chapter provides a historical review of U. S. education policy from its earliest inception to the present day with a focus on policy developments in the 21st century that have influenced the growth and development of online and blended education and those that we can foresee will have the greatest impact moving forward. Twenty-first century policies are synthesized into themes of Online and Distance Learning, Accountability, Innovation and Reform, and Teacher Preparation. This chapter contains updates from the previous edition primarily with the addition of the impact of ESSA and the 2017 National Educational Technology Plan on online and blended learning. Other updates include federal and state legislation that applies to K-12 online and blended learning, updates in annual reports such as reports from the National Educational Policy Center, and updates in applicable federal grants and initiatives.

Introduction
What is policy? Technically, the term refers to decisions, rules, and regulations enacted through legislation, which can occur at the federal, state, and local levels. Ideally, it is the way in which the preferences of a society flow between public institutions but also how these same institutions influence and shape societal preferences. In reality, policy issues and their resulting legislative action, or inaction as the case may be, is oftentimes controversial and a messy business. Educational policy does not happen in a vacuum. The influence of the reigning political climate, more often than not polarized by competing ideologies, combined with an unpredictable economic climate, all of which in our current era are further fueled by rapid advancements in technology, make for an interesting study.

Policies addressing technology use in education go back some three decades. As early as 1983, when A *Nation at Risk* was published, the authors called for all high school graduates to have an understanding of computers, electronics, and related technologies in both personal and work environments (U.S. Department of Education, 1983). Since then, numerous federal reports have been written supporting technology use in the classroom. Culp, Honey, and Mandinach (2005), authors of The U.S. Department of Education report *A Retrospective on Twenty Years of Education Technology Policy*, provide an excellent overview of these historical reports from 1983 to 2003. The story of educational policy does not begin there though. Perhaps the quote by historian James Burke says it best: "If you don't know where you've come from, you don't know where you are" (page #?). In order to understand how we arrived where we are today, it is important to capture the historical context that has influenced the culture that drives our educational systems.

Burke's quote is a fitting sentiment, in this time of what might be called educational regeneration. Regeneration is a biological term for renewal, restoration, growth, and even transformation, and aptly suited to an educational system that is straining for rebirth under intense pressure to reform. Global competition, dismal achievement reports, failing schools, and industry concerns about an unprepared workforce continue to serve as reminders that we may not be doing a good job of educating our children for the demands of the 21st century. And it seems the more policy decision, or indecision, constrains our attempts to change, the more we resist, subvert, or otherwise find ways to "work-around" existing barriers to that reform. We know this is not unusual and perhaps even to be expected. In a system that spans across fifty states, each with independent policies of their own, 15,000 school districts and 100,000 schools that serve somewhere in the vicinity of 48 million students at a rate of $2 billion each day, change can be a challenge. But it may not be as slow as it first appears. In the case of online learning, Christensen, Horn, and Johnson refer to this as disruptive innovation, and predict that by 2019, 50% of all high school courses in the U.S will be delivered online (2008).

Indeed, online education has experienced unprecedented growth since its inception at the turn of the 21st century. However, even with growth percentages measured in the double digits, the entire population of students participating in fully online virtual schools is a mere ½ to 1 percent of the total public school student population (Molnar, 2014; Watson, Murin, Vashaw, Gemin, & Rapp, 2013). The number is greater when we consider students who participate in supplemental programs and take an online course here and there, which is almost four million students by some estimates. It is the acceptance and adoption of blended learning by mainstream education where we are beginning to see the greatest, and perhaps the most transformational, change in our educational systems to date. The question of the moment is, do we have the capacity and wherewithal to support the kind of overhaul needed to manifest a disruption as great as this?

To try to answer this question, we'll begin with an overview of the historical landscape of educational policy and then fast forward to the policies that are driving transformative change today, with a particular focus on those policies that have the most impact on online and blended learning. This report is divided into two primary sections:

- Section 1: American Public Education: A Brief History provides a pre-21st century historical account of educational policy in the U.S. This is the critical foundation on which current educational policy is based and is intended to provide just a brief overview of where we have come and an understanding of the cultural and societal norms that have been highly influential in shaping our educational system.
- Section 2: 21st Century Themes in Policy and Educational Reform explores the most influential policies, publications, and recommendations influencing the development and growth of online and blended learning in the first decade of the 21st century. Emerging policies and a synthesized analysis of the major policy themes surrounding online and blended learning are identified and then discussed in detail. These themes include accountability, access, innovation and reform, and teacher preparedness.

It should be noted that, in many cases, the reports reviewed are policy recommendations rather than legislated action. Nonetheless, recommendations that begin at the federal or state level are often tied to existing or pending policy initiatives, which are then tied to funding, so they serve as an accurate depiction of national and state-level policy trends.

American Public Education: A Brief History

The history of American public school is a history of tensions between competing goals, politics, and indefinable purposes. In its earliest configuration, education of a democratic citizenry was of paramount importance on a national level, despite a lack of mention in the constitution (Hirschland & Steinmo, 2003). And we can track through the history of policy, in varying degrees and depending on the societal influences of the time, that education has been seen as a vehicle to promote a dizzying array of purposes including the development of citizenship, personal growth, global competitiveness, content area skills, critical thinking, and workforce training to name just a few (Siemieniecka, B., Siemieniecki, D., Rice, K., & Kelly, P.,unpublished manuscript).

It is in the 1830s when Horace Mann advocated for the Common School that public education was formally recognized as a legitimate enterprise. The end of the 19th century and beginning of the 20th harkened the era of industrialization, a wave of immigrants, and the first public comprehensive high school, ostensibly to educate the masses but, in reality, accessible only to the elite. Attempts at standardization and equity date back to 1892 when the Committee of Ten laid the foundation for standardized curriculum. The 1896 *Plessy v. Ferguson* Supreme Court decision with its "separate but equal" verdict was the first judicial attempt to address the inequalities in educational opportunities (McBride, 2006).

We begin to see visible and substantial federal involvement in education in the mid 20th century under the U.S. Department of Education's equal access mission. It is an attempt by federal administrators to address states' inadequacies or downright refusal to submit to government recommendations for equity and equality in educational opportunities. The *1954 Brown v. Board of Education* decision, launched the desegregation of schools in the U.S., and Russia's launch of Sputnik into space resulted in a national call to action for a more rigorous curriculum. In response, Congress passed the

1958 National Defense Education Act (NDEA) (United States), which, among other things, included support for the improvement of science, mathematics, and foreign language instruction in elementary and secondary schools. Other federal legislation and judicial action during the 1960s and 1970s addressed inequities in services for low-income, special needs, and minority students. The *1965 Elementary and Secondary Education Act* (ESEA) is perhaps the most comprehensive effort to address problems of quality and equity in the nation's schools and includes the *1972 Title I* program of federal assistance for disadvantaged children. Other efforts include *Title VI of the Civil Rights Act of 1964, Title IX*, and *Section 504 of the Rehabilitation Act of 1973*, which prohibit discrimination based on race, sex, and disability. In 1975, the *Individuals with Disabilities Act* (IDEA), a law focused on meeting the needs of special education students, was passed.

The first inklings of the current state of educational reform occurred with the publication of the landmark report, *A Nation at Risk* in 1983. The report, written by the National Commission on Excellence in Education, was in response to the belief that the U.S. was losing its international competitiveness. A poor economy, the infusion of competition from international sources in the technology and car manufacturing sectors, and American students' subpar performance on standardized tests were the drivers then and continue to be drivers now for our current focus on accountability (Christensen, Horn & Johnson, 2008). The accountability and standards movement was further promulgated with enactment of the *Improving America's Schools Act* (IASA), a 1994 (a) reauthorization of ESEA and the associated *Goals 2000: Educate America Act*. These legislative acts were an attempt to systematize school improvement efforts focused on increasing the rigor of state standards and holding states accountable for meeting those standards (U.S. Department of Education, 1994b) with stated goals to be achieved by the year 2000, including a 90% graduation rate, universal literacy, and first in the world achievement in math and science. Importantly, for our discussion, the *Educate America Act* explicitly allowed for state discretion in implementing school choice programs.

Another significant development in educational policy was the passage of the *No Child Left Behind Act* (NCLB) in 2001. NCLB was a reauthorization of the 1965 ESEA and perhaps the most highly controversial legislation at the time with critics arguing a lack of funding support, limited content area focus, and federal overreach. This federal legislation, expanding on the *America's Schools Act of 1994*, required the use of explicit metrics to better analyze student achievement data, with the goal to ensure proficiency for every student in every demographic. It was particularly concerned with closing the achievement gap between low income and minority students, and all other students, the adoption of rigorous state standards, and standards-based assessment and accountability. Under NCLB, virtual schools were considered a legitimate option for school choice: "A virtual school can be among schools to which eligible students are offered the opportunity to transfer as long as that school is a public elementary or secondary school as defined by state law" (U.S. Department of Education, 2004, p. 13). Virtual schools were considered an acceptable alternative and, in some cases, were seen to present the only option for districts that might not otherwise meet the school choice requirements of NCLB with traditional brick and mortar classrooms (Hassel & Terrell, 2004). With the advent of school choice firmly entrenched in policy and virtual schools recognized as a legitimate option, it is during this time that we see tremendous growth in alternative models of schooling such as cyber charters.

Following NCLB, the *Every Student Succeeds Act of 2015* (ESSA) was signed with bipartisan support. This reauthorization of the ESEA maintains NCLB's focus on improving educational institutions' responsiveness to individual students as well as working to close achievement gaps in the school system. The most significant difference, however, is the shift from singular, federal oversight of school progress toward greater state educational agency (SEA) control. Each SEA is given templates or guidelines with which to establish their own academic accountability indicators. These indicators may take the form of traditional testing but may also include features more specific to non-academic goals, including student opportunities, population considerations, and career and technical readiness.

Within these goals, ESSA describes increased digital learning expectations (ESSA, 2015). As a deliberate feature of student improvement, personalization, and pathway to achievement, digital skills are listed among the proposed indicator routes for SEAs to establish. Language in the legislation specifically refers to increased student access to online course options, whether through blended learning models, dual or concurrent enrollment, or total online coursework, especially in the promotion of content related to the arts or other specialized programs. However, the emphasis is primarily on blended courses and increased digital technology within classrooms. The overarching goal of this inclusion is to target disadvantaged, impoverished, rural, or special needs students (ESSA, 2015).

The potential impact ESSA will have on fully online, virtual education is uncertain and will vary between states. This legislation does not specifically address the design or management of the nation's online course options for elementary and secondary students. Each SEA is tasked with designing its own requirements and curricula, and as such, online schools operating within that state will work to meet these standards. With increased local control of accountability indicators and continuous improvement goals, there is incentive for the states to create policy directly influencing virtual education in order to create greater accountability and school improvement (Molnar et al., 2017). We can foresee that some states could hold virtual programs under stricter or more rigorous oversight, while other states might choose not to address accountability separately in online or blended programs. With renewed freedom and incentive to establish student-based, flexible, responsive, and more holistic education requirements, states may have the potential to embrace the prospect of virtual schooling as never before. While the opportunities are expansive, recommendations for approaching policy changes that will support virtual students and schools continue to be produced and offered as a roadmap of where to start (Patrick, Worthen, Frost & Gentz, 2016).

When viewing educational policy, both current and historic, it is important to understand two competing themes in U.S. education. First and perhaps the one sustaining belief has been the belief in local control and authority over educational decisions. However, Hirschfield and Steinmo (2003) argue that federal intervention existed in the earliest conception of public education. The 1862 Morrill Act with the establishment of the nation's land grant institutions of higher education "resulted in a unique policy outcome where the federal government ended up providing the greatest of foundations for education throughout the United States, all the while appearing to be out of the way. It is this type of development that contributes to the myth that education is strictly a local issue" (p. 359). Although the belief in local control has been challenged, it still remains a pervasive driving force in the policy arena.

Second, in all cases of federal legislation, federal funds have been tied to compliance with the mandates, laws, and regulations associated with that legislation. In 2011-2012, 10.8 percent of the total estimated 1.15 trillion spent on education nationwide came from federal sources. This may represent a small percentage of the total budget for education, but given progressively dwindling state funding, the federal government can exert enormous pressure on state and local governments to conform to its policies.

It is within these often-conflicting messages and cultural norms that U.S. education policy operates, educational systems thrive, or, in some cases, fail to achieve their intended goals. And when federal policy lags, which it often does, change can be difficult. On the one hand, we have recommendations and sometimes even the funding for innovation. But our hands are tied by lagging and outdated federal policies that constrain the limits of transformation.

21st Century Themes in Policy and Educational Reform

At the turn of the 21st Century, just a few short years after ubiquitous availability of the Internet, we begin to see policy recommendations targeted directly at K-12 e-learning, distance education, or online learning. To provide some perspective, Florida Virtual School, which is now the largest online program in the country with 410,000 course completions (Watson, et al., 2013), was founded in 1997. Successful state-wide supplemental programs like the Michigan Virtual School and Idaho Digital Learning Academy were launched in 1999 and 2000, respectively. The Virtual High School Collaborative, begun as a consortium of 28 schools in 1997, now has a reported 45 member schools (VHS, Inc., 2002; Watson, et al, 2013).

In 2004, the first annual Keeping Pace with K-12 Online Learning report, tracking online education activity and policy at the state level, was published; in 2006, Rice published a comprehensive review of the literature in K-12 distance education, and in 2008, Roblyer outlined the major policy challenges facing our country. You will recognize most of the same policy discussions from those early reports are still relevant today. Issues with funding, curriculum, teacher qualifications, governance, accountability, equity, and access were identified early on. With time, clarity, and an unpredictable future, we have moved on to identify additional policy themes like innovation, efficiency, scalability, and more equitable opportunities for economic and social success (Molnar, 2014).

Identifying legislation and policy related to blended programs presents a greater challenge. In a sense, blended learning is in a developmental stage as we attempt to iron out frameworks and definitions of this "blending" of both mainstream and virtual education. However, true blended models borrow many of the tenets that drive virtual schools, and so many of the challenges are the same. Seat-time policies, flexible scheduling, grade-based assessment, grade-level progression, charter school laws etc. all impact the implementation of the innovative, personalized approaches to education in the U.S.

In the next section, we'll begin first with a look at seminal policy and reports that address online learning specifically and move into a discussion on the major themes surrounding online and blended learning emerging in the policy arena.

Online Learning

The original National Educational Technology Plan, *Getting America's Students Ready for the 21st Century: Meeting the Technology Literacy Challenge*, was published in 1996 as a national framework for states in developing technology use plans. The report focused on the use of technology in elementary and secondary education in order to improve student achievement and initiated federal programs such as the *Technology Literacy Challenge Fund* and the *E-rate program*, both programs that infused large sums of money to support technology use in mainstream classrooms. Even at this early date, distance learning, that which was delivered via live interactive transmissions, was noted for improving student achievement as much as traditional methods of instruction. And further, the advantages of using technology to reach students who would otherwise not have access to quality educational experiences were also recognized.

In 2000, The Web-Based Education Commission charged by Congress and the President with assessing the potential of the Internet for learning, published *The Power of the Internet for Learning*. The authors of the report sounded a national call to action for the federal government to remove barriers to innovations in learning and to embrace e-learning as a centerpiece of federal education policy. In particular, the commission called for recognition of the value of the Internet as a viable delivery method to increase opportunities for learner-centered, anywhere, anytime, any pace educational opportunities, for improved access to Internet resources, and the development of high-quality online content.

In the 2001 report, *Any Time, Any Place, Any Path, Any Pace: Taking the Lead on e-Learning Policy*, a study group for the National Association of State Boards of Education concluded that "e-learning will improve American education in valuable ways and should be universally implemented as soon as possible" (p. 4) and recommended that state education policy-makers move decisively in establishing policies that would ensure the rapid and equitable distribution of e-learning opportunities.

In 2000 the U.S. Department of Education published the revised National Educational Technology Plan – *E-Learning: Putting a World Class Education at the Fingertips of All Children* – with its recognition that changes in education are driven in large part by digital technologies and, in some part, by virtual schools. Particularly relevant is the plan's emphasis on e-learning as a key issue facing federal, state, and local education agencies focused on increasing access to highly qualified teachers, accountability, and teacher professional development through e-learning. As early as 2002, states were formally urging systematic reform with online education at the forefront. As an example, the Center on Education Policy report, *Preserving Principles of Public Education in an Online World: What Policy Makers Should be Asking About Virtual Schools* (Fulton & Kober, 2002), provided an action summary for policymakers in implementing virtual education opportunities. The authors called for preserving those elements of public education that we value such as effective preparation for life, work and citizenship, social cohesion and shared culture, universal access and free cost, equity and non-discrimination, public accountability and responsiveness, and religious neutrality, for supplemental rather than full time virtual programs, and for a revision of state policies for attendance, scheduling, and funding formulas to better support the growth and development of virtual programs and schools.

With the requirements of NCLB taking hold across the country and the expanding interest and notoriety in online education, a newly revised National Educational Technology Plan – *Toward A New Golden Age in American Education: How the Internet, the Law and Today's Students are Revolutionizing Expectations* – was commissioned by Congress and published in 2004. This plan had a different twist from other plans in that it used data to tell the story of where we were at the time and student voices to articulate where we should be headed. This was a time of significant advances in technology and the Internet, a time when schools had more access to technology and the Internet than ever before but also a time where it was recognized that digital technologies were underutilized. It was also a time when schools were still debating whether or not there was value in technology at all! The authors of the report called for a new model in teaching and learning, for strengthened leadership, innovative budgeting, improved teacher training, support for e-learning and virtual schools, increases in broadband access, a movement toward digital content, and integrated data systems.

These early efforts in the 21st Century set the stage for the latest wave of policy development related to educational reform. Often these recommendations and policies are not directed specifically at online learning, but they can have a significant impact on them. It should also be recognized that not all policy directives are initiated at the national level. In fact, in many, if not most cases, policy is driven at the state level through organized or grass roots initiatives. This is particularly true in the case of online and blended learning where, historically, national policy has been slow to respond to transformative educational practices taking place in classrooms across the country.

In 2010, we have policy guidance from the latest revised National Educational Technology Plan – *Transforming American Education: Learning Powered by Technology* – which called for "revolutionary transformation" in our educational systems, repeating similar dialog from NCLB with references to efficiency and accountability, but with added references to flexibility, competencies, and personalized learning. We also see reference to a set of "core" standards for what students should be able to learn (U.S. Department of Education, 2010a). As in the previous plans, it encourages states, districts, and others to leverage the power of technology for anytime, anywhere learning opportunities.

In 2016 the National Education Technology Plan was again updated, but, with the rapid changes in technology adoption and use, it was determined that the regular, five-year updates were not timely enough, so a yearly pattern of smaller updates was instituted bringing us to the latest version in 2017. This latest adoption – *Reimagining the Role of Technology in Education* – reflects a continued focus on evidence-based practices but with language that aligns to the new ESSA authorization from 2015. The plan is divided into five individual but integrated domains that include Learning, Teaching, Leadership, Assessment, and Infrastructure. Most notable is the call for a movement away from assessment that is separate and distinct from the learning process, to a system of assessment for learning. Accessibility is also addressed both in terms of equity in the quality of learning experience for all students and in terms of digital access to learning materials. Online learning still takes a prominent role explicitly with respect to teacher preparation and implicitly throughout the document. Specifically, the plan calls for online access to learning opportunities, especially for those in areas where quality teachers are lacking, and the development of a teaching force that is skilled in both online and blended methods. In other areas, though not explicitly stated, support for equitable access, improved infrastructure especially in environments away from school, increased use of technology for informal learning and professional learning communities, and improved funding mechanisms all point toward a plan that supports and encourages more robust and ubiquitous online and blended learning opportunities.

Several reports, some of them annually distributed, are helpful in highlighting trends in state-level legislative action. Digital Learning Now examines state policy climates that support educational reform efforts to promote the necessary conditions for high quality, innovative learning opportunities. In their *2013 Digital Learning Report Card*, the authors report that "states debated more than 450 digital learning bills with 132 signed into law" (p. 4) building on the 2012 legislative session when 700 bills were introduced with 152 enacted into law. Ten elements of high quality learning were identified and examined in the report: student eligibility, student access, personalized learning, advancement, quality content, quality instruction, quality choices, assessment and accountability, funding, and delivery. The 2014 report indicates a significant drop in legislation from the previous year. A total of 400 digital learning bills were proposed while only 50 passed. Trends included policies that support competency-based education, data privacy, and course access (Digital Learning Now).

Authors of the second annual report in a series published by the National Education Policy Center (NEPC) estimated that in 2012, 128 bills related specifically to online learning were considered in 31 states (41 enacted, 87 failed). In 2013, 127 bills were considered in 25 states (29 enacted, seven failed, 92 pending at the time of the report). Significant policy issues identified in the NEPC report include funding and governance, instructional quality, and recruitment and retention of high quality teachers (Molnar, 2014).

In the third report in the series, the NEPC estimated that in 2015, 98 bills were considered in 28 states specifically related to K-12 virtual education (33 enacted, 62 failed), and in 2016, 113 bills were considered in 37 states (33 enacted, 60 failed, 20 ongoing). Trends of note included a significant focus on legislation related to student online data privacy concerns and an increase over time in legislation focused on the study and oversight of online schools. Oversight of virtual schools in the most recent legislation included concerns over funding, accountability policies, enrollment management, and profiteering by private, for-profit educational management organizations (Molnar, et al, 2017).

While it may appear that policy, at the state level at least, is keeping pace with rapid advancements and change, the truth is that it is simply not doing so. Some argue that the complexity of change is accelerating at such a fast pace that policy cannot keep up. While we see pockets of activity and legislative action to address more immediate concerns and easily solved problems like online charter school laws, legislation addressing the big problems, such as equitable funding and accountability, have been slower to appear (Watson, et al, 2013). Nevertheless, substantial policy activity related to online and blended learning has occurred in the following areas:

- Accountability
- Access
- Innovation and Reform
- Teacher Preparedness

The remainder of this chapter will briefly discuss examples of policy action in these areas as they specifically relate to, impact, or influence online and blended learning.

Accountability

For the last three decades, we have witnessed a move from a focus on procedural compliance to a focus on learner performance and outcomes. This focus on accountability represents a significant trend and driver for current educational reform and policy development in the U.S. (McDonnell, 2012). At its core, the accountability movement stems from a recognition that school attendance is no longer enough to support the claim that students are learning; there must be demonstrable evidence of learning. Politically, it is a response to disparate performance of students across states and growing frustrations with poor U.S. student performance on international tests indicating a growing decline in global competitiveness. Indeed, the Progamme for International Student Assessment, or PISA, test results for 2012 indicated that American students maintained a longstanding trend since 2000, performing about average in science and reading but below average in mathematics.

Representative policies related to accountability in online and blended learning environments include the standards movement, with its associated focus on standardized assessment, and the rise of learning analytics, with a focus on the increased value of data in education.

The Standards Movement

Content area standards, or curricular goals, for subject areas have been a mainstay of the American public educational system since the *Nation at Risk* report in 1983. Historically, states have been responsible for determining their own standards for what students should and would be able to learn, with the belief being that the local authorizing agencies would be a better judge of the needs of their constituencies. So the unprecedented adoption by 45 of 50 states of the national *Common Core State Standards* (CCSS) (CCSS, 2012) may seem surprising. However, when one takes into account the historical record, the movement to national standards appears to be an inevitable and natural progression of increased national influence and control (McDonnell, 2012).

The CCSS are built upon the requirements of the *Reauthorization of the U.S. Elementary and Secondary Education Act* in 2010 (U.S. Department of Education, 2010b), which is itself an attempt to ameliorate flaws in NCLB. NCLB expanded the federal role in education, in particular, to improve educational outcomes for minority and disadvantaged students, requiring annual reading and mathematics tests aligned to states academic standards. Standardized assessments are an integral part of the CCSS implementation, just as they were in NCLB. However, the tests proposed by the two major providers, Partnership for Assessment of Readiness for College and Career (PARCC) and the Smarter Balanced Assessment Consortium (SBAC), are, according to these organizations, better aligned with highly valued next generation skills in that they are delivered via a computer, adaptive, and performance-based.

Adoption of CCSS by state educational agencies was completely voluntary, but application for NCLB waivers, per the competitive *Race to the Top* fund (U.S. Department of Education, 2009), was dependent upon states' willingness to promote curricula leading to college and career readiness. Many commentators observed that this provision seemed an endorsement of CCSS by the Department of Education, even though CCSS adoption only contributed some points to an applicant's score requirement (Golod, 2014). Resulting conflict created confusion regarding CCSS implementation with respect to standards and/or assessments (McGuinn, 2016). With the passage of ESSA, Section 8526A specifically prohibits the federal department from mandating CCSS or similar standards and programs (ESSA, 2015). Despite this specific language, CCSS adoption is still possible by state education agencies, and the federal approval of state academic indicators may be supported by the rigor, skills, and assessments of initiatives such as CCSS (Finn, 2017).

Whether in agreement or not, the implementation of the CCSS provides an exceptional advantage for scalability, efficiency, and productivity, particularly in online and blended models of education. For the first time, it is now possible on a national scale to vet, aggregate, and share high quality curriculum and teaching materials. Some states have already initiated clearinghouses for shared, reviewed, and approved online courses (Molner, 2014, p. 16). Illustrating one example of the impact of standardization, Florida enacted legislation in 2013 allowing students to enroll in online courses offered by other districts and to earn credit from massively open online courses (MOOCs). This type of flexible learning opportunity is made possible and more palatable by the existence of common standards and assessments.

Accountability measures, specifically targeted at virtual schools and programs, have increased in visibility and have been approached differently by each state. In 2012 and 2013 eleven states proposed legislation calling for broader assessment and evaluation of online schools (Molnar, 2014). Examples of the wide variability in how states approach policy for virtual schools include attempts to link per-pupil funding to accountability measures in Arizona, which failed, and a $4.3 million investment to support a center for online research and innovation in Michigan. In Tennessee, enrollment restrictions are placed on a virtual school until students have demonstrated a minimum level of achievement growth (Watson, et.al, 2013).

Learning Analytics

Data driven, or data-informed, decision-making has evolved into a vastly more sophisticated concept today, than in the past, and is often referred to as BIG data or learning analytics. Although still in its infancy in education, big data has been around in consumer-driven markets for some time. One reason for the delay is that the data in education has typically not been standardized enough to process using typical analytical methods. Second, educators, policymakers, and administrators have generally been pretty fearful of data, for many reasons.

Data can take on a variety of forms. Traditionally, we think of standardized test scores and other easily accessible data such as attendance and demographics. But data is much more than that, and learning analytics has the potential to make great strides, especially in online and blended learning. In online environments, data stored in learning management server logs can provide a very rich source of data for investigating actual learner behaviors – something that is typically very difficult to do in face-to-face environments (Hung, Hsu, & Rice, 2012).

In 2009, $4.35 billion was set aside to support *Race to the Top* (RTT) grants which were focused on innovative school reform and the use of large scale student data systems to improve accountability measures and, it was hoped, student performance outcomes (U.S. Department of Education). This was a national effort to measure student performance as well as increase transparency in reporting methods.

The increased collection and use of data in education has raised concerns. The *Family Education Rights and Privacy Act* (FERPA) (U.S. Department of Education, n.d. (a)) is an example of federal policy enacted to protect the privacy of student education records and has created somewhat unpredictable consequences for the integrated data systems so necessary for accountability measures to be effective and for learning analytics in general. Legal and ethical issues surrounding privacy, ownership, and security can place institutions in a vulnerable position, especially if an analysis of student behaviors is construed as profiling, if sensitive information is collected, if data is released to non-education related parties, or if student data is saved to an externally hosted analytic server (Parry, 2011; U.S. Department of Education, 2012).

Growing concerns over student privacy are apparent by the sheer number of references in important policy related documents and legislation (Digital Learning Now, 2014; Molnar, et al, 2017). In particular, the 2017 NETP specifically calls for continued work in the area of student data privacy as well as growing concerns over network security, especially with the increase in Internet and cloud-based data solutions in schools and the anticipated ubiquitous use of learning management systems (U.S. Department of Education). Due to the emergent nature of learning analytics in education, only time and experience will reveal the full scope of the impact of policy.

Access

The question of equal access to high quality learning opportunities is not a new one. But the advent of the Internet and online learning has brought it to the forefront in ways that were unimaginable even 20 years ago. Improving the nation's infrastructure, supportive school choice policies, federal initiatives to improve global competiveness, and the significant expansion of institutions authorized to deliver publicly funded services have all served as powerful drivers in this policy area.

Equity

There are several recent federal policy initiatives supporting equity in educational opportunities. To ensure that federally guaranteed civil rights are not overwritten by state or local policies, the Equity and Excellent Commission was established in 2011, with the purpose of informing policy development aimed at examining disparities in educational opportunities that contribute to the achievement gap experienced by low income and minority students in the U.S.

Other federal initiatives are aimed at increasing Internet access through improved infrastructure. The *E-rate* program, which uses revenues from taxes on telephone landlines, has been in existence for some time, and in 2014, $2 billion in repurposed funding from E-rate was dedicated to the *ConnectED* program with the goal of connecting 99% of the nation's schools to high speed, wireless broadband within five years. According to the U.S. Department of Education (2013a) *ConnectED* will also use existing funding through ESEA to improve the technology skills of teachers.

With the implementation of ESSA, several new grant programs will be directed through individual state designs. These grant programs will directly fulfill goals within the different Title sections of ESSA, including Title II's focus on teacher training, Title III's goal of meeting the needs of all learners, and Title IV's commitment to the 21st century learner. The *Student Support and Academic Enrichment Grants* program authorized up to 1.65 billion dollars in 2017 to provide formula grants to states to meet these initiatives (Charmov, 2016). State initiatives will vary by need, but, with respect to student needs, may include online course options that increase student access to diverse courses, provide advanced and preparatory programs, offer digital learning options for English Language Learners, and increase student access to technology in underserved areas. Districts may also use grants funds – including up to 60% of sub-grants – toward blended learning initiatives; however, grant provisions stipulate that no more than 15% of funds may be used to purchase technology infrastructure (U.S. Department of Education, 2016). For meeting the needs of the 21st century learner, professional development for teachers is also described as focusing on high quality instruction, literacy, and online- and computer-assisted learning development.

State policy initiatives specifically addressing *Course Access* programs is just one example of a concerted effort to provide policymakers with a template for innovative policies and model legislation designed to provide students with quality learning opportunities that are free from geographic limitations (Bailey, Martin, Coleman, Taylor, Leichty, & Palmer, 2014; Foundation for Excellence in Education, 2015). In their report *Leading in an Era of Change: On the Ground*, the Foundation for Excellence in Education highlights lessons learned in Course Access programs from policy to implementation through selected district profiles (2015).

School Choice

Perhaps the greatest policy influence on the growth of online education, and in some cases blended learning, over the last three decades is school choice. The proliferation of school choice options for students and parents has been a significant driver of the growth in charter schools and other programs that can offer alternatives to traditional educational environments. Charter schools are seen as a tuition-free option for quality and choice. In general, charter schools are formed under a charter, or contract, and are funded through state appropriations. However, they operate independent of public schools, some with unique educational approaches (e.g. experiential learning, project-based learning, online learning). In exchange for this operational freedom, they are often required to meet higher levels of accountability than traditional public schools.

Policies governing public charter schools are enacted at the state level, so each state varies, sometimes considerably, on what it will and will not allow as well as the types of restrictions it places on charter school creation, governance, enrollment caps, and funding. Online schools fall under school choice legislation and policies, and are usually governed under charter school law. Although online schools may technically fall under existing charter laws, it has been the case where policies have been enacted that address them more specifically, either favorably or unfavorably. However, whether or not older charter laws can be used to enforce the relatively new introduction of online or blended learning has been a significant challenge facing state policymakers. Oftentimes, it is a matter of how strictly those laws and policies are interpreted that will determine whether online or blended education are allowed. For example, in a recent case in New Jersey, the New Jersey Education Association (NJEA) challenged the operation of two charter schools that planned to implement a blended approach because the charter law did not explicitly allow for "blended learning." Citing that blended learning fit within the implied intent of the law to allow "non-traditional teaching," the challenge was rejected by the state appellate court (Freeland, 2014).

As of 2014, forty-two states had charter laws and charter schools, serving about 2.5 million students nationwide with an estimated four-fold increase in the number of public charter schools, from 1500 schools in 2000 to 6500 schools in 2013-2014 (The National Alliance for Public Charter Schools, 2014). According to the Center for Education Reform (2014), favorable charter laws are those that consist of strong, permanent authorizing structures, equitable funding codified in law, and autonomy across state, district, and teacher rules and regulations. Whether or not a state has favorable charter laws is dependent on a variety of factors. In a 2008 examination of the disparity in charter school laws and enrollments, Stoddard and Cocoran (2008) determined that factors such as a higher rate of diversity in a district or state, lower than expected student achievement, and higher than expected school dropout rates were significant predictors of favorable charter laws and greater student enrollments in charter schools.

In states, where online education is allowed, oftentimes charter schools are created and operated using for-profit, education management organizations (EMOs). This may not appear on the surface to be much different from traditional charter schools, which can also be operated by for-profit organizations that develop and manage their programs. The difference in online schools, however, is that students may not be limited to one geographic area and thus an online charter school can have a much greater impact, and, in some cases greater notoriety, across an entire state, than place-based charter schools. Current trends point to increasing and more centralized oversight and accountability measures, which have the potential to negate the very independence and innovation that charters were founded upon. A significant decline (48%) in charter applications since 2012 is indicative of the greater burden and challenge placed on charter schools in this era of accountability (Allen, 2017; Center for Education Reform, 2017). It should be noted the call for additional restrictions and regulatory compliance legislation is one way to limit the growth of underperforming virtual charter schools (Barbour, Miron, & Huerta, 2017).

Somewhat related are emerging conversations about policies surrounding private and/or independent schools and students who are homeschooled. With mainstream transition to blended learning, private schools, which in the past have been relatively quiet on the subject of online education, have begun to express interest and acceptance of technology-rich learning environments. In particular, policy questions revolve around whether or not students attending private schools or those who are homeschooled, can enroll in publicly supported supplemental courses. Eight states have policies that are explicitly favorable to these actions, two states explicitly deny access, while the remaining states either have no publicly supported online programs or have no state level policy explicitly addressing the issue (Watson, et al, 2013).

Privatization and Competition

Competition for education dollars has increased dramatically over the last decade. The significant expansion of institutions authorized to deliver publicly-funded services has perhaps been one of the most powerful drivers in recent policy initiatives (McDonnell, 2012). In the U.S., the primary competition to traditional public and private education systems are for-profit institutions. Some believe these for-profit institutions are rapidly disrupting traditional education systems (Christensen & Horn, 2011), and it has been argued, not always for the better (Gutierrez & Waitoller, 2017. Molnar, et al, 2017). In part, because for-profits are entrepreneurial, they can respond to market demand more quickly and increase efficiencies through innovative processes. Although for-profits have traditionally targeted workforce training programs and drawn students who prefer a more vocational education, in the last decade, they have increased their markets to include all academic subject areas and all levels of education from K-12 to terminal degrees.

K-12 for-profit education management organizations (EMOs), have seen significant growth over the past 10-15 years. Grass and Welner estimated that in 2011, they served 68% of full-time virtual school students. Because online schools can operate outside of traditional enrollment boundaries, sometimes throughout an entire state, the potential reach of one for-profit management company can be quite extensive. EMOs have faced increased scrutiny, and in some cases, state level policies deny them the opportunity to operate at all. Policy in this area tends to be reactive and focused on challenges surrounding enrollments and boundaries. In 2015, fourteen states had some form of legislation that limits the number of online schools that can operate or their enrollments (Pazhouh, Lake, & Miller, 2015). For example, primarily in response to accountability issues, in 2013 Illinois enacted a one-year moratorium on new virtual charter schools, Tennessee and Iowa legislated virtual school enrollments caps, and Massachusetts established limits and controls on the growth of virtual schools (Molnar, 2014).

Competition in online education also exists in other forms. Many states operate online supplemental programs, which offer distinct courses to schools that may not otherwise have access to qualified teachers for example. Course curriculum, management, and the sale of these courses may be a mix of public and private funding. Course choice legislation addresses the notion of providing students with the option of taking an online course from one of several providers while maintaining enrollment in their home district. Some form of course choice legislation has been enacted in seven states (Watson, et al, 2013).

Global Competitiveness

Maintaining our competitive edge in a global and digital world is really about universal access to education. In other words, providing opportunities for the best educational experiences possible to the greatest number of learners. Increasingly, opportunities to reach more students with quality education opportunities are made possible through online and blended education. To this end, several important policy trends have evolved. Although not directly explicit to online and blended learning, these policy examples often support models of education that have the potential to reach the greatest number of learners across geographic regions.

First, recognizing the importance of access to high quality Science, Technology, Engineering, and Mathematics education is essential to maintaining our global competitiveness, we have seen rising interest in funding initiatives at the federal level for STEM related fields (Crow & Silver, 2008). The Committee on Science, Technology, Engineering and Math Education (CoSTEM), housed within the federal Office of Science and Technology Policy, was codified by the *America COMPETES Reauthorization Act of 2010* and has been tasked with developing a long-term strategic federal STEM education plan. Examples of proposed budget allocations for STEM related investments include $170 million in new funding to support STEM Innovative Networks of schools and colleges, preparing 100,000 STEM teachers, and to establish a national corps of outstanding STEM educators (U.S. Department of Education, n.d. (b)). An example of a state policy is The Utah STEM Action Center which recently made ALEKS, a web-based adaptive learning tool for mathematics, available as part of an $8 million grant initiative by the Utah Governor's Office of Economic Development (Nagel, 2014).

College preparedness is also a high priority. In response to lagging international rankings of college graduates, U. S. federal policy has focused on improving college preparedness of high school graduates as well as increasing the number of graduates from higher education programs. The goal advocated by the administration is that by the year 2020, the U.S. will have the highest proportion of college graduates in the world. This equates to about 60% of the U.S. population. To achieve this goal, several national initiatives have been targeted at making education more affordable, but also at promoting community college enrollments, which are the fastest growing educational sector (46%). An $8 billion *Community College to Career Fund* is just one example of resource allocation to support college enrollments. Accelerated learning opportunities like dual enrollments and advanced placement in high school are other examples that have a particular impact on online and blended models of education.

Following in this vein, the federal government has recognized this lack of preparedness as a national security risk. In 2012, a report prepared by a task force established by the Council on Foreign Relations, *U.S. Education Reform and National Security*, was published. The task force identified potential threats from our lack of preparedness including threats to economic growth and competitiveness, physical safety, intellectual property, U.S. global awareness, and U.S. unity and cohesion. They proposed three policy recommendations: 1) Implement common standards for content areas vital to protecting national security, 2) Make structural changes to provide students with enhanced options and competition with equitable resource allocation, and 3) Launch a national effort to assess whether students are learning the skills and knowledge necessary to safeguard American interests.

Innovation and Reform

Policies in this category represent movements to rethink traditional methods of how we teach and how we measure learning in the most efficient and productive way possible. Often these efforts include both for-profit and non-profit institutions, and may have a large philanthropic influence. Rowen (2002) dubbed this movement as the new "school improvement industry." Policies representative of this category tend to support models that are disruptive in nature, including online and blended education, which represents further evidence of their transformative influence on traditional systems.

Efficiency and Scalability

As the federal government increasingly encourages efforts to improve efficiencies and productivity, federal funding and investments have been focused on developing and scaling programs with demonstrable success. For example, the Investing in Innovation Fund is an attempt to create fewer, larger, and more flexible funding streams to assist local agencies. Other initiatives in this area have seen the federal government partnering with very large philanthropic organizations that have a vested interest in improving and/or reforming the U. S. educational system. The *Next Generation Learning Grants* is an example of such a partnership in which the federal government has partnered with The Bill and Melinda Gates Foundation and the William and Flora Hewlett Foundation to help fund innovation in education. For example, between 2009 and 2011, the Gates Foundation invested $76 million assisting state agencies and local districts in their CCSS efforts (Phillips & Wong, 2012). Over time, these partnerships have resulted in an infusion of billions of dollars in research, grant funding, and the establishment of innovative school models, including online and blended.

While we see efforts by the federal government to encourage efficiency on one hand, on the other, scalability of online programs and schools is being curtailed by some states in favor of a more thoughtful approach. Legislation to carefully assess and evaluate the impact of virtual learning was proposed by eleven states in 2012 and enacted by three, including Colorado, Maine, and Michigan. Legislation placing enrollment limits on virtual schools were enacted by Illinois, Tennessee, and Massachusetts (Molnar, 2014). While these types of explicit accountability efforts are by no means universal, they are an indication of increasing concerns over the unfettered growth of virtual schools, sometimes to the detriment of local education agencies.

Redefining School

As states have faced increasing pressure to recognize the value and importance of addressing school in a digital age, they have responded with an array of solutions. Some continue to rely on the more traditional technology integration policies to address the issue of online learning, either preferring a more holistic approach, or taking a wait and see stance, while others have been more proactive in developing policies that directly impact online programs. In 2013, online schools operated in 29 states, 26 states had state supplemental programs, and at least 24 states had blended schools, primarily operating as charters (Watson et al., 2013). Alabama, Florida, Michigan, and Virginia all required an online course for graduation, with similar pending legislation in North Carolina and Arkansas. And online courses were recommended in West Virginia, New Mexico, and Massachusetts (Watson et al., 2013).

On the surface, policy specific to the needs of blended learning environments is less evident. The reasons for this are varied, but one explanation is a lack of understanding by policy makers of either online or blended learning. It is often the definition of online and blended learning that is key in how these types of policies are shaped and implemented and will be an ongoing challenge for federal and state policymakers as they face continued pressure to reassess old policies in a digital world. And it is critical that policies for online and blended education consider the unique nature, substance, and affordances of each type of environment (Rice, 2009).

The *Online Definitions Project* by the International Association for K-12 Online Learning is one attempt to assist policy makers with this task (2011a). Similarly, the Clayton Christensen Institute for Disruptive Innovation has worked over several years to develop a usable definition for blended learning along with an implementation framework (Christensen, Horn, & Staker, 2013). Regardless of the specific school or program model, policies that address greater educational needs, such as accountability, seat-time, funding, scalability, and the like, are the very policies that will ultimately determine the fate of the vast majority of innovative schools and programs.

Although true, comprehensive systemic change is hard to come by, we do see some movement in specific policies that impact our widely held cultural beliefs about school. Thirty-nine states allow flexibility in how they approach seat-time requirements, which is the system of equating learning to the amount of time a student spends in a class (Worthen & Pace, 2014). These types of policies are critically important to online learning particularly in attendance and truancy reporting where it can be a daunting task to track student attendance when the student is physically separated from the teacher (Archambault, Kennedy, & Bender, 2013). However, even in states like Colorado that specifically address online attendance policies, the formula is still based on the amount of time a student spends in a physical classroom (Colorado Department of Education, n.d.). Other state policy areas that deserve attention are those that legislate teacher-to-student ratios. Depending on the approach, online and blended environments may offer a more efficient measure of quality instructional time, making it a better metric than teacher-to-student ratios (Headden, 2013). To this end, Ohio's *Competency-Based Education Pilot* is an example of legislation designed to support online learning as a personalized, competency-based option based on demonstrated mastery, rather than seat-time (Barbour, Miron, & Huerta, 2017).

Funding

Funding, for online programs in particular, continues to be a high-level concern in most states and is perhaps one of the most pressing issues (Watson & Gemin, 2009). Pressure for change in funding formulas comes from a variety of directions. Funding based on attendance and seat time requirements have been standing issues for full-time virtual schools since their inception, for obvious reasons. Other concerns related to funding usually revolve around issues of boundaries and how funding is allocated and include the following:

- Enrollment areas can be quite large. In many cases, students who enroll in online schools are not restricted to district boundaries.
- Districts lose funding for students who transfer to an online school.
- District responsibility for funding a student is not originally in the district, such as homeschoolers who enroll in a virtual school.
- Double dipping occurs when using enrollment as a basis for funding if students do not complete courses. Florida is the only state that funds students based on course completion and an end of course exam.
- The actual per pupil cost of attending a virtual school has yet to be determined.

More and more states are building flexibility into their funding formulas to address these issues, but they tend to be reactive and are not long-term solutions. We see a wide variety of action across states from increased per student funding in Georgia, to attempts to decrease per student funding in Pennsylvania, Virginia, Kentucky, Florida, and Michigan, and examples of funding formulas based on mastery and completion (Florida, Minnesota, New Hampshire, and Utah) (Molnar, 2014; Molnar, et.al, 2017). While there has been a call for some time to link the costs of operating a virtual school with funding allocations (Molnar, 2014), we are finally beginning to see a shift in legislative action and policy to this effect. Kansas enacted a bill in 2015 reallocating funding based on full- or part-time status of the virtual school. Legislation was introduced in New Mexico to create an advisory group to address charges of cost ineffectiveness in two virtual charters. The bill failed but is likely indicative of future policy directions which have already begun to take hold in Michigan and Oregon (Molnar, et.al, 2017).

Funding mechanisms of state supplemental programs also continues to be a high-level concern in states where these types of programs exist. In response to pressure from outside providers, including private, for-profit organizations, Florida changed its existing system in which it compensated the state supplemental school, Florida Virtual School, with funds for students who enrolled in their courses from a separate, appropriated budget. In 2012, the state created a single funding system for all online providers and now requires that they share in a prorated portion of funding with the home district in which a student is enrolled. This is a trend that is likely to continue.

Competency-Based Learning

If online has done nothing else, it has had the greatest influence on transformative instructional practices. When you remove seat time requirements, grade level designations, and learners can spend as much or as little time on content as they need or desire, pretty soon you come to a place where you realize that our outdated notions of school are just not an effective way to reach all learners. Unfortunately, on the whole, policy related to governance issues continues to reinforce an antiquated model of education through requirements for such things as place- and pace-based assessments, proficiency equated to grade level, and average GPA as a measure of mastery (Patrick & Sturgis, 2013; Worthen & Pace, 2014).

Despite policy barriers, pockets of innovation are beginning to spring up throughout the nation. For example, Oregon, perhaps the most innovative in terms of assessment, has adopted flexible assessment options including a longer testing window, adaptive assessment questions, and multiple testing opportunities for learners. New Hampshire has initiated a competency-based system to replace their seat time requirements, and along with Ohio and New York, implemented the development of performance-based assessments (Patrick & Sturgis, 2013; Worthen & Pace, 2014). Michigan has instituted a seat-time waiver and along with Ohio is exploring personalized learning options at the highest administrative level (Barbour, Miron, Huerta, 2017; Michigan Virtual University, 2012; U.S. Department of Education, n.d(c)). Maine has made great strides in moving towards a proficiency-based program going so far as legislating proficiency-based diplomas by 2017 and creating the *Collegiate Endorsement of Proficiency-Based Education and Graduation* which asks institutions of higher education to endorse and support their efforts to support college admissions for students from proficiency-based programs (Maine Department of Education, 2011; New England Secondary School Consortium, n.d.; Silvernail, Stump, Duina, & Gunn, 2013). These efforts are in their initial stages, but trends, such as the performance-based Common Core assessments developed by PARCC and SBAC and the focus on College and Career Readiness, point to a long-awaited shift in national educational policy.

Teacher Preparation

Teacher preparation, qualifications, and effectiveness, which had primarily resided in the realm of state-level policy decisions, came under increased federal control with the highly-qualified teacher requirements of the *No Child Left Behind Act* and continues today with efforts to move to more outcome-based indicators of teacher preparation program quality. In 2013, the federal government unveiled a new policy framework for transforming teaching and learning, largely culled from the *RESPECT Project: A National Conversation about the Teaching Profession* (launched in 2012). As part of the Obama administrations' attempts to reauthorize ESEA, this initiative also encompassed grant-based funding projects like *Race to the Top* (U.S. Deparment of Education, 2009) and the *Teacher Incentive Fund* (U.S. Department of Education, 2013). Although guidelines for promoting "connected educators" and professional learning communities exist in various policy frameworks, specifically in the 2010 National Educational Technology Plan, there is currently no federal requirement that differentiates between how mainstream teachers are prepared versus those who teach online or in blended classrooms.

Although national standards and guidelines for quality online teaching exist (International Association for K-12 Online Learning, 2011b), traditional preservice teacher preparation programs have been slow to respond to the increased demand for teachers with the specialized skills necessary to teach online. The onus for this has historically been left to the state, which determines through accreditation policies and resource allocation, what criteria have priority when evaluating teacher education programs. Few states have adopted teaching standards specifically addressing the competencies and skills an online teacher should possess. Even fewer require specialized training, endorsements, or certifications. Georgia and Idaho are the only two states with K-12 online teaching endorsements. Several other states have standards, suggested guidelines, or recommendations including Michigan, Louisiana, South Carolina, South Dakota, Utah, and Vermont. Wisconsin enacted legislation in 2011 requiring 30 hours of professional development for online teachers, which was subsequently repealed in 2013. Minnesota enacted legislation in 2012 requiring state board approved teacher preparation programs include the knowledge and skills teachers must possess to deliver instruction in digital and blended learning environments. However, what specific knowledge and skills this might entail were left to interpretation as they were not included in the legislation (Archambault, DeBruler, & Freidhoff, 2014).

There continue to be calls for policy directly related to teacher licensure requirements that address the specific skills required in online and blended environments (Barbour, Miron, & Huerta, 2017). The International Society for Technology in Education (ISTE) released a new set of technology standards for teachers, specifically calling for teachers who are prepared to "create innovative digital learning environments" (including online and blended) and "manage the use of technology and student learning strategies in digital platforms" (2017). Perhaps, with their specific mention of online and blended learning as viable options for innovative teaching practice, policy will follow suit.

An additional concern related to teacher preparation is the ability and flexibility of teaching across state borders. Despite early calls for action, reciprocal licensing across state lines is still not a reality. Oklahoma is only one example of a state that allows teachers with licenses from other states (Watson & Gemin, 2009). Reciprocity agreements in many states still require that a teacher become licensed in the state in which they teach.

Finally, somewhat related to teacher preparation is the notion of administrator preparation. This is a relatively new and emerging field but represents a rather important component in online and blended education. As of this writing, there are no known policy directives requiring administrator preparation programs that specifically prepare online school or program administrators either to manage and evaluate online program effectiveness or to supervise or evaluate online teachers. Most online school administrators receive on-the-ground training.

Conclusion

Early leaders set the stage for the current culture of U. S. educational policy, which included elements of local control, attempts by the federal government to ameliorate discriminatory practices, and increased access to quality educational opportunities for all learners. In the last decades of the 20th century, predominantly after the writing of the *A Nation at Risk* report, we saw more fervent and explicit federal involvement with policies aimed at improved academic achievement and accountability measures that were increasingly tied to federal funding. In the early 21st century, policies directed at technology-enabled learning and school choice drove the exponential growth in online education witnessed to date. The most recent policy enactments, exemplified by the *No Child Left Behind Act* and the *Common Core National Standards*, attempt to identify and standardize proficiency outcomes that better enable us to develop more consistent measures of academic achievement. With the passage of the Every Student Succeeds Act, educational entities at local, state, and national levels continue to shift our understanding of access and equity in education.

Arguably, one of the most disruptive influences on U.S. education systems has been the advent and proliferation of online learning for K-12 public schools (Christensen, 2008). Just a little more than a decade old, its influence on education reform has been remarkable. When teaching and learning moved online, it created an opportunity to question the timeworn structures driving classrooms today. Why do only students in affluent schools and districts have access to quality teachers? Why can't a student advance at a pace that is personalized to their individual characteristics? Why do we equate learning with seat-time? These questions, along with advances in affordable technologies, advances in learning analytics, and the search for more affordable and efficient education options, are the drivers of significant change in U.S. policy and representative of emerging practices in U.S. education. Transformation is still in the early stages, by no means systemic, and with considerable challenges ahead, but there are ways that we can improve our chances of a successful transition to a 21st century model of school. Our recommendations remain relatively unchanged from the previous version of this chapter (Rice, 2014). We feel they hold true regardless of recent legislation and may actually be more relevant to individual stakeholders if the U. S. Department of Education maintains its shift toward local/state control over educational policy. Slight additions have been added regarding ESSA and how states can leverage their new responsibilities.

Institute transparent and consistent accountability measures across all educational modalities. Policies of accountability can add legitimacy to innovative programs (Searson, Wold, & Jones, 2011), but they should be applied consistently and fairly. Policies that promote consistent accountability measures across all educational delivery modalities, along with research that identifies best practice in different modalities, are essential to understanding what makes a quality educational program, for whom and when, regardless of delivery method. Media comparison studies (eg, between online and face-to-face classrooms), while informative, are not helpful in identifying those factors that lead to improved student outcomes. In addition, policy should reflect the growing importance of and demand for learning analytics. We should strive to establish basic protocols to protect student data, while educating the public on the power of learning analytics to personalize the educational experience of every child.

Put student learning first. As we have witnessed with online, and to some extent, blended models, learning is no longer bound by geographic and demographic borders; quality educational opportunities are no longer reliant on where you live, nor is it bound by traditional school structures, discrete blocks of time allocated to learning, or grade level designations for example. Policies that promote equal access to quality educational opportunities such as school choice, flexible seat-time requirements, and competency-based education promote and put student learning front and center. We now have the ability to ensure that all students receive the type of educational experience they need at the time they need it.

Value innovative and alternative educational delivery methods and learn from them. Thanks to the influence of competitiveness we have witnessed increased differentiation and affordability options for both K-12 and higher education. Policies that allow for alternative funding models, reciprocal teaching certifications, and scalability models are essential in allowing innovation to thrive. In order to learn from the most successful programs, robust research priorities must be implemented and supported. And then we must be willing to take it a step further and bring those successful models to mainstream education. This is not an easy task with an entire industry and infrastructure built upon an assembly-line vision of education. The mainstream adoption of blended learning, the full implementation of the Common Core Standards, and the increasing availability of quality open source educational materials may provide a solution. With the passage of ESSA, individual states have the opportunity to personalize their measures of academic success within the Department of Education's framework. It is crucial to identify leaders in innovation and accessibility so that America's students do not find opportunity lacking through inadequate implementation of the most successful routes to growth.

Prepare teachers and administrators for a digital age. Recognizing first that all teachers and administrators will be faced with classrooms and school structures that look very different from those of the past and that these transformative educational environments require a unique set of skills is critical. State policies for teacher and administrator preparation should target programs in higher education and make technology-enabled education a priority. Formal teacher preparation in colleges of education, which is almost non-existent for online teachers, would establish baseline skills and knowledge (Rice & Dawley, 2009). Teacher prep programs should be held to a minimum set of standards for developing technology skills in pre-service teachers, including those skills necessary to teach in online environments (Archambault, Kennedy, Shelton, Dalal, McAllister, Huyett, 2016; Kennedy & Archambault, 2012; Archambault, 2011). Schools of education must take a leadership role in establishing partnerships with innovative schools to develop a better understanding of how they function in order to establish appropriate and effective teaching practice and research protocols.

Some would argue that U. S. classrooms have not changed much since the days of the industrial revolution. For the most part, mainstream classrooms still revolve around a structured bell schedule, where learners are expected to learn the same content in the same amount of time during the same time each day. Despite the wide availability of information, the primary instructional strategy is direct instruction and lecture. However, this does not, by any means, convey the complete picture. Every day, in hundreds or perhaps thousands of classrooms across the country, dynamic changes are occurring. Some of these changes are systemic, such as whole states, districts, and schools that advocate and implement sweeping change through legislative action and policy reform. Change is also manifested through grass roots acts of innovation and disruption by teachers who are not afraid to let students bring their own devices to class, who extend learning time outside of the classroom, who experiment with multiple delivery modalities, and who themselves influence the evolution of educational policy. It is these localized efforts that most often push state or federal action.

The history and evolution of educational policy is fraught with reactionary political maneuvering and inconsistent and fragmented implementation. Sarason argues that in order to be successful, changes made within a system must be made with a comprehensive understanding of the whole system in which those changes are made (1993). In the end though, systemic change may be more a function of cultural change than anything else (Woodbury & Gess-Newsome, 2002). It is in establishing a new culture of education where we may find mainstream transformation both in classroom practice and in policy. Our culture of teaching and learning is a deeply-embedded ideal, often defined by how we were taught – it is all we know after all. The Internet and technology have offered us an opportunity and ability, for the first time in recent history, to transform our cultural expectations and norms. But how do we translate this new culture to our classrooms today? Just as a society's culture shapes its policy, policy is one avenue that can shape and redefine culture. Policies can be implemented that reinforce our cultural priorities.

Creating a culture that values transparency and accountability, a culture that values student learning, a culture that values innovation and risk-taking, and a culture that values teacher and administrator preparation are all educational goals that can be realized through policy reform.

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5

Theoretical Perspectives in K-12 Online Learning

Anissa Lokey-Vega, Ivan M. Jorrín-Abellán, & Leslie Pourreau

Abstract

This chapter provides an introduction to terminology of theoretical perspectives and their meager state evidenced in the field of K-12 online learning. Then with a discussion of the importance of theory, the authors propose a revival of theory in the field as a means to expand researcher impact on practice. By establishing evidence of a crisis of theory within the field, the authors discuss how a scientific revolution that employs historically important theories of distance learning could move the field forward. Through a visual conceptualization of the field, the authors explain how Connectivism could serve as an ignition switch to such a revolution.

Introduction

The purpose of this chapter is to establish the current state of theory in the body of K-12 online learning research and suggest a means to building theory in this relatively new field. To do this, we focus on five objectives. First, early in the text, we scaffold novices into the conversation with general terminology and common understandings about educational theory. Second, using the literature organized in the Research Clearinghouse for K-12 Blended and Online Learning, we establish the current state of theory evident within the field. Third, we speak to the importance of strong theoretical foundations within the field. Fourth, we present evidence suggesting a lack of theory exists within the young and fledgling field of K-12 online and blended learning research that limits our impact on practice. Finally, we propose a visual conceptualization of the field via a cartography of its components and external influences. This visualization could serve as a means to ignite conversation within the field and possibly move forward and build influence over practice. As with any chapter in this handbook, ours bears the responsibility to address a variety of readers who possess varying experience with K-12 online learning theory. This responsibility greatly influenced both the structure and content of this chapter. Planning for this chapter involved extensive reading followed by group discussion and debate. Our resulting approach intends to not only engage active scholars in a discussion, but to also make that discussion accessible to novice researchers.

Towards Common Terminology

Authors often use terms like conceptual framework, epistemology, theory, model, and theoretical framework interchangeably, which can be confusing to researchers and their readers (Egbert & Sanden, 2014; Ravitch & Riggan, 2015; Anfara & Mertz, 2015). Even amongst educational philosophers and theorists the definitions vary, complement, and in some cases, contradict. To be confident in the universality of these constructs would indicate naivety, as scholars could debate and argue these definitions indefinitely. Defining these terms for ourselves is a critical beginning for the field of K-12 online and blended learning. As authors, we propose a collection of definitions for these terms to serve the purposes of this chapter, knowing full well that they are debatable and willfully challenged. However, we find these definitions to be fitting for our field and its progress at this point in time. For example, a conceptual framework according to Egbert and Sanden (2014) is simply an overall worldview. A researcher innately holds a worldview that influences his/her research whether it is communicated or not. While we do not disagree with this claim, Ravitch and Riggan provided a more in-depth description that we find more fitting for field progress stating it is "an argument about why the topic one wishes to study matters, and why the means proposed to study it are appropriate and rigorous (2016, p. 5)." A conceptual framework is something the author or researcher must develop and cannot just look up as it is unique to the author's perspective, the surrounding context, and the particular investigation. A conceptual framework may encompass components from all of our other key terms we discuss here as well as personal interests, goals, a literature review, audience, significance, and other applicable constructs (Ravitch & Riggan, 2016).

Often an unstated component of one's conceptual framework is the epistemology. According to Thayer-Bacon (2013), epistemology is a formal study within philosophy that focuses in on theories about knowledge. Epistemology is important to both educators and researchers alike, as our views of what constitutes knowledge worth teaching or investigating influences what and how we teach learners. Teachers and researchers may not explicitly state their own theories of what it means to know, but their educative actions will align with at least one epistemological school of thought. Three of the more popular epistemological perspectives include Objectivism, Relativism, and Pragmatism. Objectivism is the view that a universal truth exists no matter the experience or perceptions of the individual, and accurate knowledge will exist no matter if the individual has learned it. In comparison, Relativism places truth and knowledge in the context of experiences and relationships to other phenomena. This means that understanding of any phenomena can only be understood when placed in its context, and that if the context changed, the meaning of the object would also change. Relativism's idea that phenomena have no true meaning without a context to surround it, contrasts with Objectivism's universal truth (Schuh & Barab, 2007). Pragmatism steps outside of the dualism of Objectivism and Relativism. In fact, many philosophers do not consider Pragmatism an epistemology as it challenges the need to even describe truth, and instead insists that something essentially counts as truth if the consequences are useful and functional within concrete experiences (Thayer-Bacon, 2013; Schuh & Barab, 2007). Truth in Pragmatism is changing and uncertain depending on the individual's experience with the object to be known and the consequences of that experience. How we believe that one comes to know something as true, helps us form theories about the world around us.

Definitions of theory range from the general, stating theory is simply speculation, to the specific, such as Egbert and Sanden's (2014) definition, which we prefer for this chapter. This definition states that "for the purposes of research, [theory is] a reasonable, systematic, investigable, modifiable explanation of certain facts or phenomena that may help predict an outcome" (p. 47). This definition specifies how theory should have the influence of evidence and logic in order to serve research processes or alterations. Relating theory to a previously mentioned term, one's epistemology, such as Objectivism, could be redefined as a theory about truth and knowing. Theories in education are often grouped according to the phenomena explained. In education specifically, we are interested in understanding the processes of learning, creating a large body of literature addressing the category of Learning Theory (Jenlink, 2013). Four widely used learning theories, which in this chapter we will refer to as the foundational learning theories include Behaviorism, Cognitivism, Constructivism, and Connectivism. We will discuss these in more depth later in the chapter. In relation to our key terms presented here, within the body of Learning Theory are several other bodies of theory such as Instructional Design Theory, which is a collection of theories intended to explain how the design of instruction influences learning processes; or Human Development Theory which is another collection of theories that attempt to explain and predict processes and characteristics of the human as it grows and ages. To further differentiate between tiers of theory, some scholars refer to the larger foundational theories like Constructivism as capital T theories, or Theories, while the narrow and specific theories like TPACK (Mishra & Koehler, 2006) would be considered a little t theory.

To move from understanding and predicting outcomes, as done by theories, towards actions to influence outcomes, models based on theories provide guidance to practitioners. Confusing the literature, model is often used interchangeably with theory; however, for the purpose of this discussion, we have adopted Shoemaker, Tankard, and Lasorsa's definition stating that a "model simply represents a portion of reality, theory, object, or process, in such a way as to highlight what are considered to be key elements or parts of the object or process and connections among them (2003, p.110)." A model serves as a tool in interpreting or acting on a given theory. For example, a popular instructional design model, called the Dick and Carey Model (2001), provides practitioners with actionable steps to design instruction for effective delivery of a learning experience. With its criterion-referenced testing and traditional approach, it aligns well with an objectivist epistemology, Behaviorist learning theory, and Systems Theory an interdisciplinary theory often included among the instructional design theory literature (Dooley, Lindner, Dooley, & Hirumi, 2005). A funnel of educational understanding grows increasingly specific allowing for predictions and actions as one states an epistemology, foundational learning theory, additional educational theories, and models that fit both the researcher's perspectives and the investigation at hand.

While it is not traditional to state all these components in a journal article, it is important to make the theoretical framework clear. When a researcher plans a research project, one or more theories will inform the investigation. A theoretical framework is "the integration of the theoretical concepts that apply to the problem under investigation (Egbert & Sanden, 2014, p. 60)." A theoretical framework is study-specific and will likely develop through a review of the literature (Ravitch & Riggan, 2016). Theories can describe a multitude of relationships on any topic, and in seeking theory to inform, support, or justify an investigation, a complex and stratified theoretical framework often develops. Effectively communicating this framework such that it is cohesive and provides focus to the subsequent study allows for theories to be developed through the investigation at hand by situating the developing theory among the other theories already published in the literature (Egbert & Sanden, 2014). Just as a plant needs soil in which to dig its roots and secure itself, a new theory needs a framework of the tangential theories to help define its underlying concepts and boundaries. Such a foundation of theories and terminology are important to the establishment of a field of study. Common language within a field helps define its boundaries and provides a means for effective communication between parties.

The Gap in the Field of K-12 Online Learning

K-12 online learning consists of online programs that deliver instruction and content primarily over the Internet with the option of learning through one course (supplemental) or a fully online program or school. Some K-12 online programs deliver instruction and content via partially online, or blended, programs. These programs divide instruction between brick-and-mortar schools and home, with the online portions allowing students some control over time, place, or even pacing for non-pencil and paper assignments (Schwirzke, Vashaw, & Watson, 2018).

K-12 online learning and distance education are often referred to as closely related fields, as it is often considered that K-12 online learning is a sub-field of distance learning, as seen in a small group of dedicated K-12 focused chapters in the *Handbook of Distance Education* (Moore, 2013); however, the closeness of the relationship between these two fields could be challenged as researchers in the fields often work in silos separate from one another with separate journals, separate research organizations, and separate bodies of literature that narrowly cross reference. Perhaps key differences in the contexts have limited communication between the two fields. For example, some issues that plague K-12 online learning in a different way or that don't come on the radar of distance education at all include online teacher certification, government funding models, seat time policy, internet safety, child development, access and equity, parental involvement, and curriculum mandates (Cavanaugh, 2013; Clark, 2013; Rice, 2014). The history of both distance education and K-12 online learning and how they intertwine is fuzzy at best (Saba, 2013). While the history of the two fields both reference back to high school correspondence programs such as the North Dakota Center for Distance Education and The University of Nebraska High School in the early twentieth century, the fields don't appear to agree on a shared history after that (Black, 2013; Barbour, 2013; Pittman, 2013; Watson & Murin, 2014). For two fields with so much in common, they are quite different and appear to communicate with one another minimally. Mass adoption of K-12 online learning seems to have emerged not down from higher education or even simultaneously beside distance education, but instead from inside the K-12 context outward towards an awkward re-meeting with distance education. Here in this space of awkward commonality, distance learning theories are new to K-12 online practitioners and distance learning experts wonder why their solutions fail to solve the challenges of the K-12 environment.

Traditionally researchers in higher education have not focused on solving real K-12 classroom problems, and research in distance education has not solved the problems inherent in K-12 online education. K-12 schools were not readily adopting online education based on the knowledge base provided prior to the 1990s (Watson & Murin, 2014; Rice, 2014). K-12 online educators were left to re-invent distance education in a design and development fashion such that it would address the unique constraints and policies of their setting such as curriculum standards, seat time, teacher certification, and terminology culturally specific to the broader K-12 setting. K-12 online learning research, like many emerging fields, began with a focus on media comparison studies, and new media comparison studies continue to dominate the literature (Waters, Barbour, & Menchaca, 2014). The research has focused on whether the online solution was effective rather than how to make K-12 online education better. As Biesta (2012, pp. 2) suggests, such "learnification" of the educational discourse makes it difficult, if not impossible, to ask the crucial educational questions about content, purpose, and relationships. In media comparison studies, an objectivist epistemology is often assumed and theoretical frameworks infrequently defined. This emphasis on quantitative comparisons have left the question of *why* and theory largely out of the solution, perhaps inadvertently. This doesn't mean that the field has been completely void of investigations that take into account qualitative data; however, this is not the greater trend within the literature (Waters, Barbour, & Menchaca, 2014).

If we zoom out from our immediate contexts and studies-in-progress to look at the field of K-12 online learning as a whole, Kuhn's theory of the Structure of Scientific Revolutions (1970) may provide us with a tool for self-reflection and guidance in moving forward. Kuhn's theory states that normal science is the period of scientific investigation where researchers adhere to a common set of processes and foundational beliefs. Kuhn argues that recognition and investigation of anomalies that challenge current understanding, serve to shift a field of study. In K-12 online learning, much excitement and hope for the potential of this new mode of instruction has surrounded the field as growth in enrollments establish a common assumption or belief that K-12 online learning is needed and helpful. However, as media comparison studies have shown time and time again, this new mode of instruction is not as effective as expected. Many scholars have claimed that K-12 virtual charter schools are actually failing our K-12 learners (Waters, Barbour, & Menchaca, 2014; Woodworth, et.al, 2015). The effectiveness of virtual schools will continue to be a hot debate for years to come in light of contradictory findings. Still, researchers must push forward as the field matures beyond media comparisons, which give us little information in how to proceed or improve moving forward. We should not ignore the complex collection of challenging evidence, nor should we perpetuate and celebrate a continued overabundance of media comparison studies.

The field of instructional technology has experienced a similar crisis as argued by Thomas Reeves in 1995. He reasoned that the field of Instructional Design had been so preoccupied between the late 1980s until the mid 1990s with media comparison debates, that researchers had populated the field with an abundance of invalid analytic studies, which lacked social relevance. Eventually, the field of instructional design matured beyond media comparison to improve the social relevance and catapult the advancement of that field. Scholars have argued that the published media comparison studies in K-12 online learning have had little social relevance (Waters, Barbour, & Menchaca, 2014). Social relevance requires that research adheres to the basic principles of scientific inquiry while at the same time "addresses problems that detract from the quality of life for individuals and groups in society, especially those problems related to learning and human development (p. 460)." Perhaps K-12 online learning research has reached a natural point in maturation that is both ready for and demands greater social relevance, rethinking the theoretical foundations and challenging the dominant assumptions in the field (Selwyn, 2017). Kuhn's (1970) theory gives us additional insight towards a solution that can move us forward. As a collection of researchers, we could investigate the anomalies of success within K-12 virtual schooling, as opposed to generalizing them as representative of a broader truth. We need to discover why these successes occur and begin to build theories of best practice around them. These investigations should provide researchers and practitioners with new directions and theories that can solve the problems experienced in the broader context of K-12 virtual schooling making research more socially relevant.

Acknowledgement of the anomalies of success and the emergence of a scientific crisis open the opportunity for our field to birth new theories better serving students and education by hopefully steering researchers towards new, increasingly socially-responsible questions in the field such as: How are the successful virtual schools succeeding as an anomaly? What factors influence successful students in otherwise failing virtual schools? What instructional design characteristics have better learner outcomes in K-12 online environments? How can we make K-12 online instruction increasingly effective for all learners? As mentioned before, the field is not void of such investigations. The start of a shift in our questions as a collective is visible in a less-acclaimed, but perhaps more forward-thinking, collection of studies that already move past the media comparison trend. For example, Freidhoff et al. (2015) published a study in the *Journal of Online Learning Research* that took into account multiple forms of qualitative and descriptive data to describe the characteristics and actions of three successful on-site mentors working in virtual schools. Best practice of on-site mentors has been unknown but needed knowledge for K-12 virtual schools. Investigating the anomalies of successful mentorship provides useful insight that begins to offer practitioners guidance. Studies like this are a critical first step in efforts to solve real K-12 virtual school problems by beginning to build a foundation of literature that can establish new theories and models aimed at improving learner outcomes.

Another example of moving the field forward can be found in Borup, West, Graham, and Davies' (2014) article about their Adolescent Community of Engagement (ACE) framework, which builds on Moore's (1993) transactional distance theory, Garrison et. al.'s (2000) Community of Inquiry, and various parent engagement frameworks (Epstein, 1987; Hoover-Dempsey & Sandler, 2005). This new youth-focused framework provides researchers a means to examine adolescent online learning contexts and make recommendations for improvements. Additionally, their ACE framework demonstrates how we can use knowledge established in other closely-related fields to develop new knowledge relevant to the field of K-12 online learning. Freidhoff et. al (2015) and Borup et al. (2014) have identified the need for a shift before a crisis was even suggested. The field, as it stands today, is ready for growth that centers around using and developing theory as a means to drive understanding and improvements in the K-12 online context.

State of Theory in the Field

Perhaps as researchers in K-12 online learning, one disagrees with a claim that theory is poorly used in the field. To address this concern further, we investigated the available literature for evidence of theory, such that a broad stroke view would be apparent. Using the database titled Research Clearinghouse for K-12 Blended and Online Learning, we wanted to see if learning theories were evident in the publications considered applicable to the field. The clearinghouse is a reputable repository made available through a joint venture between the Michigan Virtual Learning Research Institute (MVLRI) and the International Association for K-12 Online Learning (iNACOL) and houses references for a combination of scholarly articles, books, reports, and other publications. While we acknowledge that the clearinghouse database may not be comprehensive of the field's research, we felt it provided the broadest collection within a single publicly accessible and clearly-bounded system. We specifically were interested in identifying publications in the repository that indicated theoretical underpinnings in the title, abstract, or keywords. On the date of repository download, 802 records were available. Of these references, twelve were duplicates and thrown out, leaving us with a collection of 790 records of references to analyze. Once we had the complete reference list, we had to seek the abstracts and keywords from outside the repository system. References for all 790 records were included; however, not every record had an accessible abstract and/or a set of keywords. Those records that had available abstracts freely accessible on the Internet were included among the searched data. One assumption of our process that created a considerable limitation is the assumption that literature that was based on theory would mention such theories in the selected data and not just the full text. We recognize the limitation of excluding the full text of each document, making it possible that studies were miscounted. Using Atlas.ti (Atlas.ti, 2013) to hold and search the data, we used search terms as listed in Table 1, which shows the frequency with which each theory appeared in the title, keywords, or abstract of a publication in the repository.

Search Terms by Frequency

Social-Emotional Learning = 27

Personalized Learning = 22

Social Presence = 14

Self-Regulated Learning = 11

Community of Inquiry = 11

Mastery Learning = 8

Inquiry-Based Learning = 7

Caring Pedagogy = 5

Constructivis(m/t) = 5

Knowledge Construction = 5

Learning Styles = 5

Technological Pedagogical Content Knowledge (TPACK) = 5

Situated Cognition = 4

Connectivis(m/t) = 3

Transactional Distance Theory** = 3

Behaviorism / Behaviourism = 2

Cognitivism = 2

Experiential Learning = 2

Cognitive Load Theory = 1

Collaborative Learning = 1

Constructionis(m/t) = 1

Metacognition = 1

Multiple Intelligence(s) = 1

Participatory Learning (and you) = 1

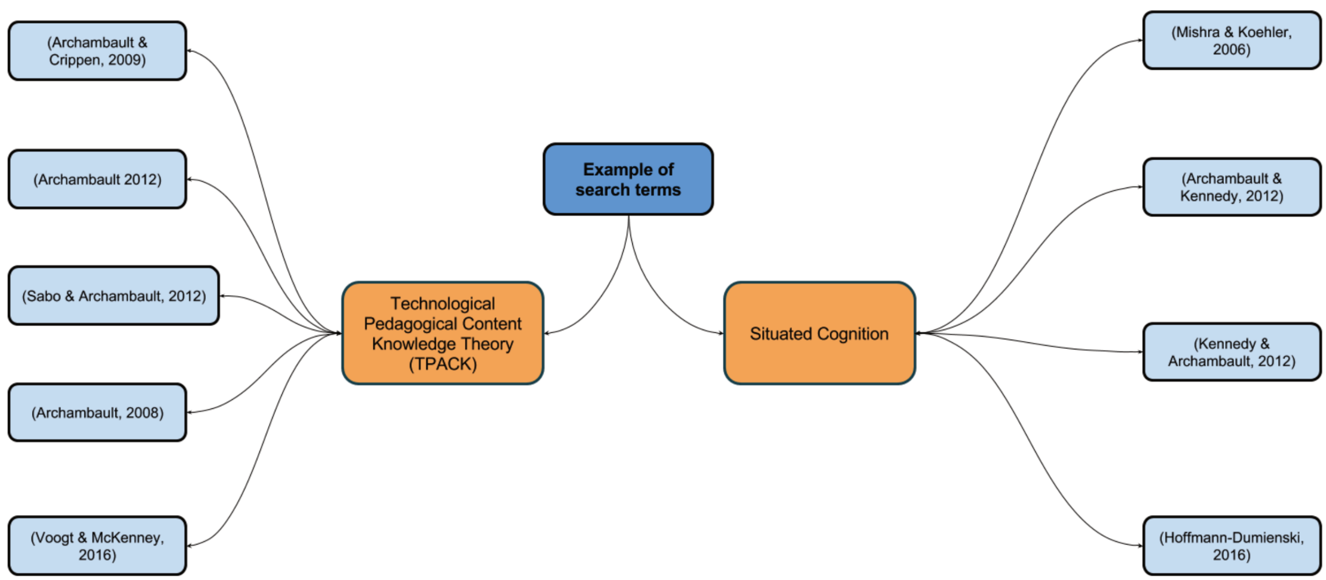
Social Learning Theory = 1

Theory of Online Learning = 1

**The articles retrieved from the repository only mention "transactional distance" in their titles, abstracts, or keywords. While this is the main concept that emerges from TDT, "transactional distance theory" does not appear explicitly in any of the titles, abstracts, or keywords examined for this study.

These search terms were collected using a two-phase process. First, we examined the repository's keyword search terms for keywords that provide evidence of theoretical foundations, by which we mean any epistemology, foundational theory, learning theory, historical perspective, conceptual framework and/or instructional model that has helped or might help build the theoretical support rooting a given field of study. Second, we examined the titles, abstracts, and keywords of the

790 references mentioned previously for further evidence of theoretical foundations. As a result, we came up with the list of 26 terms presented in Table 1. When we conducted a search for these 26 terms, we found that 137 references or 17% of the 790 records we examined included words and phrasing in their titles, abstracts, and references that corresponded directly to one or more of these theoretical foundations. Table 1 also shows that five of these 26 theoretical terms appeared more frequently than the other 21 terms. Social-Emotional Learning appeared most frequently (27 times), followed by Personalized Learning (22 times), Social Presence (14 times) and then Self-Regulated Learning and Community of Inquiry each appearing eleven times. The next highest number of occurrence came with Mastery Learning (8 times), followed by Inquiry-Based Learning (7 times), then Caring Pedagogy, Constructivis(m/t), Knowledge Construction, Learning Styles, and Technological Pedagogical Content Knowledge all appearing five times each. The remaining fourteen theories, which account for just over half of the list, were referenced four or fewer times. Figure 1 below provides further insight into how we identified the appearance of these theories by showing two examples of the organization of theory groups evident within the data.



Example of two coded groups of literature found in the Research Clearinghouse for K-12 Blended and Online Learning

While this investigation did employ basic content analysis strategies using simple computer-enacted word searches, it was not intended to turn this chapter into a research report. In fact, given the limitations of this brief investigation, we encourage future research to further analyze the state of theory in the field of K-12 online learning through a more in-depth meta-analysis. However, this brief investigation provides a glimpse at the limited proportion of literature in the field that readily speak to theoretical foundations, which supports our claim that a revival of theory is needed within our burgeoning field.

Why Theory

It is easy to agree on the idea that theory is the backbone of science. Any discipline that perceives itself as scholarly gives theory a substantial consideration. However, it is more complicated to agree that theory might also be the cornerstone of any field of practice, mainly because practitioners are usually concentrated in solving real-life problems as they appear, having little time to reflect on the theoretical repercussions of their work. This situation is even more pronounced in the field of education, where teachers are usually overwhelmed by the plethora of tasks they are required to address on a daily basis. K-12 online learning, as a particular context within education, also suffers from this challenge. Teachers in online settings not only have to deal with the issues affecting the broader profession and K-12 context, but also need to orchestrate the role technology plays in the equation, which is often complex and burdensome, given the heterogeneous array of resources currently involved in this modality of teaching. Theory can help address this challenge, supporting our claim that theory is key in the field of K-12 online learning. Moreover, we also suggest that the field needs a revival in theory. Readers may ask why theory is of such relevance. We will investigate a published metaphor from the umbrella field of Technology Enhanced Learning to illustrate the relevance of theory before proposing a potential "theoretical" direction for the field.

The difficulties teachers have to implement effective learning activities in online and blended environments have been profusely studied under the umbrella of the "orchestration" metaphor (Dillenbourg & Jermann, 2010; Prieto et al, 2011; Muñoz-Cristóbal et al, 2015). This comes as a result of the impact technological advances in the last decades are having in the transformation of educational contexts into heterogeneous ecologies of technological and social resources (Luckin, 2008). Roschelle, Dimitriadis, and Hoppe defined orchestration as "an approach to Technology Enhanced Learning that emphasizes attention to the challenges of classroom use of technology, with a particular focus on supporting teachers' roles (2013, p. 523)"

As these authors recognized, the field of Technology Enhanced Learning is highly theoretical, and it has been mainly developed by researchers instead of by teachers and practitioners. This particularity might explain why the adoption of research-based practices and technologies by teachers is, and has been, so slow. Moreover, they recognized that the field needs a rethinking, going from a "laboratory" view to a "field" view (Chan, 2013). This would imply leaving behind the idea of developing technologies in laboratory idealized conditions to then be transferred to the classroom and start promoting deep reflection from within the settings of practice.

Just as researchers in the cutting-edge field of Technology Enhanced Learning, which has many commonalities with the field of K-12 online learning, have recognized the "over-theoricalization" of the field, we should recognize the "over-practicalization" and the "learnification" (Biesta, 2012) of K-12 online learning and its almost-premature rise in program growth and enrollments that indicates mass adoption ahead of effectiveness planning. Acknowledgement of this paradox could be a good starting point for the proposed theoretical revival in our field.

Theoretical development has been an issue in the agenda of the related field of distance education since the middle eighties. Seminal authors like Holmberg (1983) and Keegan (1986) called for "a firmly based theory of distance education in order to provide the touchstone against which, financial, educational, and social decisions can be made with confidence." Translating this agenda item for our field of study, there are multiple benefits for the field of K-12 online learning in the promotion of a revival in theory, but why should we welcome educational frameworks and theory? Wilson (1997) provided three strong reasons in his work "Thoughts on theory in educational technology." Firstly, he suggests that theory helps practitioners envision new worlds and possibilities for any given field. In other words, we need theory in order to reflect on the way education can take advantage of the discoveries made in any field related to technology and educational technology. This would help the field evolve in an organized fashion, avoiding the repetition of mistakes already studied. Secondly, Wilson suggested that a good theoretical development would also help practitioners in the field make advancements in a timely manner. Anderson (2008) stated with this regard that "we need theories of online learning that help us to invest our time and limited resources most effectively." Teacher workload is a well-known drawback and challenge in K-12 online education (Archambault, 2010; Rice, 2009; Rice & Dawley, 2007). The incorporation of firmly based theory (Keegan, 1986) within the field will help practitioners maximize their efficiency by suggesting for instance, recommendations for online course development, management, and delivery that have not previously been considered. Finally, Wilson stated that firmly based theory will also help us build upon what is already known, helping us to interpret and plan for the unknown. Moreover, he also underscored that "theory will help us to look beyond day-to-day contingencies and ensure that our knowledge and practice of online learning is robust, considered, and ever-expanding (Anderson, 2008, p. 46)"

Even though the benefits of incorporating good and strong theory to our field seem to be clear, we still do not have a body of theory that is exclusive to K-12 online learning. This might be a result of: a) living in an environment where technology, society, economics, politics, and approaches to learning are all in transition (Simonson, Schosser, & Hanson, 1999); and; b) the inheritance of the current challenges in the use of theories in the educational sciences. With regard to this second cause, Klette (2011) identified four main challenges that are affecting the role of theory in the educational sciences. First, she argued that there is not a well-established unified "theory of education" supported by educational researchers and practitioners. Hence, there are multiple co-existing theories that depend on particular schools of thought, that many times seem to be incompatible. As a result of this, many of the theories cited in our field are borrowed from authors belonging to other fields, and they are used in "eclectic or vague ways." Moreover, the lack of a unified body of theory in education also generates theoretical battles within and between theories, depending on their origins and advocates. Finally, the last challenge posed by Klette has to do with the poor match that seems to be between the theory invoked in the works of some educational researchers and practitioners, and its actual impact and application in their daily practice. These four challenges easily extrapolate to the field of K-12 online learning, thus constituting a solid argument to support the need of a revival in theory.

In the next section, we will tackle the main theoretical perspectives, understood from a historical perspective, that have contributed to the evolution of the distance learning field which hold potential value for K-12 online learning (i.e. Guided Didactic Conversation, Transactional Distance Theory, and Connectivism). Acknowledging the fundamentals of these three learning theories is crucial not only for the teachers teaching in online settings but also for the theoretical evolution and a possible starting point of communication between the two online learning fields. As mentioned by Johnson & Christensen (2007) these theories will help us explain how and why the components of K-12 online education function the way they do. Moreover, these theories will be invaluable in guiding the complex practice of a rational process such as teaching and learning at a distance (Garrison, 2000); they will provide us–the educational researchers and practitioners–with an explanation to make sense of the complex practices and phenomena we are dealing with in such a rapidly changing domain.

Theoretical Perspectives: A Historical Approach

In this section, we address the seminal theories in distance education, from a historical point of view, which could or should have an impact in K-12 online learning. We are devoting this section to them, since we believe there is a need for a dialogue between our field and previously employed frameworks in the related field of distance education, which hold potential to make K-12 online education more effective.

Among the myriad of conceptual frameworks and theories that could be of help, we will focus our attention in the following three: a) Guided Didactic Conversation (Holmberg, 1983); b) Transactional Distance Theory (Moore, 1993) and; c) Connectivism (Siemens, 2008). The reasons behind selecting only these three instead of incorporating for instance, the numerous ones included in Keegan's (1986) taxonomy of theories of distance education (Theories of independence and autonomy; Theories of industrialization of teaching, and; Theories of interaction and communication) is that we will only pay attention to those which are seminal and might have a clear impact in solving some of the current challenges affecting K-12 online learning. We are including the theory of Guided Didactic Conversation because of the importance interaction currently has in our field as well as for the many possible benefits that emerge from it that could potentially help overcome some of the current challenges in K-12 online learning (see Table 2). Moreover, we will also address the Transactional Distance Theory, as it offers a number of practical applications to be implemented in accordance with some of the current theoretical trends under the umbrella of educational research such as the Deeper Learning and Personalized Learning movements (see Table 3). We will also describe the basics of Connectivism as a possible bridge between the learning theories traditionally included in the theoretical framework supporting the field, and the previous two conceptual frameworks. We will dive into these aspects right after describing the key components of the three aforementioned conceptual frameworks. Among others, these three frameworks helped build the theoretical foundations of the field of Distance Education, and can be seen as a valuable resource to help the lack of theoretical foundations existing within the young field of K-12 online learning. Moreover, a final reason to select these three historical theoretical approaches has to do with the lack of evidence in their use as theoretical foundations in K-12 online learning, as depicted in the previous section devoted to the state of theory in the field.

Guided Didactic Conversation

Guided Didactic Conversation (GDC) is a theory postulated by Börje Holmberg, who viewed distance education as the "conversation-like interaction between the student on the one hand and the tutor/counselor of the supporting organization administering the study on the other (Holmberg, 1983, p. 114)." Neacşu, Arhip, and Adăscăliţei (2007) argued that this particular theory "has explanatory value in relating teaching effectiveness to the impact of feelings of belonging and cooperation as well as to the actual exchange of questions, answers, and arguments in mediated communication." It essentially describes education as a communicative process in the form of didactic conversations. Holmberg's theory relies on the idea that the student follows a process of interpreting texts using what he called "internalised conversation," Holmberg (1983, p.1). This process represents a potentially useful learning strategy that can be exploited by educators for improved learning. Simplifying, a guided didactic conversation managed by the teacher should help students develop meaningful texts as an outcome of the learning process. As he stated, the more a student is dependent on guidance, support, and encouragement, the greater impact the guided didactic conversation will have on positive learner outcomes.

Moreover, this approach is based on the following seven postulates, assuming that: a) feelings of personal relation between the teaching and learning parties promote study pleasure and motivation; b) such feelings can be fostered by well-developed self-instructional material and two-way, communication at a distance; c) intellectual pleasure and study motivation are favorable to the attainment of study goals and the use of proper study processes and methods; d) the atmosphere, language, and conventions of friendly conversation favor feelings of personal relation according to postulate a; e) messages given and received in conversational forms are comparatively easily understood and remembered; f) the conversation concept can be successfully translated for use by the media available to distance education; g) planning and guiding the work, whether provided by the teaching organization or the student, are necessary for organized study, which is characterized by explicit or implicit goal conceptions.

These seven assumptions constitute what Holmberg called "the essential teaching principles of distance education" (2003, p. 38). Further framing his theory, Holmberg argued that distance teaching supports student motivation; promotes learning pleasure and makes the study relevant to the individual learner and his/her needs; creates feelings of rapport between the learner and the distance-education institution (its tutors, counsellors, etc.); facilitates access to course content; engages the learner in activities, discussions, and decisions; and generally cater[s] for helpful real and simulated communication to and from the learner.

We believe this theory should be taken into account in the field of K-12 online learning since it offers ways to promote rich social engagement among teachers and peers through didactic conversations that enable the pleasure of getting educated by promoting intrinsic motivation and student agency. These constitute key factors to promote deeper learning (Halla, 2015) in K-12 online settings, which includes the development of the following six competencies: a) mastering rigorous academic content; b) learning how to think critically and solve problems; c) working collaboratively; d) communicating effectively; e) directing one's own learning; and f) developing an academic mindset. Even though the concept of *deeper learning* is a term first introduced in 2010 to define the skills and knowledge that students should possess to succeed in 21st century jobs and civic life, we find multiple connections with the principles of the GDC approach. Communication, collaboration, student agency, and the use of rigorous content constitute bridges between both theories.

On a more practical level, Holmberg's Guided Didactic Conversation proposes a number of aspects that might be implemented by online teachers in order to overcome some of its current challenges, like the ones identified by Rice and Dawley (2007) and Archambault (2010) regarding time management and teacher workload, management of course content, content accessibility for the students, and student isolation. Table 2 below summarizes some of the relationships between current challenges evident in the field and lessons-learned derived from the Guided Didactic Conversation approach.

Transactional Distance Theory

Another distance learning theory that holds potential to serve K-12 online learning is Transactional Distance Theory. Transactional Distance Theory (TDT) is a theory developed by Michael Moore (1993) over twenty years ago, in which he suggested that "distance education is not simply a geographic separation of learners and teachers, but, more importantly, is a pedagogical concept (Moore, 1997, p. 22)." Moore stated that this pedagogical concept helps describe the universe of teacher-learner relationships that exist when learners and instructors are separated by space and/or by time. He suggested

Possible Benefits of Guided Didactic Conversation (GDC) for K-12 Online Learning

Challenges of K-12 online learning	**Lessons-learned from the Guided Didactic Conversation theory to overcome it.**
Time management and teachers' workload	The provision of explicit advice and suggestions to the student as to what to do and what to avoid, what to pay particular attention to and consider (offering reasons and clear justifications) might not only help students to better learn, but also the teacher to better deal with time constraints and workload issues. Moreover, the use of a set of well-structured dialogues or mediated discussions in which student ideas and assessments are promoted and valued in a horizontal fashion also can be of help for the teacher, since at some point student interactions will be auto-regulated.
Management of course content	The provision of learner-content interaction through well-designed instructional materials, as suggested in GDC, might help K-12 teachers better manage the content of their courses, as well as the motivational aspects of learning. The mediated conversations proposed by GDC can now also be a part of the elaboration of multimedia and multimodal resources (i.e. video clips, websites, games, augmented reality contents, etc.), not just text, thus promoting the personal responsibility of the students in the learning process as well as collaborative processes to solve real-life situations.
Content accessibility for students	GDC suggests the generation of easily accessible presentations of study matter, using clear, somewhat colloquial, easily-readable language in writing, and moderate density of information. This will contribute to the accessibility of content for the students, possibly minimizing one of the challenges in the field postulated by Archambault (2010).
Student isolation	The GDC approach suggests the promotion of dialogues for an exchange of views, questions, and positionalities in the learning process, which might help minimize student isolation and issues of agency.
Student motivation	GDC suggests teachers emotionally engage students by using a personal teaching style, so that they take a personal interest in the subject and its problems. This will likely contribute to the promotion of students' motivation by stressing personal responsibility when being educated.

Possible Benefits of Guided Didactic Conversation (GDC) for K-12 Online Learning

that this separation generates a special didactic relationship between the learner and the teacher, characterized by a set of special patterns of learner and teacher behaviors, that sometimes lead to a potential misunderstanding.

Moore proposed a taxonomy of these relationships around the following dimensions: the structure of instructional programs (structure), the interaction between learners and teachers (dialogue), and the nature and degree of self-directedness of the learner (learner autonomy). These three dimensions will help define the transactional distance of a particular online setting, which is relative and different for each individual involved in the teaching/learning process. The extent of the transactional distance for each case will be determined by the interaction among three variables: dialogue, structure, and learner autonomy. The greater the structure and the lower the dialogue in a program the more autonomy the learner has to work, which constitutes the cornerstone of TDT. Moore argued that the intrinsic nature of distance learning settings requires more autonomous behavior by the learner in order for success to occur. Assuming Moore's theory is true and relevant to K-12, this may further justify the role of the K-12 online mentor, advisor, or learning coach as a nurturer of learner autonomy.

As we can derive from the brief notions given thus far, there are multiple connections between TDT and the principles of deeper learning (Halla, 2015). The promotion of critical thinking and problem solving will help learners direct their own learning. Moore (1993) claimed this can be achieved by developing online programs driven by purposeful and constructive dialogues between teachers and learners within flexible program structures, supported by communication tools that are responsive to the needs of the students. These general recommendations emerging from Moore's theory compliment the definition of personalized learning provided by the U.S. Department Education's 2016 National Educational Technology Plan (NETP), providing an example of the way in which the historical perspectives presented in this section supports current trends in K-12 online learning. Personalized learning has some roots back to TDT. The U.S. Department of Education defined it in the following way:

> Personalized learning refers to instruction in which the pace of learning and the instructional approach are optimized for the needs of each learner. Learning objectives, instructional approaches, and instructional content (and its sequencing) may all vary based on learner needs. In addition, learning activities are made available that are meaningful and relevant to learners, driven by their interests and often self-initiated. (2016, p.7)

The following table summarizes the possible benefits of Transactional Distance Theory for K-12 Online Learning as well as a set of existing connections between Personalized Learning and Transactional Distance Theory, in order to identify a number of relevant strategies provided by the former to design personalized learning programs. Perhaps these connections can serve K-12 teachers and instructional designers in putting theory into practice, which otherwise sometimes translates as vague and too theoretical. Table 3 constitutes an example of the deep impact this historical theory could have in our field, and another reason to support the revival of theory.

Possible Benefits of Transactional Distance Theory for K-12 Online Learning and Connection with Personalized Learning

Challenges of K-12 online learning	Connection with Personalized Learning	Tips to overcome them from the Transactional Distance Theory
Time management and teachers' workload	PL emphasizes student-driven instructional objectives, content, pace, and sequencing. When learners are given more choice, they take more ownership of their learning, and develop the academic mindsets, learning strategies, and self-regulated learning behaviors that are necessary for meeting immediate goals and for lifelong learning.	It argues that one of the key factors in promoting learning in online settings has to do with the promotion of the autonomy of the learner. Autonomy is achieved by generating instructional dialogues that should be purposeful, constructive, positive, and directed towards an improved understanding of the student.
Management of course content	It promotes learning that is connected to each individual's development, background, interests, and experiences; and provides an approach that broadly and equitably supports educators' efforts to empower learners as individuals.	Successful distance teaching depends on the appropriate opportunities for dialogue, and the appropriately structured learning materials. To do so, distance education programs should structure the following teaching processes: 1. Presentation of information, skills, models of attitudes and values. 2. Support of motivation: stimulate and maintain the learner's interest including self-motivation. Various techniques of stimulation, feedback, and dialogue help to reach this goal. 3. Stimulate analysis and critique: learners are expected to develop these higher order cognitive skills, but must be assisted on their way. Example: organizing discussions. 4. Counsel the learning process: how to provide guidance on the use of learning materials, on study techniques; how to deal with study problems. 5. How to arrange practice and evaluation; how to give opportunity to apply new knowledge; and to practice these skills. 6. Arrange for student creation of knowledge; and providing opportunities for learners to share in the process of creating knowledge.

Student motivation & Student isolation	It often includes the use of technology to facilitate student ownership of learning and to provide tools for individual pacing and more efficient assessments to inform and tailor instruction.	TDT argues that the interactivity of the technology (communications media) used in a given program is the major determinant of dialogue in the teaching-learning environment. By manipulating the media, dialogue can be increased, and thus transactional distance reduced. TDT also suggests a rating of the communications media that can be used in distance environments. It refers to the teaching processes described in the previous row: ·Self-study guide: not very useful for any process ·Audio recording/broadcast: not too bad for presentation and motivation ·Video recording/broadcast: excellent for presentation and motivation ·Correspondence: excellent for analytic and critical development, application and evaluation, fair for all other processes ·Video conference: fair for presentation, motivation, analytic and critical development, application and evaluation ·Audio conference: excellent for learner support ·PC conference: excellent for analytic and critical development, application and evaluation, and learner support
Content accessibility for student	It implies tailoring learning for each student's strengths, needs and interests–including enabling student voice and choice in what, how, when, and where they learn–to provide flexibility and supports to ensure mastery of the highest standards possible.	The program's educational objectives, teaching strategies, and evaluation methods are crucial to accommodate each learner's individual needs. Highly structured environments (VLEs) means little or no dialogue and inputs from learners, while less structured environments allow more dialogue and a wide range of alternative responses to student questions.

Connectivism

Some of our readers might be surprised to find Connectivism (Siemens, 2005) here as one of the three historical perspectives chosen to justify and exemplify the need to incorporate existing theories in the theoretical corpus of knowledge framing K-12 online learning. Connectivism differs from the theories previously presented since it constitutes a solid emerging epistemological position addressing an evolution of the traditional learning theories. In addition to being an epistemological position, Connectivism can also be understood as a historical perspective in the field of distance education that emerged as a reaction to the deep change promoted by the development of the Internet and its influence over the conceptualization of the nature of knowledge (Downes, 2012). Given this, we believe Connectivism can help bridge the gap among the epistemologies, learning theories, and conceptual frameworks coming from related fields that are shaping K-12 online learning. This belief is further supported by Siemens (2005), who states that knowledge comes from a wide range of domains, fields, and disciplines, and access to the World Wide Web makes it easier. He highlighted that the ability to make connections among fields, ideas, and concepts is a core skill in the 21st century that can help learners better learn, and domains of knowledge, such as K-12 online learning, evolve.

Connectivism basically defends that new forms of knowledge can only happen as a result of the collective connections generated between all the nodes comprising a given network. This implies that knowledge is created beyond the level of individual human participants, and is constantly shifting and changing (Siemens, 2004). Based on this assumption, Downes (2012) made a clear distinction between Constructivism and Connectivism, stating that "…in connectivism, a phrase like "constructing meaning" makes no sense" (p. 85) since connections form naturally, through a process of association, and are not constructed through any sort of intentional action. This constitutes a huge difference with Constructivism, since Connectivistic knowledge is not transferred, made, or built. On the contrary, it argues that the learning practices we conduct help us grow and develop ourselves and our society in a connected technological fashion. With this regard, Siemens (2005) defined the following eight principles of Connectivism: a) learning and knowledge rests in diversity of opinions; b) learning is a process of connecting specialized nodes or information sources; c) learning may reside in non-human appliances; d) capacity to know more is more critical than what is currently known; e) nurturing and maintaining connections is needed to facilitate continual learning; f) ability to see connections between fields, ideas, and concepts is a core skill; g) currency (accurate, up-to-date knowledge) is the intent of all Connectivist learning activities; and h) decision-making is itself a learning process.

These guiding principles might be of help in K-12 online learning in two different ways. First, on a theoretical level, Connectivism can provide a new epistemology to researchers and practitioners in the field. This will help the promotion of critical dialogues among the epistemologies, learning theories, and conceptual frameworks coming from related fields that shape K-12 online learning, which from our understanding will be beneficial in light of the current state of theory in the field. Second, and this time on a more practical level, Connectivism can make a significant difference in current K-12 online teaching practice by promoting authentic learning situations supported by social media discussions, forums of learning communities, video platforms, and other online learning tools that will help the delivery of collaborative, interactive, and experience-rich online courses for our children.

To get started, we propose the following ideas emerging from Connectivism that may contribute to the research and delivery of K-12 online programs. These three ideas are based on the nurtured autonomy of our children (facilitating curricular negotiation and choice), the promotion of connections with other schools and institutions to enrich the curriculum, effective use of the Internet to find and criticize information thus complementing the learning content, and the collaboration of students and teachers in hands-on projects where communication and interaction is central:

1. Getting online learners involved: Motivation and personal responsibility of K-12 online learners is still a challenge in our field. Using Connectivist principles, we could design and research programs that provide a learning experience in which students are challenged. This could be facilitated by creating opportunities for exploration beyond the standard curriculum of the course, partially controlled by the students. Letting students find creative solutions to real problems based on their interactions with multiple resources and learners in different settings.
2. Creation of online communities of learners: For knowledge connections to occur, it is relevant for our students to realize that they live in an interconnected world in which they are part of a greater community of online learners. This way, communicating with others in a didactic manner is key to helping our students solve the daily challenges derived from learning in a distance fashion. Setting up (and researching) opportunities for discussion with other learners in different contexts, learning similar content, will also help cultivate meaningful connections and learning.
3. Promoting the use of Open Educational Resources (OER): K-12 online education could take advantage of existing platforms of Open Educational Resources, and new ones collaboratively created by in-service teachers, as a way to incorporate divergent perspectives into the curriculum. Moreover, teachers and students can become active producers of content, shifting from a passive role in the learning/teaching process, to a more active one. The use of OER is still a weak area in K-12 education (Tosato, Carramolino, & Rubia-Avi, 2014), and there is a lot of potential and space for growth and research in this area.

Besides starting with investigations of the successful anomalies as recommended by Kuhn (1970), these three ideas offer a starting point for those settings where lessons learned from the anomalies do not fit or where successful anomalies do not exist. Allowing the field to stagnate in a phase of media comparison studies would be neglectful to the children attending virtual schools now and in the near future. Our field is surrounded by a network of knowledge that can serve practice and research today. Understanding the makeup of the field of K-12 online learning helps us identify our connections with other fields. Finally, Table 4, in alignment with Tables 2 and 3, shows the possible benefits of using ideas coming from Connectivism to overcome current challenges in K-12 Online Learning.

Possible Benefits of Connectivism for K-12 Online Learning

Challenges of K-12 online learning	**Tips to overcome them from Connectivism.**
Student isolation	Connectivism could help us build communities of learners across spaces (face-to- face, virtual, and hybrid) with the aim of facilitating the discussion of daily challenges derived from learning in a distance fashion.
Student motivation	Getting online learners involved: Motivation and personal responsibility of K-12 online learners is still a challenge in our field. Using Connectivist principles, we could design and research programs that provide a learning experience in which students are challenged. This could be facilitated by creating opportunities for exploration beyond the standard curriculum of the course, partially controlled by the students. Letting students find creative solutions to real problems based on their interactions with multiple resources and learners in different settings.
Content accessibility for student	Promoting the use of Open Educational Resources (OER): K-12 online education could take advantage of existing platforms of Open Educational Resources, and new ones collaboratively created by in-service teachers, as a way to incorporate divergent perspectives into the curriculum. Moreover, teachers and students can become active producers of content, shifting from a passive role in the learning/teaching process, to a more active one. The use of OER is still a weak area in K-12 education (Tosato, Carramolino, & Rubia-Avi, 2014) and there is a lot of potential and space for growth and research in this area.

Moving Forward

As part of the proposal we are making in this section, we share here a cartography of the theoretical underpinnings that, from our humble opinion, should be considered in order to ground our field and push it to evolve. The cartography does not try to be comprehensive nor complete. It constitutes a visual summary of the scholarly work done to complete this chapter. This visual representation can be seen as a "boundary object" (Star & Griesemer,1989) aimed at defining a number of relevant epistemologies, instructional models, learning theories, historical perspectives, and conceptual frameworks coming from related fields, that have helped us conceptualize the role theory plays and should play in K–12 online learning. Therefore, it should be individualized by any party in the field, based on his/her knowledge, experiences, and practices. As a boundary object, this cartography tries to be plastic–enough to adapt to the local needs and constraints of the multiple stakeholders in K–12 online learning who might be using it, yet robust enough to maintain a common identity across different communities, frameworks, and possible scenarios in which it could be employed.

The cartography includes five components: a) epistemologies that have traditionally help conceptualize the nature and scope of knowledge in the field (objectivism, relativism, and pragmatism); b) the foundational learning theories that have been used in K–12 online learning to organize the principles explaining how students acquire, retain, and recall knowledge (Behaviorism, Cognitivism, Constructivism, and Connectivism); c) a set of historical perspectives in the field of distance learning that could have an impact on our field, and from which we can still extrapolate recommendations to solve current challenges in K-12 online learning (Guided Didactic Conversation, Transactional Distance Theory, and Connectivism); d) a set of conceptual frameworks coming from fields deeply related to ours, from which we can extract meaningful lessons to evolve our field (Technology Enhanced Learning, Distributed Learning, Blended Learning, e-Assessment, Human Computer Interaction, Teacher Technology Integration, Instructional Design, and Computer-supported Collaborative Learning among others), and finally; e) a fifth component called "Instructional Models" connecting the proposed epistemologies and learning theories with the aim of highlighting the guidance to practitioners that some instructional models have provided in the field. The size of this component is smaller since it operates at a theoretical level below the previous four. Each component of the cartography is defined in Table 5.

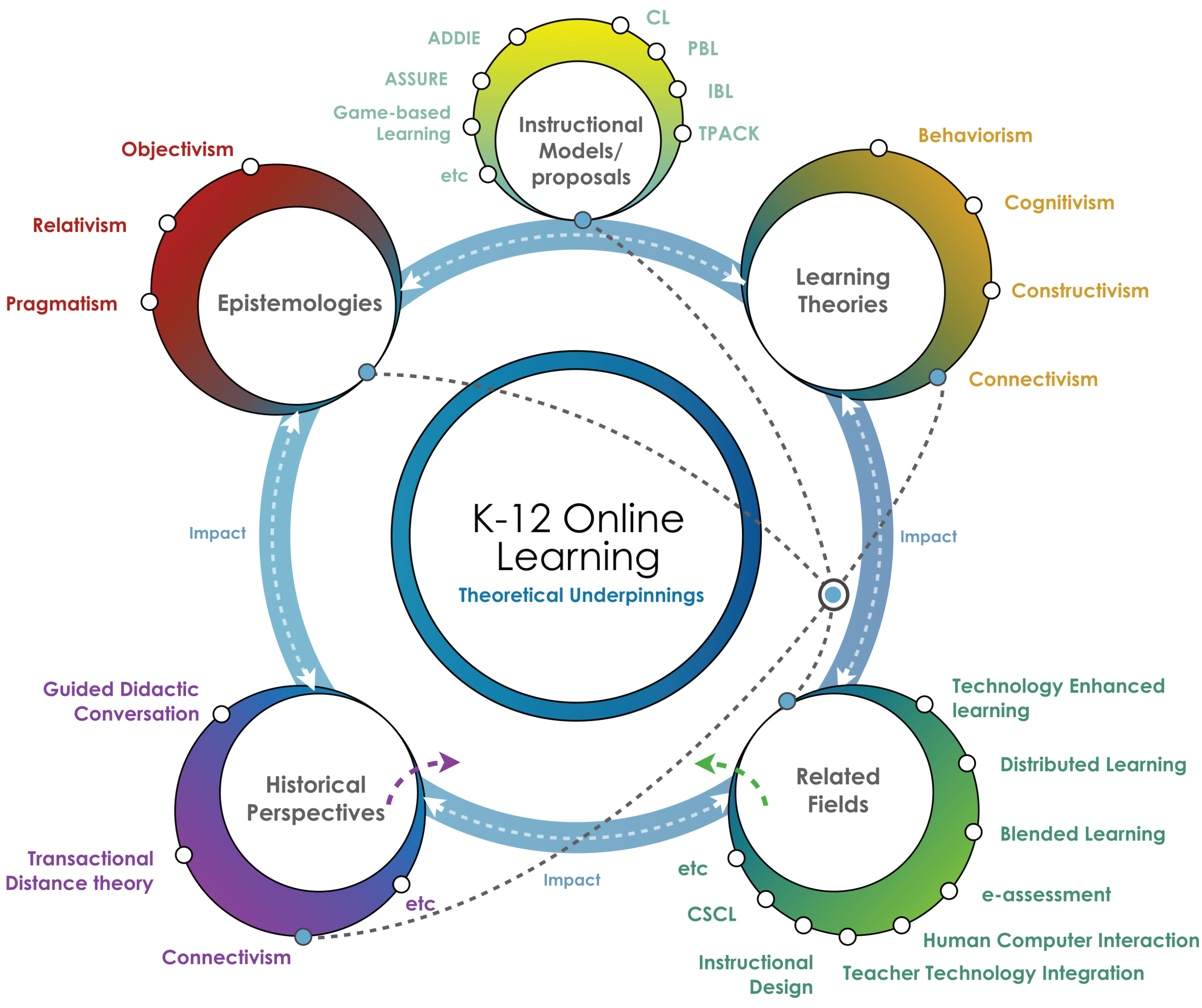


Figure 2. Cartography of the Theoretical Underpinnings in K-12 Online Learning

The cartography also highlights in a graphical fashion (light grey broken line) the special role Connectivism plays, from our point of view, in understanding the need for a revival in theory for the field as we claim throughout this chapter. As described in previous sections, we see Connectivism as an emerging epistemology that might be used to promote critical dialogues among the other five components.

Components and Definitions of Terms Included in the Proposed Cartography

Components	Definitions
Epistemologies	• Objectivism: Any of various theories asserting the validity of objective phenomena over subjective experience (Merriam Webster) • Relativism: A theory that knowledge is relative to the limited nature of the mind and the conditions of knowing (Merriam Webster) • Pragmatism: An American movement in philosophy founded by C. S. Peirce and William James and marked by the doctrines that the meaning of conceptions is to be sought in their practical bearings, that the function of thought is to guide action, and that truth is preeminently to be tested by the practical consequences of belief. (Merriam Webster)
Foundational learning theories	• Behaviorist learning theory: It equates learning with changes in either the form or frequency of observable performance. Learning is accomplished when a proper response is demonstrated following the presentation of a specific environmental stimulus. (Ertmer & Newby, 2013, p. 47) • Cognitivist learning theory: It stresses the acquisition of knowledge and internal mental structures and, as such, are closer to the rationalist end of the epistemology continuum. Learning is equated with discrete changes between states of knowledge rather than with changes in the probability of response. (Ertmer & Newby, 2013, p. 51) • Constructivist learning theory: It is a theory that equates learning with creating meaning from experience. Even though constructivism is considered to be a branch of cognitivism (both conceive of learning as a mental activity), it distinguishes itself from traditional cognitive theories in a number of ways. Most cognitive psychologists think of the mind as a reference tool to the real world; constructivists believe that the mind filters input from the world to produce its own unique reality. (Ertmer & Newby, 2013, p. 55) • Connectivism: Learning theory developed by George Siemens that explains how Internet technologies have created new opportunities for people to learn and share information across the World Wide Web and among themselves. It basically defends that new forms of knowledge can only happen as a result of the collective connections generated between all the nodes conforming a given network (Siemens, 2005)
Historical perspectives in the field of distance learning	• Guided Didactic Conversation: A theory postulated by Börje Holmberg that understands distance education as the conversation-like interaction between the student on the one hand and the tutor/counselor of the supporting organization administering the study on the other. (Neacşu et al, 2007) • Transactional Distance Theory: Theory developed by Michael Moore suggesting that distance education is not simply a geographic separation of learners and teachers, but, more importantly, is a pedagogical concept. This pedagogical concept helps describe the universe of teacher-learner

	relationships that exist when learners and instructors are separated by space and/or by time. It suggests that this separation generates a special didactic relationship between the learner and the teacher, characterized by a set of special patterns of learner and teacher behaviors, that sometimes lead to a potential misunderstanding. (Moore, 1997, p. 22) • Connectivism: Learning theory developed by George Siemens that explains how Internet technologies have created new opportunities for people to learn and share information across the World Wide Web and among themselves. It basically defends that new forms of knowledge can only happen as a result of the collective connections generated between all the nodes conforming a given network (Siemens, 2005) • Etc.
Conceptual frameworks from related fields	• Distance Learning: Also called distance education, e-learning, and online learning, form of education in which the main elements include physical separation of teachers and students during instruction and the use of various technologies to facilitate student-teacher and student-student communication. (Encyclopedia Britannica) • Technology Enhanced Learning: Approach to the provision of distance, blended, and classroom-based learning experiences through the use of a full range of information and communications technologies undertaken by communities of educational researchers, designers, information and communications technologists, and media specialists. (Parchoma, 2011) • Distributed Learning: Usually distributed learning or spaced learning is defined as opposed to massed learning. Distributed learning means that the material to be learned is distributed over a long period of time so that the learner must integrate the various separated parts of material into a unique entity. Contrarily, massed learning means that the material to be learned is provided within a short period of time. Distributed learning is grounded on the assumption that long-term memory will be improved when there is more time between acquisition and retrieval of information. Accordingly, it has been argued (Litman and Davachi 2008) that it would be better for exams to be taken after a break than before, assuming there was a review before the exams, because of the spacing effect. (Encyclopedia of the Sciences of Learning. (Seel, 2011) • Blended Learning: Term used to describe the way e-learning is being combined with traditional classroom methods and independent study to create a new, hybrid teaching methodology. The Online Learning Consortium defines blended learning as a course where 30%-70% of the instruction is delivered online. • e-Assessment: The end-to-end electronic assessment processes where ICT is used for the presentation of assessment activity and the recording of responses. This includes the end-to-end assessment process from the perspective of learners, tutors, learning establishments, awarding bodies and regulators, and the general public. (Jisc, 2016) (Tomas, Borg & McNeil, 2015) • Human Computer Interaction: Human-computer interaction (HCI) is an area

	of research and practice that emerged in the early 1980s, initially as a specialty area in computer science embracing cognitive science and human factors engineering. It is concerned with the study, design, construction and implementation of human-centric interactive computer systems. (Encyclopedia of Human-Computer Interaction, 2nd Ed) • Teacher Technology Integration: The use of technology for instructional purposes planned to some degree by a teacher. The International Society for Technology in Education (ISTE) has promoted technology integration since 1998 (Roblyer & Doering, 2010). • Instructional Design: The Association for Educational Communications and Technology (AECT) defines instructional design as "the theory and practice of design, development, utilization, management, and evaluation of processes and resources for learning" (Reiser, 2002, p. 1). • Computer-supported Collaborative Learning: Computer-supported collaborative learning (CSCL) is a branch of the learning sciences concerned with studying how people can learn together with the help of computers. (Stahl, Koschmann, & Suthers, 2006) • Etc.
Instructional Models	• TPACK: It is a model developed by Mishra and Kohler (2006) for educators as they begin to use digital tools and strategies to support teaching and learning. This model, is designed around the idea that content (what you teach) and pedagogy (how you teach) must be the basis for any technology that you plan to use in your classroom to enhance learning. • IBL: Inquiry-based learning is an approach to teaching and learning that places students' questions, ideas and observations at the center of the learning experience. Educators play an active role throughout the process by establishing a culture where ideas are respectfully challenged, tested, redesigned and viewed as improvable, moving children from a position of wondering to a position of enacted understanding and further questioning (Scardamalia, 2002). • PBL: Project-based learning is a comprehensive instructional approach to engage students in investigation. The learning activities are organized around an authentic and meaningful question. The question has real-life significance and may be multidisciplinary in nature (e.g., how to prevent cyber bullying). Students pursue solutions to the problem by asking and refining questions, debating ideas, making predictions, planning investigation, collecting and analyzing data, drawing conclusions, communicating their findings to others, and creating artifacts such as reports, models, computer programs, and video productions (Blumenfeld et al. 1991) • ADDIE: It is a framework that lists generic processes that instructional designers and training developers use. It represents a descriptive guideline for building effective training and performance support tools in five phases: Analysis; Design; Development; Implementation, and; Evaluation. (Morrison, 2010) • ASSURE: It is an Instructional Systems Design process that was modified

	to be used by teachers in the regular classroom. It incorporates Robert Gagne's events of instruction to assure effective use of media in instruction: Analyze learners; State standards & objectives; Select strategies, technology, media & materials; Utilize technology, media & materials; Require learner participation, and; Evaluate & revise. (Heinich et al, 1999) • Game-based Learning: It refers to teaching-learning actions carried out in formal and/or informal educational settings by adopting games. (Prensky, 2001).

Conclusions

Through this chapter, we hope to ignite a conversation that thrusts the field forward and initiates new researchers into the field. As illustrated through the cartography above, the relatively young field of research in K-12 online learning has achieved much in establishing ourselves as a distinct and definable group. However, the work has just begun as we stretch our field to seek and understand instances of success and test well-supported historically-important Distance Learning theories, such that we can build a body of best-practice literature founded on theory. Such a body of literature will go beyond serving researchers; but most importantly, it will play a socially responsible role in impacting the problems facing teachers and children in K-12 online learning contexts.

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6

A Brief Look at the Methodologies Used in the Research on Online Teaching and Learning

Susan Lowes & Peiyi Lin

Abstract

This chapter looks at the research methods used during the first fifteen years of research on K-12 online teaching and learning. It first reviews overall approaches, moves on to a discussion of studies that compare online and face-to-face, and then looks at studies of online learning itself. In both sections, the focus is on the specific methods used by different researchers, including surveys, interviews, and ethnographic studies, and at the different types of analysis, including content analysis and learning analytics. The discussions of each approach and method are illustrated with examples from studies in the field.

Introduction

The goal of this chapter is to look at the methods that have been used during the first fifteen years of research in online teaching and learning at the K-12 level. In what follows, we will look at the overall approaches, or research traditions; at the specific means of collecting data; and at the various ways that data has been analyzed within a particular approach.

Researchers generally break methodological approaches into three categories (Bernard & Bernard, 2012; Creswell & Creswell, 2017). The first is quantitative research, which includes descriptive, correlational, quasi-experimental, and experimental studies. The second is qualitative research, which generally takes the form of studies of smaller groups (teachers, students, classrooms). The third is mixed methods research, which has both quantitative and qualitative components. Although some methods and types of analysis tend to be associated with specific research traditions—statistical analysis with experimental designs, for example, and content analysis with qualitative research—data collected using almost any method can be analyzed quantitatively. Many researchers, and particularly evaluators, use a mix of methods, for example by combining an experimental or quasi-experimental study with a series of smaller qualitative studies to help explain the results and give voice to the participants. All of these approaches, when done carefully and transparently, are equally valid. Each brings a different perspective and type of information to the research question. In addition, different methods allow us to address new and different questions.

The research discussed here looks at two forms of online learning: supplemental online learning, experienced by students taking one or two courses in their site-based schools or on their own, and full-time online learning, such as that experienced by students in a virtual charter school. Supplemental online learning has by far the greatest number of enrollments—close to 1 million in state virtual schools alone in 2015-2016 (Evergreen Research Group, 2017)—but full-time online learning has grown and now numbers approximately 260,000 students in almost 450 schools (Miron & Gulosino, 2016). Blended learning, which combines face-to-face with online in a number of different ways, poses very different challenges for researchers and is not covered here. For a detailed description of the landscape of K-12 online learning, see Evergreen Research Group (2017). Both supplemental and full-time online learning can encompass different instructional models, from paced virtual classrooms with both student-teacher and student-student interaction to self-paced courses that rely primarily on student-teacher interaction, from courses where most of the interaction is synchronous to those where it is almost entirely asynchronous. One of the weaknesses of the literature is that the model is often unspecified, although it clearly affects both teaching and learning.

Much of the early research on online learning at the K-12 level focused on comparing online supplemental courses with their face-to-face counterparts. These comparisons were considered of paramount importance for policy reasons—it was considered necessary to show that online was as good as, or better than, face-to-face site-based learning—but there is a line of research that has continued these comparisons, using more sophisticated statistical approaches. This is particularly true for full-time online learning. The rest of the research falls under the broad heading of studies of particular cases—classes, courses, schools, or groups (teachers, administrators, students)—published as journal articles, chapters in edited collections, and increasingly by research organizations such as the Regional Educational Laboratories (RELs) and the Michigan Virtual Learning Research Institute (MVLRI). To date, there are only a few book-length academic studies by a single author. Not only was there a great deal of groundwork to be done before classic in-depth academic studies could begin—we had to know more about what we were studying in order to know what questions to ask—but academic books often derive from dissertations and it takes time for dissertation-level studies to be completed. In addition, many are first published as articles not books.

The lengthiest studies are program evaluations of virtual schools or virtual schooling course providers, often undertaken to meet the requirements for outside (federal, state, or private) funding. These evaluators' reports are a tremendous resource but they are seldom published formally, although many are posted online. They will only be discussed here if the evaluators published their results in research journals.

We also have a great deal of practical experience, much of which has been built into guidelines and standards for teaching, administration, and course design. It should be noted, however, that although these guidelines may be sound in terms of past experience, reviews of some of the standards (Ferdig, Cavanaugh, DiPietro, Black, & Dawson, 2009; Adelstein & Barbour, 2016; Rozitis, 2017) argue that many are not backed by research, particularly at the K-12 level. There are also many articles written by practitioners from personal experience, such as some of the chapters in the volumes edited by Cavanaugh and Blomeyer (2007), Ferdig and Cavanaugh (2011), and Barbour, Hasler-Waters, and Hunt (2011). These are not research in a traditional academic sense and so will not be discussed here, but they are an invaluable resource for understanding this rapidly expanding world and provide the base for subsequent academic research.

In addition, this review will not discuss those articles and reports that, although sometimes written by academics, are designed for policy or advocacy purposes. They include lessons relating to policy and practice that are based on the researchers' experience working with virtual schools, often as evaluators or advisors, and suggest best practices or revisions of current practice—for example, iNACOL's series *Promising Practices in Online Learning* and its *Research Briefs;* the reports written for state governments (for example, the Trujillo Commission report on Colorado in 2007, the Buechner Institute for Governance report for the Colorado Department of Education in 2012, and the report from the Office of the Legislative Auditor in Minnesota in 2011); and the annual *Keeping Pace* reports produced by the Evergreen Research Group. These are all worthy pieces of work, but are not academic studies in the traditional sense.

The research described in the following pages has been chosen as illustrative and is not by any means exhaustive. As examples of approaches, the focus here is not on the findings, which may differ even when the same research question is being addressed. In addition, the focus is on K-12, and there is no discussion of the extensive body of online learning research in higher education: Adult learners are different from K-12 learners, and it is an unresolved, but researchable, question which aspects of the research on higher education can be applied to K-12.

Comparing Online and Face-to-Face

As noted above, many of the first studies of K-12 online learning compared supplemental online courses to face-to-face courses. This was the result of an early policy need to show that learning online was just as good as, or better than, learning in classrooms in brick-and-mortar schools. Administrators and online course providers wanted this type of analysis in order to win acceptance as a legitimate form of learning and also to argue for funding. Many research hours have been spent on these comparisons, including not only individual studies but extensive meta-analyses (Bernard et al., 2004; Cavanaugh, Gillan, Kromrey, Hess, & Blomeyer, 2004; U.S. Department of Education, 2009). In general, the meta-analyses suggested that online education done well is as good as face-to-face education done well. However, very few of the studies included in the meta-analyses were found to have been well designed, many were actually referring to blended or hybrid courses, only some came from K–12 environments, and most had very small samples of students. In fact, the most recent meta-analysis, done by SRI for the US Department of Education in 2009, found only nine studies conducted with K–12 students, and *all* of these were in some kind of blended environment.[1]

These types of comparisons have continued for subsets of supplementary online learning, particularly credit recovery courses. There have been fewer studies comparing students in full-time virtual schools with their counterparts in brick-and-mortar schools, but those that exist are also more comprehensive, examining the terrain of full-time virtual schools as well as making comparisons with face-to-face learning.

Quasi-Experimental Studies

Since randomizing students or classrooms into treatment and control groups required for experimental studies is almost never possible in real life situations, the studies comparing online and face-to-face have generally been quasi-experimental. With quasi-experimental studies, researchers attempt to match a treatment group with a comparison group based on the characteristics that they believe to be most important, such as age, grade level, gender, and poverty level. This matching process is a difficult task. We know from prior research, as well as our own experience, that many different factors have an impact on student results in face-to-face classrooms. These include teacher expertise, such student characteristics as prior achievement, the mix of students, the curriculum itself, and the design of the instruction. Thus if we were to study the benefits of a new course in a face-to-face setting, we would consider the new course's results to be the variable under investigation, and control for as many factors as possible. Such factors might include the same teacher or one with comparable qualifications, students from backgrounds and prior learning, equal amounts of time spent on learning and instruction, the same end-of-course tests, and so on. The same holds true for comparing online and face-to-face classrooms and students. If the environment is the variable we are testing, then we need to control for every variable except the environment itself.

The problem is that this has seldom been possible, for a number of understandable reasons. Probably the most important is that the students in an online course or school are almost always different from the students in the counterpart face-to-face course or school, simply because they made the choice (or were chosen) to work online. For example, as part of their evaluation of the Alabama ACCESS distance-learning program, Roblyer, Freeman, Donaldson, and Maddox (2007) compared the results of synchronous online delivery with in-person classroom delivery. Although the students in the face-to-face classrooms had significantly better achievement scores, the authors note that there was no control for prior student abilities and speculated that the students in the online courses could have had prior lower achievement scores.

A second important reason for the difficulty in making these comparisons is that there is a greater likelihood of attrition in online courses than in face-to-face classrooms. Even if the students are comparable at the start, the online students are often a self-selected group by the end. This issue was faced by Hughes, McLeod, Brown, Maeda, and Choi (2007) in their study of Algebra students in online and face-to-face schools. Not only were the students different from the start, with a much higher percentage of the face-to-face students being college-bound, but many students did not complete the online course. To make the situation even more difficult, the end-of-course assessment was voluntary for the online students—and few of them volunteered. Although the online students appeared to have outperformed their face-to-face counterparts, the attrition rate in the online course put the validity of the comparison in doubt.

It seems likely that differences in instructional design also play an important role in differences in the outcomes in the two environments. Comparing the impact of design factors has been difficult, because the costs of course design make providers

1. This raises the issue of how to define a course as online. For example, two excellent studies cited in the USDOE report (2009) as examples of online learning would today be considered blended. One was a study of an online Algebra course delivered to students in school settings by in-class teachers that was compared to the same course delivered to students in a school setting by distance teachers with in-class assistant teachers as support (O'Dwyer, Carey, & Keinman, 2007). The second was an evaluation of a Spanish course delivered to students using a combination of face-to-face and online in a school setting (Rockman et al., 2007). Both studies therefore had a major face-to-face component and an in-class teacher or teaching assistant. By our definition, these are blended rather than online courses. As versions of this model have become increasingly popular, a research literature on their efficacy is growing, as shown by some of the chapters in this book.

reluctant to alter design aspects for the sake of a research study. One of the few attempts was that of Cavanaugh et al. (2008) when they compared the use of a module in an Algebra course that integrated an interactive toolset for teaching linear equations with one that did not. The courses with and without tools were carefully aligned. The students were pre-tested in order to remove those who could have completed the module easily, and students were assigned to the two conditions based on their time of entry into the course, with later students using the interactive tools. Although this was not random assignment, there was no reason to assume bias. However, the results were inconclusive, both because of the small group size at the start and the imbalance in group size at the end, due to attrition and incomplete assessment results for the online group.

As the difficulties of comparing online and face-to-face became more evident, researchers have made a greater effort to design quasi-experimental studies that better control for the differences between the treatment and comparison groups. In one example, Edwards, Rule, and Boody (2013) compared student attitudes to learning online with learning face-to-face by having two naturally occurring groups of students alternate between online and face-to-face versions of the same course over two semesters. As with the Cavanaugh study, the course modules were carefully aligned using matching printed and digital textbooks, and similar stand-up and recorded lectures. Students favored online learning for enjoyment—although there was a drop in the effect size over the course of the year—and for learning mathematics concepts, primarily because they could work at their own pace. However, they did not like the online mode of teacher-student communication. Subsequent analysis of gain scores showed no difference between the groups.

Heissel (2016) took a very different approach to comparing the outcomes of face-to-face and online credit recovery courses offered by North Carolina Virtual School (NCVS). Rather than assigning students to one group or the other at the beginning of the project, she used propensity scoring to pair online and face-to-face students, matching on those variables she considered important to the outcome. She was thus able to create treatment and comparison groups based on existing data. She was also able to take advantage of a change in district policy that put advanced eighth graders into a virtual Algebra 1 course while students in other districts remained in face-to-face courses. The NCVS students underperformed relative to their eighth-grade peers in face-to-face classrooms and relative to students who waited until ninth grade to take the course, a finding that Heissel argues had important policy implications. Propensity score matching is an appealing approach, precisely because it can be done with existing data; however, it has its critics. One issue is that there may be students who cannot be matched because there are not enough students judged to be equivalent—thus potentially biasing one or the other group. Another issue is that attrition reduces the number of pairs to the point that statistical power is lost. One of the strengths of Heissel's study is that it includes detailed explanations of the methods and of potential issues with selection bias.

There have also been a number of quasi-experimental studies that have compared the performance of full-time virtual schools with traditional brick-and-mortar schools. Most have found that students in full-time virtual schools were behind their traditional counterparts, whether the measure was Adequate Yearly Progress (AYP), state test scores, on-time graduation rates, or year-to-year academic growth. However, as with comparisons of supplementary online courses with their brick-and-mortar counterparts, a major challenge for these comparisons has been to create matched comparison groups. This challenge is in part because attrition has been a greater issue in full-time virtual schools than in traditional schools, and in part because of gaps in reporting by the virtual schools in particular. For this reason, it is important that the methods used be described in detail. In 2015, the Center for Research on Educational Outcomes (CREDO) at Stanford University looked at academic growth by using a matched pairs approach: Each student in a virtual charter school was matched with a student in a brick-and-mortar traditional school with the same demographic and achievement characteristics (CREDO, 2015). The National Education Policy Center (NEPC) reports by Miron and colleagues take a different approach, matching students by state in order to compare full-time students with their brick-and-mortar counterparts at both the local and national levels (Miron & Urschel, 2012; Miron, Gulosino, & Horvitz, 2014; Miron & Gulosino, 2015; Miron & Gulosino, 2016; Miron, Gulosino, Shank, & Davidson, 2017). These were complex studies and each includes appendices with raw data and, in the case of the CREDO report, a detailed discussion of how the data was analyzed.

Experimental Studies

Experimental studies avoid the problem of non-equivalent groups but are logistically challenging since it is difficult to find situations where students, classrooms, or schools can be randomly assigned into two conditions—and, in the case of supplemental online learning, where both students and teachers are often distributed across many geographic spaces. However, as the field of online learning has grown and schools have begun to recognize the need for carefully controlled research, a few researchers have been able to work with course providers to design experimental studies. For example, Hannum, Irvin, Lei, and Farmer (2008) used randomized assignment in their research on whether having a local facilitator trained in learner-centered psychological principles (LCPs) would lead to greater engagement and higher completion rates among students in rural schools taking a supplementary online course. In this case, the experimental design was possible because the intervention was specifically designed by the researchers to address their research question. Schools were recruited, paired for similar demographic characteristics, and then assigned to the treatment or control conditions. The researchers found that the students in the experimental schools remained in their courses longer and were more likely to complete than students in the control group, regardless of which teacher was teaching. The researchers include a discussion of why their findings might not apply more widely, including an analysis of the differences between rural and non-rural students.

The Regional Education Laboratories (RELs), which were set up to partner with state and local education agencies in order to conduct applied research, have developed strong collaborations with local districts, which have facilitated access to larger datasets. Using these datasets Heppen and colleagues (Heppen et al., 2011) were able to randomly assign schools in Maine and Vermont that did not already offer Algebra 1 to eighth graders to one of two conditions: schools in the treatment condition received an online Algebra 1 course while schools in the control condition implemented their usual mathematics curriculum, which had a sizable Algebra component. They were able to administer a pre-test to all students and used the existing eighth grade mathematics assessments of Algebra knowledge and general mathematics achievement as post-tests. They found that the online students outperformed the control students on the end-of-grade assessment. Perhaps more important, they also found that the students who took the online course were more likely to pursue an advanced course sequence in later grades. They then did a number of follow-up analyses to tease out the impact of various factors, including prior mathematical knowledge. This was an important study not only because of its methodological sophistication, but also because it was framed not so much as a comparison but as a test of the ability of online courses to broaden access to a gatekeeper course to previously underserved populations.

Similarly, researchers from the American Institutes for Research (AIR) and the Consortium on Chicago School Research (CCSR) at the University of Chicago were able to team up with Chicago Public Schools (CPS) to look at the comparative efficacy of offering Algebra 1B (the second semester of Algebra) as an online summer credit recovery option for at-risk ninth graders (Heppen et al., 2017). Because the researchers were working with CPS, they were able to use within-school randomization to place students into either the online or face-to-face group and to administer a student survey that included items relating to classroom experience (engagement, difficulty, mathematics confidence, etc.). They found that while the two groups of students did not differ on many items, the online students found the course more difficult than did the face-to-face students, they scored lower on the post-test, and they were less likely to recover credit. However, there were no significant differences on the grade ten mathematics assessment, on subsequent course performance, or on cumulative math credits by the end of the second year of high school. This is another study that is exemplary for the detailed explanation of its procedures and results.

Statistical Approaches

Setting up experimental or quasi-experimental research designs in education settings is so difficult that some researchers instead chose to compare two conditions by statistically controlling for as many demographic, achievement, and environmental characteristics as possible. Typically, these researchers have access to much larger data sets than the experimental and quasi-experimental studies described above because they work with the virtual schools and the relevant state education departments.

In terms of statistical approaches, researchers interested in binary outcomes (i.e., pass/fail) tend to use logistic regression while those interested in continuous outcomes (i.e., final grades) tend to use linear regression; some use a combination. For example, using data provided by Florida Virtual School (FLVS) and the state of Florida for grade nine and ten students for the years 2005 to 2011, Chingos and Schwert (2014) found that when directly comparing FLVS students with other students, the FLVS students seemed to be the more academically and socioeconomically advantaged group, but when they used linear regression and controlled for demographics and prior achievement the difference was greatly reduced. Hughes, Zhou, and Petscher (2015) also used FLVS data to compare grade nine through twelve students in 20 of Florida's most common academic courses and all of its credit recovery courses from 2007 to 2011. In this case, they used logistic regression to examine the odds of success and found that virtual school students were likely to earn a grade of C or better, although the success gap was highest in ninth grade and diminished to almost nothing by twelfth. They found this was true across most subgroups. Taking a school-based approach, Ahn and McEachin (2017) used linear probability regression models, an alternative form of logistic regression, to compare differences in student enrollment and achievement in full-time virtual schools and full-time brick-and-mortar charter schools. In addition, they compared these two types of choice-based schools with traditional public schools. They were able to do this because they had the cooperation of the Ohio Department of Education, which provided both achievement and demographic data for all Ohio students over four years. They found differences in enrollment by race and differences in achievement by type of school, with virtual school students scoring significantly lower on the Ohio high school graduation test than students in traditional charter and public schools. This was a nuanced study that looked at the data through several different lenses and argued for paying more attention to differences in context and pedagogy in order to better support students in any venue.

In all these cases, the results are presented as an association between the characteristics and the outcomes, not as a cause-and-effect relationship. In contrast, in her comparison of end-of-course Algebra 1 scores of North Carolina Virtual Public School (NCVPS) and face-to-face public-school students described above, Heissel (2016) used a difference-in-difference (DID) approach, a regression technique that allows any difference to be attributed causally to one or the other condition.

Some researchers have used both linear and logistic regression depending on the outcomes they are considering. For example, Stallings et al. (2016) used linear regression to compare the short-term success (end-of-course test scores) and multivariate logistic regression to compare the long-term success of likelihood of graduating and graduating on time for NCVPS students and face-to-face public-school students enrolled in credit recovery courses between 2008 and 2012. They found little difference in short-term course success rates but a significant difference in the likelihood that the online students would graduate and do so on time. They use the results to suggest that online credit recovery students differ in important ways from credit recovery students in face-to-face classrooms, and may therefore require different types of support. This study is one of the few that tries to tease out the differences in the two conditions.

Although there is a need to continue comparing the success of online learning with that of face-to-face learning, not only for policy reasons but also in order to improve teaching and learning, the effort has been hampered by a focus on those variables that make the two groups equivalent rather than those that make them different. After all, a major reason for having an online option available is that students may benefit from an environment that is very different from their face-to-face classrooms. However, to discover what these variables are, we need to understand the online environment itself. The next section focuses on efforts to do this.

Looking Within the Online Environment

When little is known about a mode of teaching and learning, studies of particular cases provide the background and insights on which further research can be built. They come in many forms but are generally studies of groups, such as teachers, classrooms, schools, or subsets of individuals. They can use almost any data collection method or combination of methods, each with its advantages and disadvantages, but tend to use surveys, focus groups, interviews, and observations. In the sections below, we look at the methods used to collect data and then the ways it has been analyzed, qualitatively and quantitatively.

Surveys

Surveys are a useful tool for understanding a population, and early researchers in online learning often started by surveying the populations in which they are interested. This method has provided us with a fairly large collection of analyses based on broad surveys of perceptions, attitudes, and experiences. All of these are extremely useful as a starting point and, at the same time, suggested areas for further research and discussion.

Survey results have to be used carefully, particularly when the characteristics and size of entire population are not known, making it impossible to be sure if those who respond are representative of the larger population. In the case of online learning, this has often been an issue because survey response rates tend to be low, particularly in broadcast surveys, where there is no personal relationship with those surveyed and no incentive to respond. This means that the results can only be analyzed using frequencies or basic statistics, and are not easily generalized to other groups. If the responses are consistent across respondents, it can be assumed with some confidence that the findings are likely to apply broadly across the population but if they are not—if there is a great deal of variation—then there are a number of next steps that that need to be taken to explain the results, such as follow-up interviews.

In most of the early attempts to survey the field of K-12 online teaching and learning, the size of the specific population was unknown, the response rate from those surveyed was low, and the results did not show consistency. Unfortunately, low response rates have continued to be an issue for those trying to reach populations beyond their own schools or classrooms. A few examples follow.

Surveys of Teachers

When the recent upsurge in online learning began in the mid-2000s, little was known about who was teaching online, so the goal of some of the early survey work was to find out more about these teachers and their needs. In 2007, Rice and Dawley conducted the first national survey of online teachers, administrators, and trainers in order to gather descriptive data on their experiences, with a focus on professional development (Rice & Dawley, 2009). They received 259 responses from a purposeful sample from a wide range of types of online schools or programs. There was no assumption that the respondents were representative of the larger population. Instead, the results showed that there were many different models for delivering professional development, with different amounts, different providers, and different topics covered.

While Rice and Dawley focused on professional development, Archambault and Crippen (2009) followed a similar procedure in their more general study of the characteristics of teachers who taught or had previously taught at least one online class with K–12 students in a state-sanctioned virtual school in the United States. They sent their survey to 1,795 teachers, using email addresses collected from the websites of state-sponsored schools listed in the annual *Keeping Pace with Online Learning* for 2006 (Watson & Ryan, 2006). They found that those who responded were more likely to be part-time than full-time, teaching only one or two courses online, had more years of traditional teaching experience than the national average for face-to-face teachers, and were more likely than the general teaching population to have Master's degrees. Equally important, in terms of personal characteristics, these teachers were generally adventurous and looking for new challenges. However, the researchers had only a 33 percent response rate and, since the population of teachers was unknown but presumably larger than the number who received the surveys, we can assume the percent of teachers included in the results is even lower. The authors then followed up with the 80 respondents who had reported that they were teaching secondary science, sending them a new survey that asked how laboratory activities were being enacted in these courses (Crippen, Archambault, & Kern, 2013). The response rate was still low at 35 percent, so the percentages of each activity may not be representative, but the real value of the results was in the examples of the range of activities rather than in the proportion of each practice.

Zweig and Stafford (2016) had a similar response issue when they surveyed teachers in three supplemental online learning programs and one consortium in the Midwest. All the programs offered some form of training for their teachers, but they differed considerably in content and structure. The number of teachers in each program varied, from 7 to 216, and the response rate varied as well, from 44 percent to 100 percent. They report the results for all the responses taken together but were careful to note the ranges in the responses and the differences among the programs.

Other researchers have surveyed smaller sets of teachers, generally from one school. For example, Lowes (2010) surveyed teachers at Virtual High School in order to look at the migration of teaching practices between face-to-face and online classrooms as these teachers moved back and forth between the two. Oliver, Kellogg Townsend, and Brady (2010) surveyed elementary and middle school teachers at North Carolina Virtual School to elicit their needs in developing their online courses, finding that they wanted bite-sized and targeted professional development that covered a wide range of topics beyond the actual curriculum itself. In both cases, it was the character of the responses that was of interest, not the precise percentages.

Surveys of Students

Researchers who want to see how students perceived the benefits and challenges of online learning have also relied on surveys—in part because the students are often scattered across a wide geographical area and hard to reach by other means. Low response rates have been an issue here too. For example, in Barbour's study of students taking an online course that combined synchronous and asynchronous modes of interaction (Barbour, 2008), it is unclear how large the surveyed population was as no numbers or response rates are given; however, since the survey was circulated in 18 schools, 36 respondents seems small and the findings possibly biased. More recently, Lewis, Whiteside, and Dikkers (2014) had better results when they looked specifically at at-risk students who were enrolled in different programs that used NCVPS courses from 2012 to 2014. In this case, they had an almost 100 percent response rate from the smaller programs that had a face-to-face component (i.e., the students met in educational centers) and a high 80 percent rate for a large group of credit recovery students surveyed in 2014. They felt that the results were consistent enough for them to be able to report that, one, the students all saw the benefits of online learning to be their ability to pace themselves and to work ahead and, two, that all found time management and taking responsibility for their own learning to be a challenge. The researchers used their findings to argue for better support systems for these students.

Some of the research on students has used existing end-of-course surveys, sometimes modified to address specific research questions. End-of-course surveys also almost always suffer from response bias. A good example is Oliver, Osborne, and Brady (2009), who studied secondary students' expectations of their teachers at NCVPS. The researchers received 1,648 surveys, a large number, but a response rate of only 32 percent. The findings were ambiguous and the reasoning behind the responses was unclear, leading to the need for in-depth content analysis of the responses to the open-ended survey questions. In follow-up studies, Oliver, Kellogg, and Patel (2010, 2012) probed more deeply into the results by analyzing the data by course. They found significantly lower levels of satisfaction among students taking foreign languages and math compared to other courses, to the extent that it seemed clear that something was going on with these two subject areas. To understand these findings, they then did follow-up surveys with both sets of students and teachers. This time the researchers used open-ended questions, which were analyzed qualitatively. Although the student response rates were low—between 20 and 25 percent—the two types of data together made it possible to develop an extensive set of recommendations for designing and teaching courses in these particular subject areas.

A few researchers, mostly those working with small groups of students, have been able to administer outside instruments to address questions in which they are interested. For example, in early days of online learning when high drop-out rates were a primary concern, Roblyer and Marshall (2002) administered the Educational Success Prediction Instrument, or the ESPRI. They hoped that the ESPRI would predict the likelihood of a student succeeding in a course—not to discourage enrollment but to identify those who might need additional support. The researchers then surveyed all the students at one supplementary course provider using the ESPRI (Roblyer, Davis, Mills, Marshall, & Pape, 2008). The response rate was relatively high—about 70 percent of the total number of students at the school—but in the end there were complete data sets (i.e., including such additional data as demographics and course scores) for only about 53 percent. Their analysis showed that some variables were predictive, including students' past ability as reflected in their GPA, environmental conditions such as having time in school to complete the course, and such cognitive student characteristics as self-efficacy. However, these factors were far more predictive of success than of failure.

In a similar effort, Lowes and Lin (2015), used Rotter's locus of control instrument to examine if students who had higher levels self-regulation did better in the online environment. Their study sample was about 600 advanced high school students enrolled in asynchronous online courses from one course provider during the school year 2013–2014. They found that total scores were not useful, that some factors were more important than others in terms of their relationship with final grades, and that certain factors best described male responses while other factors best described female responses.

A final example is Kim, Park, and Cozart's (2014) use of two well-known instruments, the Motivated Strategies for Learning Questionnaire (MSLQ) and the Achievement Emotion Questionnaire in Mathematics (AEQ-M), to investigate the relationships among motivational factors, affective factors, and cognitive processes and achievement for students enrolled in online mathematics courses at one virtual school. They found a complex set of relationships that led them to suggest that more attention needs to be paid to motivational and emotional components of online learning. While the instruments used in the study have been well validated, the authors note that their findings were limited by the small number of participants (they do not give a response rate) and the lack of information on preexisting differences among participants such as prior achievement.

A few researchers have been able to develop their own surveys in order to address the specific questions in which they are interested. For example, Borup, Graham, and Davies (2013) developed a survey to measure the time that students in a full-time online school and their parents spent on course interactions, and to investigate the focus of those interactions. They chose to look at 250 students in a core freshman English course in two different semesters. They had 82 student-parent paired responses, a 33 percent response rate. Although the respondents may have been a biased group, the range in the amount of interaction was large enough to presume it covered all likely responses—even if the percent of each might not have been exact—and the fact that the researchers could correlate parent and student results, as well as correlate both with outcomes, made this a particularly interesting study.

Surveys of Administrators

In the early days of supplemental online schooling, most of the teachers were face-to-face classroom teachers who moved into online teaching. As the field grew and it became evident that many more teachers would be needed, questions began to be raised about the extent to which schools of education were preparing pre-service teachers for online teaching, and particularly whether they were providing the online counterpart to the traditional field experience. Kennedy and Archambault (2012) surveyed administrators of schools that prepare pre-service teachers for teaching online in the K-12 environment. They sent their survey to 1,528 administrators of teacher education programs or others who they felt could answer the relevant questions for their schools; 522, or 34 percent, responded. They found that only a few of the colleges and universities that train students to teach in face-to-face classrooms are also training them for online teaching and that very few virtual schools were currently offering pre-service teachers training placements or field experiences. Because the response rate was low, the authors note that the results were descriptive rather than definitive. However, their findings confirmed what had previously been known only anecdotally and led several virtual schools to open their doors to these types of experiences. They also used the results to develop seven models of virtual school field experiences, based on their design and requirements. This approach provided insights into the range of offerings, as well as some of the misconceptions schools have about how these programs should be structured. An update (Archambault et al., 2016), reported only incremental progress among teacher education programs across the country.

Interviews

Interviews are used to probe for deeper understanding than surveys allow, but time constraints generally mean a much smaller number of respondents. Interviews have therefore been used less frequently than surveys. An early example was Roblyer's (2006) interviews with teachers from five virtual schools in order to find out what they believed to be the factors that supported student retention. A similar effort was DiPietro's (2010) study of 16 successful teachers of supplemental courses at a Midwestern virtual school in order to elicit the perceptions they held regarding their instructional roles and gain insight into the instructional strategies supporting their coordination of pedagogy, technology, and content (DiPietro, Ferdig, Black, & Preston, 2008; DiPietro, 2010). The teachers were deliberately chosen on the basis of their experience teaching online, their certification, and their identification as successful by the school. Analysis of the results elicited five themes or beliefs, each with associated specific pedagogical practices, that these teachers consistently held to be important: connecting with students, fluid practice into teaching online, engaging students with the content, managing the course, and supporting student success. This work made it clear that online teachers were highly aware of the differences between online and face-to-face environments, and of the best practices needed to be effective in the online environment. However, work by Hawkins, Barbour, and Graham (2012) suggests that this is by no means always the case. These researchers conducted semi-structured phone interviews with eight teachers at the largest state-led virtual high school in Utah and had quite different findings: the teachers they interviewed felt disconnected from their students, from their traditional notions of what it meant to be a teacher, and from their fellow teachers. These findings may be due to differences in the instructional design of the courses, which affects the teacher role. The value of both pieces of research is that they show the insights that interviews can provide into what it feels like to be an online teacher.

Other interview-based research has focused on programs and administrators. Lowes (2007) interviewed four of the largest online course providers to learn how they had constructed their professional development offerings, including the underlying pedagogy and how that translated into practice. Similarly, Kennedy interviewed six virtual school administrators from across the United States and used these results to find out what mentors were doing in virtual schools (Kennedy & Cavanaugh, 2010). Kennedy was able to identify three quite different roles and then described how these played out in each school. This type of in-depth analysis shed much-needed light on the variety of practices across the world of virtual schools.

Researchers have also used interviews to provide insights into the practices of other participants in the online learning process. For example, Drysdale, Graham, and Borup (2014) interviewed online mentors—called shepherds—for a full-time online public charter high school in order to determine how they perceived and fulfilled their roles and how they felt the shepherding affected their teaching. This is one of the few studies that started with focus groups, which are useful for providing information that is then used in developing surveys or interview protocols. Five of the focus group participants who taught different subjects were then invited to participate in additional in-depth interviews. The resulting qualitative analysis revealed several different roles the shepherds felt they played, often simultaneously, and how they believed that the act of shepherding helped them become more effective teachers. Borup and Stevens (2016a, 2016b) took a similar approach when they interviewed a small sample of parents and students in order to better understand teacher engagement and teacher practices in the same school.

Although interviewing online students who are dispersed across many sites is difficult, interviewing students in one school is easier. Thus Pettyjohn and LaFrance (2014) were able to interview twelve students in one Georgia high school who were enrolled in supplemental online credit recovery courses. The students saw the benefits as being able to control their own learning and becoming more self-reliant but had difficulty managing their time and staying motivated. They would also have liked more interaction with their teachers. The two teachers and four graduation coaches who were also interviewed felt that the online environment was better for the students than the face-to-face environment. The authors concluded that students in credit recovery courses need both on-site and online support. Similarly, in order to investigate how students perceive educational care in their online experiences, Barnett (2016) interviewed seven students who were identified as at-risk and yet had successfully completed one online course in order to meet the graduation requirement. The interviews focused on the students' "perception of care" as they moved from the traditional classroom to the online environment. The focus on different aspects of care provided useful insights into why these students succeeded where others did not.

While administrators, teachers, and students are the visible face of online learning, course designers play a fundamental role in the learning experience. Bakia et al. (2013) interviewed representatives from six different providers of online Algebra I courses to middle and high school students in order to learn about their approach to core elements of each course such as content, approach to instruction, and types of assessment. The results provide a much-needed window into the thinking of the course designers.

Observational Studies

Observational studies attempt to understand a setting by observing the participants in their natural setting. Observational studies necessarily involve fieldwork—visits to the site of teaching or learning—but are often combined with interviews and document analysis. While the number of people observed is generally small, observational studies offer rich detail that is difficult to obtain in other ways, especially when combined with other types of data. Observational studies are generally case studies—one school, one course, or even one individual—and so may not be generalizable, but they can provide an in-depth look into how virtual learning operates. Since it has proved difficult for outside researchers to get permission to look deeply into a course or a school, these types of studies have often been conducted by insiders—former or current teachers in the school under study or researchers working as part of evaluation teams for that school. In addition, since observations are difficult in a virtual environment where the participants are often at different sites, most of these studies have focused on students as they take their online classes while sitting in their face-to-face classrooms.

An early example is a case study of students in a rural school in Canada in 2005 carried out by Barbour and Hill (2011). Using video-recorded classroom observations of students in their distance-learning classrooms, interviews with students taking synchronous online courses, and interviews with online teachers, they were able to provide a nuanced picture of how these students used their class time, the extent to which a community developed among classmates, and their use of the resources provided. They found that the students used their class time for other than class work and made little use of the resources provided. This was followed by analyses of two individual students: an at-risk student and a female student who was struggling with her online course (Barbour & Siko, 2012; Barbour, Siko, Sumara, & Simuel-Everage, 2012). These case studies provide insights into student behavior in synchronous online courses that is still relevant today.

Another example of the benefits of observation is Ingerham's (2012) study of students in an Algebra course at NCVPS. Here too the observations were of students working on their online course during regular class time, with a focus on four students in each of several classes. The result was a detailed look at how students spend their time "in" an online course. Their key finding, similar to that of Barbour and Siko (2012), was that the students spent a great deal of the class period doing other things than the coursework.

Studying online teachers at work is even more difficult logistically than studying online students at work. Belair (2012) attempted this in her study of how daily phone calls by teachers affect students in four virtual high schools. She observed and interviewed teachers at work and also interviewed a few of their students, and then combined these with archived communications, student submissions, phone logs, and teacher notes. Not all observations were strictly in-person as some were via webcam, but they were all scheduled for times when the teachers planned to be communicating with their students. Although it is possible that the information learned in the interviews could have been elicited with a survey, it is likely that the researcher would not have known enough about the communication process to ask the right questions. The teacher interviews, which immediately followed the observations, were able to add the teacher's perspective to the communication process.

A final example is Hasler-Waters and Leong's (2014) study of the multiple roles played by learning coaches and teachers in a cyber charter school in Hawaii. These were self-paced courses for home-schooled students where most of the interaction was one-on-one with the teacher, facilitated by the learning coach in the home. Hasler-Waters used field observations including home visits, interviews, and documents such as email correspondence in order to elicit see these roles from the subjects' point of view.

Not surprisingly, given the amount of time involved in this kind of research, all of these articles, as well as the one book on full-time virtual schools (Klein, 2006), were based on dissertation studies. In addition, most took place in the physical spaces where the individual students took their online courses. For a look inside these courses, we need to turn to two different types of research. One uses various forms of content analysis to look at interactions within the online courses. The other uses data from the course management systems in an attempt to discern patterns that indicate engagement or learning and can then be correlated with other indicators of success.

Content Analysis

Content analysis is used to analyze any form of communication, written or oral, and has both qualitative and quantitative aspects.[2] It can take the form of highly complex semantic analysis or less linguistic content analysis. In the field of online learning, the discourse being analyzed generally takes the form of written teacher-student or student-student communication, often in a discussion forum but also in email correspondence. There are a large number of studies in this area in higher education but fewer in K-12. Much of what exists is based on modifications and adaptations of the Community of Inquiry (COI) framework, which was developed for analyzing discourse in computer-supported environments (Garrison & Arbaugh, 2007; Swan, Garrison, & Richardson, 2009). COI comprises three analytical categories—social presence, cognitive presence, and teaching presence. Although not all researchers use these, the term "teacher presence" in particular has infused the literature in K-12 online learning.

One of the first K-12 examples is Haavind's (2007) study of dialogue in discussion forums in over 100 Virtual High School (VHS) courses offered in Spring 2003. This was still early days for fully asynchronous online courses, and there was a great deal of discussion about best practices for facilitation and the challenges of encouraging student-student interaction in the main site of such interactions at VHS, the discussion forum. Haavind's indicator of collaborative dialogue was thread depth beyond an initial post and response. She chose three classes that appeared to be highly interactive and analyzed the threads in terms of the quality of the student conversations and the amount and type of teacher presence (discourse facilitation, evaluation, and feedback). She found a complex interplay among these, and with the instructional design of the course itself.

De la Varre, Keane, and Irvin (2011) also looked at teaching presence, but did this by expanding the definition of teacher to include on-site facilitators. They then used the components of teaching presence to analyze interviews with a subset of facilitators and instructors about the practices and activities of the on-site facilitators. Although the researchers did not analyze the results quantitatively by counting the number or percent of each type of discourse, as many who use the COI framework do, the results provide an in-depth look at how teachers see the role of facilitator and how facilitators see their own roles.

Other studies have used content analysis to analyze the open-ended questions in end-of-course surveys. For example, in their study of NCVPS, referred to above, Oliver, Osborne, and Brady (2009) used content analysis to analyze the responses to open-ended questions in order to explain their otherwise ambiguous quantitative results. They found that students had unrealistic expectations of their online teachers and a number of things they wanted from their teachers and their courses. Although the results seem obvious now, at the time they provided new insights into how students viewed these courses and showed NCVPS areas in which it could improve its course design and delivery.

More recently, Lowes (2014) looked at group work in asynchronous online courses by conducting an in-depth analysis of student discourse during a series of group projects. The data included not only student contributions to the discussion forums but a step-by-step analysis of each student's contribution to a group wiki. Although such analyses are time consuming, her overall finding—that there may not be as much "group" in group work as course designers and teachers believe—could not have been achieved with any other approach.

Although content analysis is generally used to analyze discourse, Barbour, Clark, DeBruler, and Bruno (2016) used it to examine state-level legislation and policy documents, finding a great deal of variation in how the states approved and evaluated online programs.

Social Network Analysis

Social Network Analysis (SNA) looks at the relationships among actors in a network in order to uncover patterns of interaction and connection. Network analysis is quantitative, providing a number of measures of network density and centrality, but is probably best known for the sociograms that show the relationships graphically. It has been used extensively in the study of relationships within and among groups, but has rarely been used for K-12 online learning. Lowes, Lin, and Wang (2007) and Kellogg, Booth, and Oliver (2014) both used SNA to look at interaction among the participants in discussion forums. Lowes et al. compared four sections of an online professional development course for teachers. When they combined the results of the network of density, reciprocity, and centralization were highly correlated

2. There is a distinction between discourse analysis, content analysis, and conversation analysis. Most of the work cited here falls into the category of content analysis within a discourse analysis framework—in other words, it is inductive, contextualized, and exploratory but often using other scholars' coding schemes. It will be referred to as content analysis. For more on the differences between the two see Hardy, Harley, & Phillips, 2004.

with satisfaction. Kellogg et al. analyzed the nature of peer support in two MOOCs, one for administrators and one for mathematics teachers, and then used the results to develop profiles of different types of users.

Statistical Approaches

There have been a number of statistical studies that look at online courses or students. These studies range from those that look at simple correlations, such as between course success and student factors like satisfaction with the teacher, to those that build sophisticated statistical models using back-end data from a course's learning management system (LMS). As Ferdig and Cavanaugh (2011) noted in their introduction to *Lessons Learned from Virtual Schools: Experiences and Recommendations from the Field*, most K-12 online programs are woefully unprepared for the collection and analysis of the data that is required to truly inform and transform practice. Until recently, there was very little use of data from the different LMSs, in part because online providers have been reluctant to provide datasets and also because such data is difficult to manage and interpret.

The first work in this area used LMS data to develop simple measures of in-course activity and link them with student success or to combine them with data from other sources, such as background data or satisfaction survey results. An early example is Dickson's (2005) brief analysis of Blackboard's very basic click results, which was part of a larger study of student behavior and performance at Michigan Virtual High School. He found that clicks were highly correlated with academic performance, but recognized that clicks alone might not be the most useful variable.

In 2011, Liu and Cavanaugh published a set of studies from one virtual high school: one analysis of Biology courses, another of Algebra courses, and a summary article that analyzed 15 high enrollment courses, including those for Biology and Algebra (Liu & Cavanaugh 2011a, 2011b, 2012). They used Hierarchical Linear Modeling (HLM) to analyze the impact on achievement (as measured by end of course exam results) of learner background characteristics such as race/ethnicity, full-time or part-time status, participation in a free or reduced lunch program, number of teacher comments in the course itself, and such LMS activity as the number of times logged in and amount of time spent logged-in. They found a mixed picture: although time spent in the system was the factor that had a significant effect for more courses than any other variable, it was not consistent across courses.

In two studies that used LMS data from asynchronous online courses delivered to advanced high school students, Lowes, Lin, and Kinghorn (2015, 2016) used Structural Equation Modeling (SEM) to explore the relationship between final course grades and the level of LMS activity, including a combination of number of days accessed, logins, hours spent, posts viewed, posts authored. They found that higher levels of online behaviors were associated with higher performance. However, when attendance and interactivity behaviors were looked at separately, these two types of behavior seemed to function differently depending on gender. They suggested that these gender differences might have implications for researchers, course providers, and course designers.

Data Mining Approaches

The above studies used traditional statistical approaches, which test hypotheses based on the literature. With the growing popularity of data mining, which inputs selected variables and lets the data speak for itself, researchers have used data mining approaches to let the data reveal to the researcher how their subjects are grouped based on the variables chosen. These types of studies are increasingly common in higher education but are beginning to be published at the K-12 level as well.

One of the first was Hung, Hsu, and Rice's (2012) analysis of LMS output from one statewide provider with between 3,000 and 4,000 students, which they combined with student demographic data and course evaluations. They used cluster analysis on the combined data set in order to explore the differences in outcomes and engagement levels as measured by LMS activity, subject, and gender. They then used another data mining technique, decision tree analysis, which showed that level of engagement and gender had a stronger association with final grades than such environmental variables as age, school, or city. This, as well as a number of additional findings, led them to suggest that certain types of students were more likely to be successful in online courses and that certain students were more likely to be at risk of failure; although, they were unable to say this with a high degree of certainty.

Lowes and Lin (2017) used points earned for each of the course assessments and the week in which the points were earned as shown in time-stamped data for two cohorts of about 50 students who took a self-paced online Algebra 1 course at Michigan Virtual School (MVS). TwoStep cluster analysis confirmed that four clusters provided the best model fit—students with good pacing/good grades, poor pacing/poor grades, poor pacing/good grades, and good pacing/poor grades. They found that while the good-good students tended to pass and the poor-poor students tended to fail, those with poor/good combinations were inconsistent. The implication was that these in-between students needed particular kinds of support depending on what was poor and what was good.

Using, and interpreting, LMS data has proved to be far from simple and the results far from clear cut. This may be because all the relevant variables have not been taking into consideration. For example, it seems likely that instructional design issues are more important in online environments than in face-to-face classrooms, so that the type of activity when logged in may be more important than the time spent. In addition, the relationship between time spent and final results may not be linear, both because efficiency of time use may be a factor and because time spent in a course may become more or less important as the course evolves. Determining this will require additional analysis and the addition of extensive qualitative work.

Conclusion

The goal of this rapid tour through the existing approaches to researching online teaching and learning was to show how researchers have used different methods at different stages in the evolution of research in a field, and also to show how researchers can use different methods to address similar questions. For example, in a new area of research such as online learning was in the early 2000's, surveys that cast a wide net were needed in order to discover the varieties of practice. At the same time, small scale case studies were also necessary to understand the deeper meaning of the practices that the surveys uncovered. Similarly, as mining and analyzing LMS data produces insights into teacher and student behavior inside the LMS, we will need interviews with those same teachers and students to interpret the results. In terms of research methods, then, we can expect a continuation of the same combination of broad and narrow.

In addition, the more we know, the more we find there is to learn. As the body of research grows, the field attracts more researchers; and as these researchers take faculty positions, research on K-12 online teaching and learning becomes an increasingly acceptable academic pursuit for their graduate students. More and more academic journals now welcome this research, and journals and research centers dedicated to online learning contribute to this growth. We are just beginning to see the results of these changes and can expect a real blossoming of more sophisticated quantitative, qualitative, and, most particularly, mixed methods research in online teaching and learning in the near future.

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7

Measurement in Emerging Learning Environments

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Abstract: Recent focus on evidence-based educational practice, coupled with the emergence of new learning environments, has highlighted the shortcomings of traditional research methods. In a fast paced, innovative, responsive setting, there is often not enough time for a carefully controlled, randomized controlled trial – on top of ethical concerns about withholding potentially beneficial interventions from students who need them. This chapter briefly describes the history of causal educational research and looks ahead to the methods that are being used to overcome its limitations. Some of these methodologies are well-established, but are only now being applied to instructional innovation. Other methodologies are themselves new, developed specifically for these emerging learning environments. All of them, however, focus on answering questions that arise from practice – they aim to generate evidence and findings that can be applied sooner rather than later in classrooms, so that students and educators can benefit as fast as possible.

Education in the 21st Century in the United States is experiencing an invigorated focus on learning experiences that work for all students (Slavin, 2002). While this approach has opened the door for innovative practices that support traditionally underserved students, and it has led to the emergence of new, previously impossible learning environments, it has also made it harder for us to measure and understand what is working, for whom, under what conditions, and what is likely to work for other learners.

The objective of this chapter is to describe some of the challenges that emerging learning environments pose to traditional causal research approaches (designs, analyses, and techniques), and to document and illustrate how alternative research approaches can be used to overcome some of these challenges.

Here, *emerging learning environments* is used broadly to refer to any learning environment that does not require same-aged-learners and teachers to be located in the same physical space at the same time for instruction to occur. In reality, this definition would include learning environments that are individualized or personalized, and/or those that enable competency- or mastery-based progression through content; such as digital or virtual learning environments, blended learning environments, "personalized" learning environments, and others. The term *intervention* is used to describe any instructional practice or group of practices that are being measured, usually as the focus of a research study, in order to determine effectiveness. The term *comparison group* is used in this chapter to describe a group of students that are not receiving the intervention of interest — instead receiving instruction as typically delivered in their usual educational setting, but whose data are collected and used to contextualize any trends or changes seen in the treatment group.

The approaches described include Bayesian analysis, rapid cycle evaluation, regression discontinuity design, improvement science (design-based implementation research and the plan, do, study, act cycle), and implementation research. In some cases, these are different analysis techniques that augment the traditional randomized design. In others, they are new designs that augment traditional analysis. In yet other cases, new designs are coupled with new analysis techniques, providing different windows into the data that help us better understand effective implementation. This chapter does not include methods, usually primarily used in other fields that do not seek to answer questions about effectiveness (e.g., ethnography, network analysis, etc.); although these certainly have been used successfully to better understand emerging learning environments.

History of Educational Measurement

Established in 2002, the federally-funded What Works Clearinghouse developed a set of standards for determining the "best evidence" we have for educational interventions (What Works Clearinghouse, n.d.). These standards, at first solely focused on randomized group research designs, grounded the theory of inferential statistical analyses in practical research designs, in order to extract genuine causal relationships from data. The randomized controlled trial (RCT) was appropriately highlighted as the "gold standard" for investigating causal relationships (What Works Clearinghouse, 2008), with care taken to ensure group equivalence both at baseline (through statistical corrections, if necessary) and at post-test (by checking for attrition bias). Failing randomization, quasi-experimental designs such as closely matched group designs with baseline equivalence were determined to meet the standards "with reservations" (What Works Clearinghouse, 2008).

As these standards evolved, they began to include methods for reducing other potential sources of bias, such as measuring fidelity of implementation within the treatment group, as well as the extent to which there was similarity between instruction in the treatment and comparison groups (to better understand which aspects of the intervention could be driving effects). In addition, standards were developed for other research designs that could support causal claims, such as regression discontinuity designs, single-case designs, and cluster randomized designs (What Works Clearinghouse, 2014).

Further, a distinction was made between "efficacy", or an effect that was measured for implementation under ideal conditions, and "effectiveness", or an effect that was measured for implementation under authentic conditions (Flay, 1986). For example, an efficacy study could have included teacher PD on the intervention of interest that was led by the intervention developer, and multiple observations and coaching throughout the year to ensure that it was being implemented with fidelity. In contrast, an effectiveness study could include a single day of inservice PD for all of the teachers implementing the intervention, with little follow up and coaching, to allow implementation to proceed as it would have without researcher or developer involvement. This distinction was useful in understanding how likely a particular intervention was to "work" in unstudied contexts (including constituents, like students and teachers; as well as conditions, like access to resources, infrastructure, procedures, and policies).

The development of these standards, and funding of research based on them, led to a robust and thriving educational research ecosystem, and a research cycle that generates evidence about learning in troves. The intent was for this evidence to make its way into classrooms across the country, in much the same way that R&D funding has driven advances in the energy, agriculture, and defense industries. However, dissemination of findings in the social sector, especially with the goal of changing behavior, has been largely futile – and practitioners have found themselves making decisions based on cost, intuition, and sales pitches rather than evidence (Penuel et. al, 2016). Measurement in emerging environments in particular is especially important for reducing risk in the inherently risky environment that is innovation, as rigorous evidence uncovers what is most likely to work for the most students.

The Downsides of Randomized Controlled Trials

The randomized controlled trial (RCT) is, in fact, still the best tool we have for understanding causal relationships between instructional strategies (or "interventions") and outcomes (Cappelleri & Trochim, 2010). As such, it is also the best tool we have for determining how risky a particular intervention is when deciding whether to implement it in a context that has not yet been studied. However, it still has some practical limitations as a research design, especially for those who are most concerned with effectiveness in their own local context as opposed to broad generalizability of their findings. Some of these most relevant limitations include the fact that:

- RCTs do not actually answer the intuitive question of interest, but instead answers the question, "if in truth my intervention has no effect on outcomes, what is the likelihood that I would have measured an effect of the size that I did find?"
- The time and expense required to conduct a rigorous RCT is usually more than most schools and districts can afford
- Many schools and districts are unwilling or unable to randomize individual students to treatment and comparison groups
- Many schools and districts are unwilling or unable to even create a comparison group (in other words, they are

unwilling/unable to provide two types of instruction to two groups of students, or "withhold" the intervention from a group of students)

- Many schools and districts are unwilling or unable to hold instruction constant for a long period of time, they would prefer to continuously improve instruction if it appears to *not* be working in the short term, and/or allow "treatment creep" into comparison groups if it appears to be working in the short term
- Instruction in emerging environments is constantly and rapidly changing, or the combination of instructional strategies and content delivered is unique to each student
- The theoretical and empirical questions being answered by RCTs often lack the nuance and relevance to practice that schools and districts can benefit most from

One may disagree with the underlying assumptions that lead to these limitations (for example, is it really "withholding" an intervention if we don't yet know how effective it is?) but the truth is that these limitations exist when trying to understand effectiveness in actual, authentic educational settings. In the case of emerging learning environments, these limitations may be especially present, since these learning environments are usually designed to be individualized, responsive, fluid, and flexible, with constant changes over very short periods of time (Horn & Fisher, 2016).

Alternatives to Randomized Controlled Trials

RCTs can (and have) been done in emerging learning environments, many of them are described in other chapters of this Handbook. However, given the limitations listed above, other research approaches can and have been used as well. These include Bayesian analysis, rapid cycle evaluations, regression discontinuity designs, improvement science, and implementation research.

Bayesian Analysis

This analysis method is based on traditional inferential statistical methods, and still requires random assignment to treatment or comparison groups in order to fully and directly support causal inferencing (Rubin, 1978). However, Bayesian analysis answers the *intuitive* question that most people have when conducting a research study or pilot. Namely, it answers the question, "Given the data that I have collected, what are the chances that my intervention had a true effect?" Both analyses generate point estimates of the effect, but rather than *p*-values (the probability of the null hypothesis being true given the data) and confidence intervals (the range in which a threshold % of *estimated* effects would fall, should you conduct your study repeatedly), Bayesian analyses generate a probability of the true effect being higher or lower than a predetermined threshold, as well as a credible interval — the range in which there is a stated probability that the *true* effect lies. In other words, instead of calculating the likelihood of your data, given a hypothesis (the null hypothesis), Bayesian analyses calculate the likelihood of a hypothesis, given your data. Note that this is simply an alternative analysis method to frequentist analyses, not an alternative design, so, to support causal interpretations, Bayesian analyses still rely on random assignment to treatment and comparison groups, or at least closely matched groups that are equivalent at baseline in order to control for potential bias (Rubin, 1978).

One unique application of Bayesian analysis is found in the US Department of Education's Office of Educational Technology's Rapid Cycle Evaluation Coach (Mathematica Policy Research, Inc., 2016a). Here, districts and schools that are piloting educational technologies and gathering outcomes of students who have experienced the technology, and students who have not, can walk through an "analysis wizard" to determine an estimate of the technology's effect, the probability of that effect being greater than a user-determined threshold probability, and the range (bounded by a user-determined threshold probability) in which the true effect is likely to fall. In this case, the use of Bayesian analysis allows findings to be described in plain English, for example, "*x%* probability that the intervention increases the outcome by *n* units or more.", or, "*y%* probability that the true impact of the intervention is between *j* and *k* units," (Mathematica Policy Research, Inc., 2016b). This makes the analysis and findings more approachable and interpretable, and is less likely to lead to unreasonable expectations, or unfounded recommendations, when trying to understand the effectiveness of an innovative instructional intervention.

Next we turn to another alternative that relies on randomization, but addresses the length and cost of traditional RCTs.

Rapid-Cycle Evaluation

Similar to Bayesian analyses, rapid cycle evaluations (RCEs) largely rely on traditional research designs, with two key differences (Asher & Cody, 2014). First, the "intervention" being studied is usually isolated to a single instructional practice or strategy at a time. Second, the outcome that is measured tends to be one that can be expected to change within a short period of time (and the associated measures are sensitive to smaller changes in this outcome). These two adaptations allow for a series of studies to be conducted in quick succession over a relatively short period of time, and at relatively low cost. Because time and expense are minimized, rigorous, causal evidence can be gathered and much can be learned even in low-resource implementation contexts. If existing data are used as part of a rapid cycle evaluation, costs can be brought down even more, and decisions can be made both quickly and with a high degree of confidence. Again, RCEs still rely on traditional approaches to group assignment in order to support causal claims, but because the studies are limited to "single" instructional strategies or elements of the intervention, and focused on rapidly-changing outcomes (which can be thought of as leading, rather than lagging, indicators), these designs are no longer limited by high time and capital costs.

For an illustration of how RCEs have been used to better understand emerging learning environments, refer to two reports from local education agencies that received and used their Race to the Top – District funds to implement and evaluate educational technologies. The first report (Bates, Hartog, & El Omari, 2017) describes KIPP DC's RCEs of reading technologies (*iReady* and *Lexia*) as well as a mathematics technology (*ST Math*). In both content areas, the types of research questions that could be answered took the form, "Does using the intervention technology increase content area achievement among students in a certain grade, compared to similar students not using the technology?" This type of research question is of high interest and value to those implementing emerging learning environments. An RCE approach, coupled with a design that supports causal claims (the ability to closely match treatment and comparison students), as well as Bayesian analysis, resulted in clear answers to the research questions. In the second report (Dillon & Hartog, 2017), Clarksdale Municipal School District used RCE to evaluate *iRead* effectiveness in two contexts, their summer school program, and an after school and Saturday program (both of which targeted struggling readers in the elementary grades). Here, similar research questions were of interest, taking the form, ""Does *iRead* increase reading achievement among students in the out-of-school program, compared to students who do not use *iRead*?" Again, this is a relevant and straightforward research question that was answerable using RCE methods along with random assignment and already used outcome measures.

Bayesian analyses and rapid cycle evaluations are not ideal in situations where randomization itself is not possible or desired. There are, however, designs and analyses that do not require random group assignment, these are discussed next.

Regression Discontinuity Design

Regression discontinuity designs (RDDs) have been used in education since the 1960s (Thistlethwaite & Campbell, 1960). RDDs are, in fact, "micro" RCTs that take advantage of our inability to perfectly measure psychological outcomes like learning (Trochim, 2001). Broadly, an RDD requires strict assignment to treatment or comparison group based on a cut-score (often "need" for the intervention), and so eliminates the barrier of inability or unwillingness to (randomly or otherwise) provide treatment to some students and withhold it from others. In this design, a pretest is given to all students in the sample, and those who fall below (or above) the cut score — those who most need support — are assigned to the treatment group. Based on assumptions about the "functional form" or underlying relationship between the assignment and outcome variables (e.g., linear, quadratic, more exotic), outcome scores are regressed on assignment scores, and a break in the regression line at the cut score (a "discontinuity") indicates an effect. This is possible because at the cut score, assignment to treatment or comparison group is based as much on measurement error (which is random), as it is on the individual student's achievement. Therefore, at the cut score, students are effectively randomly assigned to groups, and so a discontinuity or change in the predictive power of the pretest on the outcome represents a true difference in outcomes (or a true effect).

The main limitations of this design are: (1) it requires a larger sample for adequate power than a traditional RCT would, (2) it assumes that the underlying functional form is known or obvious from the data, and (3) the effect is only estimated at the cut score on the pretest (it is a local average effect, rather than the general average effect estimated in traditional designs). There are ways to address these issues, including increasing sample sizes, especially at the cutoff (and/or using a pretest) to increase power; using a pretest or prior research to determine what the functional form likely is; using multiple cutoffs to either generate multiple local average effects across the distribution or to recenter to a unique cutoff; or using (and comparing discontinuities across) multiple assignment variables/cutoffs. This last approach capitalizes on the fact that a false positive effect is highly unlikely to show up in an outcome across groups created using several different assignment variables, so if multiple groups are formed and all or most show an effect, it is most likely a true effect (Wong, Steiner, & Cook, 2013).

RDDs are most relevant in learning environments where it is important to provide extra supports to students with the most need, and there is a clear criterion for determining who will and will not receive the intervention. Ethically, this design allows for assignment to group based on potential benefits, rather than requiring random withholding of potentially beneficial resources from those who need them most. Although the design is especially well-suited to situations that are very common in emerging learning environments, it has unfortunately not often been used (in education or any other social science field; Cook, 2008; Trochim, 2006), although use is increasing in testing effectiveness of educational interventions (What Works Clearinghouse, 2014).

In some cases, a "real" or "true" comparison group is not at all available or accessible. In these instances, data may exist that allow for the creation of a comparison group, such as a virtual comparison group, that can instead be used to contextualize findings.

Virtual Comparison Groups

The inability or unwillingness to even have a comparison group, similar to the infeasibility of randomization, is not unique to emerging learning environments. However, the use of technology in these environments can facilitate more creative ways to make up for these missing counterfactuals. In cases where random assignment to treatment groups has not occurred (including cases where all students in the study are receiving the intervention and there is no comparison group), a "virtual" or "simulated" matched group can be created if outcome (and pretest) measures are administered to a broader group of students than just those participating in the study. A focal, local matched group provides the greatest internal validity, and provides a more nuanced understanding of effects over comparison to national norms or averages, or even "expected" scores or growth. Focal matches (Cook, Shadish, & Wong, 2008) are those matched on variables that are known to be highly correlated with the outcome, and thus very likely to account for differences between groups (often, characteristics like gender, socioeconomic status or free/reduced price lunch eligibility, language status, and disability status). Local matches (Cook et. al., 2008) are matches proximal in time and space (within classroom, school, or district, if possible). In emerging environments, novel variables can be used for focal matching, such as prior achievement on competencies or micro-competencies; along with those that can make the comparison more local-like (e.g., urbanicity of school, teacher experience, school socioeconomic/language/disability status, school of choice vs. zoned district school, etc.). This is especially possible when the outcome measure is an assessment that is widely used across the country, such as the NWEA MAP assessment. Extensive virtual comparison groups can be created with multiple matches for each participating student (this also increases the power of the analysis to find smaller effects).

The limitation here is that less might be known about the instructional practices ongoing at comparison schools, so there is less clarity about which practices deserve attribution for any effects. However, if the sources of virtual comparison groups can be limited to schools and districts for which something is known about the context and instruction happening there, then this limitation can be reduced.

RAND's study of the Gates Foundation-funded personalized learning initiatives produced two reports using NWEA MAP virtual comparison groups (The Bill & Melinda Gates Foundation & RAND Corporation, 2014; Pane, Steiner, Baird, & Hamilton 2015). In the first report, 23 charter schools that had implemented personalized learning initiatives for two years were included. In the second, the sample was expanded to 62 schools that included district schools that also implemented personalized learning for two years. The research questions that were answered by this virtual comparison group design included, "Is there a difference between the math/reading performance of students in personalized learning environments and similar students selected from comparable schools?", and, "Do achievement effects differ across the achievement distribution?". Without this virtual comparison, research questions and findings would have been limited to questions about student performance being "above average" or "greater than expected", which is less precise about the size of the effects themselves, and also leaves more room for bias from unmeasured variables to be contributing to the calculated effects.

The alternative approaches described above conceptualize the intervention being measured as a relatively stable, group administered instructional strategy or strategies, which is often not the case in emerging learning environments. The following approaches can be used to measure flexible, changing, and individualized interventions.

Iterative, Implementation-focused Approaches

Emerging learning environments bring with them a focus on individual students, both instructionally (in the case of personalization and mastery or competency based education), as well as in understanding effectiveness (Horn & Fisher, 2016). Such interest in what works for individual students, or small groups of students, demands research and dissemination designs, methods, and techniques that likewise focus on individuals.

Improvement science allows for continuous improvement of the intervention during the course of the study, thus eliminating the requirement of traditional research to hold the intervention constant for relatively long periods of time. This is possible because of a fundamental difference in its underlying paradigm. In improvement science, effective implementation occurs when new implementation is integrated with local "knowledge-building" systems, rather than when new implementation occurs "with fidelity" (Lewis, 2015). In this paradigm, modifications of the intervention are anticipated and expected when transferred to new contexts. Therefore, implementation can always be improved, since scaling effective practice requires new knowledge (of the new context) to be built and integrated locally. In addition, measurement in this paradigm is practical, and proximal, focusing on leading indicators rather than (often lagging) outcomes. Two research approaches within this paradigm are Design-Based Implementation Research (DBIR), and the "Plan, Do, Study, Act" (PDSA) cycle.

DBIR is based on four principles that place it squarely in the improvement science paradigm (Fishman, Penuel, Allen, Cheng, & Sabelli, 2013). These are:

- Developing research questions from a practitioner perspective (i.e., focusing on problems of practice experienced by multiple stakeholder groups),
- Responsive design that is both collaborative and iterative,
- A focus on generating evidence about implementation as well as effectiveness, and
- Capacity building for sustained implementation.

One can see that these four principles are distinct from a more inferential approach to measurement, which tends to view knowledge as an independent "Truth" that exists in the world and that we can uncover using objective, controlled methods and implementation, and that we can replicate by generalizing findings to similar contexts, and implementing interventions with a high degree of fidelity. The DBIR approach instead allows findings to be flexibly applied in a variety of contexts and with a range of constituents, without having to maintain strict fidelity to the way implementation occurred in previous studies. It acknowledges that implementation may not be "one size fits all", and that what is possible in one classroom and with one group of students may not be possible in every classroom and with all students.

DBIR can be used to answer research questions like, "What aspects of implementation can be tweaked to fit my context without reducing effectiveness?", and "What elements of implementation should be considered non-negotiable, or core to improving learning outcomes?" (US Department of Education, Office of Educational Technology, 2013). These questions are especially applicable to emerging learning environments that enact personalized or individualized learning, because these interventions are premised on being flexible and responsive to individual students.

Similarly, the Plan, Do, Study, Act (PDSA) cycle (Bryk, Gomez, & Grunow, 2010; Langley et. al., 2009; The National Implementation Research Network, n.d.) is an iterative approach to improvement that is embedded in three central questions:

1. What is the goal (including what is the problem we are trying to solve)?

2. What does improvement look like?
3. What actions will achieve the goal?

It can be thought of as an experiment shrunk to its smallest possible grain size. PDSA takes traditional methods of inquiry and shrinks the time and resources required to conduct them by taking a laser focus on specific, individual goals one at a time. By iteratively planning, making small changes, measuring progress, and revising implementation, evidence can be accumulated even as implementation is improving – overcoming the historical challenges of needing to hold the treatment and comparison conditions constant throughout a study before anything is learned. Again, the improvement science paradigm that knowledge exists in the local setting and implementation (including the people and systems that the intervention affects; Lewis, 2015) allows for this continuous change as the intervention is studied.

This approach is particularly useful in emerging learning environments where components of the environment (e.g., the students developing a particular skill, the small group that an individual student is a part of, the content being used to introduce a topic, etc.) may be constantly changing – or the combination of components that make up the intervention is unique to each student. In this framework, possible research questions are reflected in the three core questions above, namely, "Are proposed improvements (or changes) to the intervention related to desired outcomes?"

Implementation research is an entire field geared towards understanding if and how evidence-based practices are implemented in service-provision in the social sector, most often in public and mental health, education (including early childhood education), and social and employment services, among others (Fixsen, Naoom, Blase, Friedman, & Wallace, 2005). Recommendations from this field of research for facilitating and driving the incorporation of evidence-based practices into routine practice are relevant to measurement in emerging learning environments. Specifically, measurement and research in emerging learning environments need to recognize replication and implementation as crucial foci, and be designed accordingly. One framework for designing studies that focus on and are relevant to problems of practice is the RE-AIM framework (Bull, Gillette, Glasgow, & Estabrooks, 2003). Studies that use this framework include detailed data about, not just outcomes, but also individual-, agent-, and setting-level characteristics that describe the intervention and implementation at a level of detail that allows others to appropriately generalize findings and determine how relevant they are to their own contexts. This level of detail also allows effective practices to be implemented in new settings, because enough is known and shared about the practice that others can implement it. Rather than opening the door for new and different hypotheses to be tested, the RE-AIM framework provides guidance for increasing the chances that research findings are shared and implemented in practice, a crucial step in bridging the research and practice divide.

A Note About Outcomes

Along with emerging learning environments have come a need to measure academic and non-academic variables that have not traditionally been central to understanding effectiveness (Tough, 2013). This brings another challenge to measurement in emerging learning environments. The rigor and validity of any study hinges on the measures used, findings are only as good as the data on which they are based. There is an urgent need for valid and reliable measures of constructs of interest, including social emotional learning competencies like self- and social-awareness, character traits such as zest and curiosity, and meta/cognitive skills like self-efficacy, mindset and grit (Duckworth & Yeager, 2015). Debates continue about what these groups of skills should be called, as well as how distinct each group is from the other. Of immediate consequence, however, is the fact that states, districts, and schools are increasingly interested in understanding the extent to which their students are changing or growing these skills, and we as a field by and large do not have valid, reliable, sensitive measures to help them answer these questions.

Recommendations

There are several approaches to understanding emerging learning environments that address many of the major limitations of RCTs and also allow for new, more practical, research questions to be answered. Educators and other decision-makers are asking, and being asked, these practical questions as they determine which instructional strategies should be used to meet the needs of the students they serve. They deserve to have evidence-based answers to these questions. It is highly recommended that future research be focused on the questions that arise from practice, and that researchers think beyond the RCT and the research questions it can answer when determining what future studies to pursue. The alternative approaches outlined here (Bayesian analysis, rapid cycle evaluation, regression discontinuity design, design-based implementation research, the plan, do, study, act cycle, and implementation research) can and should be deployed as appropriate to address these problems of practice.

In addition, when considering the recommendations for future research that appear throughout the following chapters of this Handbook, also consider when alternatives to RCTs are more applicable to the gaps and needs outlined. The field is ripe for these approaches to be used, as there is a real need for applied research to bring evidence to bear on the practical choices and decisions being made every day that affect the lives and futures of all students.

The Takeaway

The disconnect between research and practice is not unique to emerging learning environments, nor even education. While research in any social science should be in the service of practice, often the needs of practice outpace research, resulting in decision-making processes that rely on available information rather than evidence. In addition, the evidence that is generated is commonly shared and known in research networks only – maintained in a format that is irrelevant, not applicable, or inaccessible to practice (Bryk et. al, 2010). These novel environments do present old and new challenges to our traditional means of measuring effectiveness, but also stand to benefit from evidence just as much as learning environments ever did. Some of the consequences of this disconnect are heightened in emerging learning environments. The pace of implementation and change in these innovative learning environments exacerbates the delay between questions being asked and answers being generated. The up front investments required by these new learning environments (such as infrastructure, human capital, time, for example) also increase the stakes of "failing" – a risk that could be reduced by evidence, but often remains high due to the research-practice disconnect.

While randomized controlled trials are not impossible in these emerging settings, they are not perfect, and other designs, methods, and techniques can be used to overcome some of their limitations. Every implementation of an emerging learning environment can and should be measured, if only to ensure that the students experiencing the environment are being maximally supported in their learning. If alternative research approaches are not deployed in these environments, the potential opportunity cost is great, and will be borne by students – a conceivable outcome we should all view as unacceptable, and one that we should avoid at all costs.

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8

Program Evaluation in K-12 Online & Blended Learning

Tom Clark

Abstract: The purpose of this chapter is to provide an introduction for researchers to program evaluation and how it relates to research within the context of online and blended learning. Working with evaluators and participating in program evaluations can provide valuable opportunities for researchers to conduct studies that advance knowledge in the field. The evolving nature of program evaluation is considered in relationship to trends in online and blended learning.

As they conduct studies in pursuit of their research agendas, many academic researchers encounter program evaluators. Some researchers engage in program evaluation themselves and are familiar with evaluators and program evaluation, but others may not be as familiar. Collaborating with evaluators can help researchers conduct more effective research and build valuable professional relationships.

In this chapter, the relationship of evaluation to research is considered. Common evaluation approaches are described, with examples from online and blended learning program evaluations. The value of collaborating with evaluators is explained, and ways in which evaluation is evolving to keep pace with trends in online and blended learning are explored.

What is Program Evaluation, and What is Its Relationship to Research?

Program evaluation is defined here as "the systematic collection of information about the activities, characteristics and outcomes of programs to make judgments about the program, improve program effectiveness, and/or inform decisions about future program development" (Patton, 2008, p. 39). Research is defined as "a systematic investigation, including research development, testing and evaluation, designed to develop or contribute to generalizable knowledge" (U.S. GPO, 2017). This is the definition of research in U. S. federal regulations that protect human subjects. Program evaluation is generally not seen as research as defined in these regulations, as its basic purpose is to improve practice, not to develop or contribute to generalizable knowledge. However, program evaluations may include activities that are considered research, which therefore need to be submitted prior for institutional review board approval.

Evaluation and research are separate but overlapping disciplines. Researchers and evaluators use many of the same tools to gather evidence, such as surveys and interviews, and many of the same methods for analyzing it, such as content analysis and learning analytics. To answer questions about a program, program evaluators may seek to triangulate many sources of qualitative and quantitative evidence, including empirical research studies. Researchers may gather evidence on the subjective values and viewpoints of participants for a qualitative research study, an approach that is also common in program evaluation. As Mertens (2009) notes, "There is a place at which research and evaluation intersect–when research provides information about the need for, improvement of, or effects of programs or policies" (p. 2). Some of the fundamental differences between research and evaluation are highlighted in Table 5.1. One of the key differences is the focus in research on producing generalizable knowledge, and the focus in evaluation on improving and demonstrating the worth of the individual program.

Table 5.1. Research vs. evaluation

Research	Evaluation
Produces generalizable knowledge	Judges merit or worth
Engages in scientific inquiry based on intellectual curiosity	Responds to policy and program interests of stakeholders
Advances broad knowledge and theory	Provides information for decision-making on specific programs
Conducted in a controlled setting whenever possible	Conducted within a setting of changing actors, priorities, resources, & timelines

Adapted from Blome (2009)

Common Approaches to Program Evaluation

Evaluation may be internal, conducted by program staff, or external, conducted by outside evaluators. It may be formative, providing feedback for improvement, or summative, assessing a program's merit or worth (Clark, 2014). Many state education agencies developed or endorsed state-led supplemental online learning programs in the late 1990s and early 2000s. Some invited external program evaluations, primarily to meet legislative mandates related to program start-up, but also to answer questions of interest or to provide third party validation of the program's educational value in a changing political landscape. Over time, many of these state level programs internalized routine evaluation tasks such as surveying stakeholders and tracking key data indicators. Some release reports publicly via internally developed annual evaluation and/or legislative reports. Good examples include the legislative report of Florida Virtual School (2017) and its annual stakeholder survey, which was conducted by internal staff (Morris & High, 2016).

Formative and summative evaluation both play important roles in K-12 online learning program improvement and accountability (U. S. Department of Education, 2008). While research seeks to build knowledge and advance the field, the primary focus of program evaluation is on improving program practice. According to Stufflebeam (2007), "evaluation's most important purpose is not to prove, but to improve" (p. 2). Formative evaluation generates feedback during program development and implementation that stakeholders may use to make improvements or changes to the program.

Formative evaluation. Formative evaluation may be both internal and external. During the formative evaluation stage, external evaluators often seek to work collaboratively with internal evaluators and to include internal evaluation evidence in their analyses. The evaluation may be comprehensive or focused more narrowly on specific questions of interest or a single evaluation method (Stufflebeam, 2007).

Many online and blended programs now routinely gather improvement feedback via internal evaluation processes. For example, Connections Education encourages students, parents, and staff to provide feedback on lessons via its StarTracker System. Since 2008, over 3.8 million lesson ratings have been generated, and the average score has increased from 4.02 to 4.15 out of 5. These ratings feed into course revisions in Connection's six-year curriculum cycle (Clark, 2016).

An external evaluation may influence an online learning program's strategic direction. For example, in response to new federal performance standards under No Child Left Behind, the evaluator of a multi-state consortium's federal digital learning grant proposed a change mid-project to focus on reading, mathematics, and science content. Partners shifted their content emphasis, and the percentage of staff development completions in these topics rose from 5% in year 2 to 36% in year 5. Overall, participating educators completed over 100,000 hours of digital staff development during the five-year project. The refocus helped the project meet federal goals (Clark, 2006).

Evaluators must be ready to redesign or refocus a formative evaluation based on facts on the ground. For example, a large urban school district commissioned a focused evaluation to study the effectiveness of a tutorial tool in improving student completion rates in online Advanced Placement (AP) courses. However, local school compliance with the randomized research design could not be obtained, and district-level data needed for a matched comparison study was unavailable in the study timeframe. The evaluation focus was shifted to another student support element, an intensive mentor support model that was about to be implemented in schools district-wide. Student AP course completion rates went up, especially in schools that complied fully with the mentor support model (U. S. Department of Education, 2008).

Summative evaluation. According to Scriven (1998), the discipline of evaluation seeks to determine whether "merit, worth, or significance" are "attributable to the entity being evaluated" (p. 64). This is the essence of summative evaluation. Summative evaluation is typically conducted at the end of a program. It examines the program's impact and effectiveness, and whether it met its stated goals. Summative evaluation findings may be used by funders for accountability purposes. Summative evaluation may be seen by schools as "high-stakes" and more threatening than formative evaluation (U. S. Department of Education, 2008). For example. Alabama ACCESS evaluators conducted both formative and summative evaluations during a multiple year evaluation project. They found staff willing to assist with formative evaluation focused on program improvement, but less eager to collaborate on summative evaluation, which they saw as potentially threatening. By effectively communicating evaluation goals and sharing draft findings early, the evaluators were able to increase buy-in. In most cases, summative findings backed up the anecdotes and hunches shared by program staff.

Many other dichotomies in evaluation approaches exist, such as quantitative or qualitative, ongoing or short-term, and goal-based or goal-free (Newcomer, Hatry, & Wholey, 2010). An evaluation plan may combine a variety of approaches to provide the best evaluation for a particular program.

Differences in evaluation approaches. There are many approaches to conducting program evaluation, and no one approach is universally accepted. Alkin (2013) proposes organizing evaluation approaches used by prominent evaluators in the field, based upon their relative emphasis on use, methods, or value (see Table 5.2). These evaluation approaches are often intertwined within a single program evaluation.

Use-focused evaluation approaches (Patton, 1997) are used to provide information that program leaders need to improve the program or demonstrate progress. Multiple sources of evidence are gathered and improvements recommended that the program may decide to implement. Patton (2010) believes that evaluations "should be judged based upon their utility and actual use" and that evaluators must keep use in mind "from beginning to end" (p. 11). This led Patton to develop the best-known approach of this kind, utilization focused evaluation, or UFE (Patton, 2002, 2008). UFE has a primary focus on the usefulness of the evaluation for evaluation stakeholders. Bledsoe and Graham (2005) see use-focused approaches as evolving out of a variety of evaluation approaches that focus in part on use. Used-focused approaches are valuable to incorporate into online and blended learning evaluations.

Methods-focused evaluation is used to determine program effectiveness through experimental or quasi-experimental research that allows an expert judgement to be made on whether program participation causes desired changes in participant outcomes, such as improved test scores. In outcomes-based planning and evaluation, there is a focus on working with the program to identify key outcomes (changes in participants) and ways that they can be measured (Shaping Outcomes, n.d.). In this handbook, Mohammed's chapter on *Measurement in Emerging Learning Environments* (ELEs) provides an overview of a variety of new and existing empirical research methods for measuring program impact and effectiveness that should be of interest to both new and experienced researchers.

Value-focused evaluation is used to actively engage local staff and stakeholders in the evaluation process. This helps evaluators make sure that the program fits local needs and interests, and can help ensure local buy-in and capacity building needed to sustain the program. Evaluators may identify equity and social justice issues relevant to local stakeholders and study how the program impacts them. In participatory evaluation, stakeholders are actively involved in the evaluation process (Gujit, 2014). In empowerment evaluation, stakeholders are empowered to use evaluation themselves to monitor and improve the program and their own lives (Fetterman, 1994). Evaluators often incorporate value-focused approaches to gather stakeholder feedback early in an evaluation.

Table 5.2. Differences in use-focused, methods-focused, and value-focused approaches to evaluation

Key features	Use-focused evaluation	Methods-focused evaluation	Value-focused evaluation
Key questions	• What do decision makers need to know to improve program usefulness?	• What is the program's casual impact on desired outcomes?	• How do program processes affect the relative standing of different groups?
Evaluation focus	• Process • Use of evaluation results • Organizational learning and capacity building • Formative evaluation	• Intended objective or outcomes • Program theory • Summative evaluation	• Process • Unintended outcomes • Power relationships • Equity and social justice
Who primarily judges program's benefits	• Evaluator	• Decision Maker	• Public/Society
Common methodologies and methods	• Pragmatic • Multiple sources of evidence • Interviews/focus groups • Quantitative and qualitative data	• Post-positivist • Controlled experiments where possible • Outcome measurement • Quantitative data	• Constructivist • Critical or participatory methods • Action research • Qualitative data

Adapted from: (Hall, 2013; Smith, Mitton, Cornelissen, Gibson, & Peacock, 2012)

Program Evaluation Examples

In this section, program evaluation examples are presented in several areas where evaluations have the potential to impact policy and practice in online and blended learning at the state, national, or multinational level.

Federal evaluations in the U.S. The U. S. Department of Education has funded a series of programs and associated program evaluations that have had a significant impact on the evolution of K-12 online and blended education across the nation. Several early K-12 online learning initiatives were launched in the late 1990s with large federal grants that required an external program evaluation, including the University of Nebraska-Lincoln's Class Online project and the Hudson (Massachusetts) Public Schools' Concord Virtual High School (VHS) (Clark, 2001). For example, SRI International developed a series of publicly available evaluation reports on the Concord VHS, the forerunner to the current VHS Consortium, a consortium in which participating high schools received student seats in NetCourse sections in return for contributing a section taught by a local teacher.

Federal grant evaluations in the U. S. are typically multi-year, and require annual formative reports and a summative report at project's end. In their year 3 report, SRI evaluators (Kozma, Espinoza, McGhee, Yarnall, Sells, & Lewis, 2000) drew on findings from case studies, student surveys, and academic assessments to conclude that the VHS and face-to-face experiences were similar in terms of course characteristics and quality of instruction, and had similar outcomes, including low student dropout and similar grades. The evaluators also found some persistent issues in NetCourses, such as less time spent in student-student interaction and group work, lower student-teacher interaction ratings, and technological limits to visual content and hands-on activities. The evaluation team leaders distilled much of their multi-year evaluation work into a well-regarded book (Kozma & Zucker, 2003).

National and multinational evaluations. An international survey of 60 nations (Barbour et al, 2011) found a lack of interest in many countries in the use of online learning in K-12 education. Respondents were more likely to report development of school networking infrastructure or "schoolnet" and the use of Information and Communication

Technologies, or ICTs, to collaborate, communicate, and share resources. Many related evaluations have been completed. For example, Balanskat, Blamire, and Kefala (2006) reviewed 17 studies, including evaluations and audits of national ICT initiatives, and summarized evidence of the impact of ICTs on student outcomes across Europe.

However, some countries did report national online learning initiatives. For example, Kim and Seo (2015) developed a case study of the Cyber Home Learning System in Korea that included evidence from a series of internal evaluations (such as KERIS, 2007) on its effectiveness in reducing the education gap for economically disadvantaged children through online supplemental education and tutoring.

State and provincial-level program evaluations. In the U. S., states may commission external evaluations of federal pass-through grants they administer. These evaluations are akin to the federal grant evaluations described above. Due to their primary role in educational governance. U. S. states as well as Canadian provinces directly conduct evaluations and audits of online and blended learning programs that operate in their jurisdictions.

Barbour, Clark, DeBruler, and Bruno (2014) found that states and provinces follow a wide range of policies and practices in evaluating and approving these programs. They identified five evaluation and approval constructs that are apparent in the ways that states carry out these program evaluation activities. They include level of approval, approval requirement, geographic reach, delivery model, and approval timeframe. Examples are provided below that help illustrate each construct.

Level of approval. State evaluation efforts may focus at the local school program level, course level, or both. For example, in Georgia, the Department of Education reviews documentation from K-12 online course providers before adding them to an approved course provider list, and reviews the content of each course for alignment with state curriculum standards before adding it the state's clearinghouse of courses approved for use by local school programs.

Course providers may also act as operators of online learning programs, which undergo a different evaluation process. In states and provinces, the program-level evaluation process for local school programs is typically the same whether an external provider's program or a locally developed program is offered. Full-time online charter schools in the U. S. are internally reviewed by their authorizers with state oversight. In British Columbia, districts that offer distance learning programs must complete regular internal reviews and participate in periodic external program audits.

Approval requirement. State approval may be required or optional. When it is optional, it is often tied to other mechanisms. For example, California does not mandate course approval, but for high school credits to be accepted by University of California campuses, online courses must be "CLRN-certified" through a review process conducted by the non-profit California Learning Resource Network (CLRN).

Geographic reach. Evaluation and approval mechanisms may differ for in-district and multi-district courses or providers. For example, the state of Washington has two paths to approval: a full review for online learning programs implemented across multiple school districts, and a relatively streamlined review process for programs implemented locally within a district.

Delivery model. Some states make a distinction between online and blended programs, to determine whether to apply a review process, and to track their use in schools. However, their definitions vary widely. For example, 80% of content and instruction must be delivered online to constitute online learning in Maryland, while the threshold in Minnesota is 50%. In Maryland, the threshold for blended learning is 30% delivered online, while in Ohio, the definition is akin to the Staker and Horn 2012) definition[1], and does not cite thresholds.

Approval timeframe. Evaluation and approval may be one-time, such as the front-end approval by the state education agency and the authorizer for multi-district online learning programs in Colorado, or ongoing, as in British Columbia, where

1. Ohio Senate Bill 316 (2012) states that "blended learning means the delivery of instruction in a combination of time in a supervised physical location away from home and online delivery whereby the student has some element of control over time, place, path, or pace of learning." http://www.legislature.state.oh.us/BillText129/129_SB_316_I_N.html

programs receive front-end approval, then participate in periodic program reviews and on-site external review team audits conducted by the Ministry of Education.

Barbour, Clark, DeBruler, and Bruno (2014) conclude with recommendations to states and provinces for improving their evaluation and approval processes for online and blended learning courses and programs.

- Continue input-focused evaluation and approval processes for full-time online schools to ensure they meet basic quality standards.
- Develop policies that more closely monitor full-time online schools, and periodically audit and review these schools.
- Consistently define online and blended schools and track their performance data separately.
- Provide public online access to comparative analyses of performance data based on a student growth model for full-time online, blended, and brick & mortar schools.
- Adopt processes across states for third party external validation of online courses and programs.
- Collaborate actively with researchers to help build the evidence base for K-12 online and blended learning.

In recent years, activity and growth in K-12 online learning has moved from state-level programs and charter schools to individual schools and districts that use a variety of models to deliver online learning opportunities, including supplemental online learning, fully online learning, and blended or hybrid learning (Evergreen Education Group, 2016).

This burgeoning growth and mixed academic results of full-time online learning programs has led to increased scrutiny of online and blended learning though state-level program evaluations and audits, as cited in national studies by the National Education Policy Center (for example, Molnar, Huerta, Shafer, Barbour, Miron, & Gulosino, 2015; Molnar et al, 2017). The 2017 study found that only 37.4 percent of full-time online schools overall received acceptable ratings from the state. The on-time graduation rates in full-time online schools overall (43.4%) fell far short of the national average of 82.3%. These national studies might best be considered as policy research rather than program evaluation, since they study the impact of specific policies, such as those enabling the establishment of full-time online schools, across programs and states. They rely on state-level program evaluations for much of their evidence.

Working with Program Evaluators

As the primary audience of this handbook is educational researchers and those interested in educational research, it is important to address the issue of how researchers work with program evaluators. There are many good reasons to collaborate with evaluators. Three come to mind. First, working with evaluators can provide opportunities for researchers to conduct studies relevant to their research agenda. Second, evaluators and researchers may share an interest in program improvement and effectiveness, although evaluators often focus on the individual program and researchers often on generalizable research. Third, researchers may be able to fund part of their research through the evaluation budget. For example, evaluators and researchers may collaborate on program evaluation proposals that include pertinent research studies.

Both small and large-scale funded programs may provide opportunities for academic researchers to conduct studies. Small-scale funded programs may provide an opportunity for researchers to conduct exploratory research on promising approaches to teaching and learning worthy of further study. Large-scale funded programs often have a comprehensive program evaluation in place that incorporates rigorous empirical research methods. Large urban school districts often have several of these programs underway. Researchers interested in doing small focused research projects in these programs should be aware that there may only be room for a limited number of these projects, which district and/or evaluation team gatekeepers directly solicit or select from among those applying.

Many of the challenges faced by evaluators can be addressed through effective planning and design of useful evaluations (Newcomer, Hatry, & Wholey, 2010). Perennial challenges faced by program evaluators may also become issues for academic researchers who seek to conduct research studies within a program that is being evaluated. For example, state and federal leadership transitions may lead to changes in policy goals and programs that fund grants. These changes may in turn impact the continuity of funded programs and therefore the opportunity to conduct evaluation and academic research within a given program setting.

Challenges at the school and district level include turnover in school leadership and program staff, which may impact trust-based relationships with evaluators (and by extension, with researchers). In addition, gaining access to student records data may be complicated, especially in a large school district. Data requests need to be made well ahead of time. Lines of inquiry that rely on data that is unlikely to be obtained in the evaluation timeframe should be avoided.

Another challenge is grant funding periods, which are often too short to fully develop a program treatment and gather evidence about how it works and its impact on outcomes. Evaluators are often asked to provide evidence of a program's effectiveness or proclaim its value well before it is realistic to do so. These pressures to product results may also be felt by those doing research in the program.

In addition, evaluators asked to evaluate a funded project near its end may find that key data needed to determine success or understand program context had not been gathered prior. Similarly, researchers may find that extant data needed for research is unavailable or does not exist.

Finally, evaluators face challenges with getting programs to use evaluation results. Utilization-focused evaluation (Patton, 2008) is an evaluation approach that directly addresses this issue (see prior section on Use Focused Evaluation). Evaluators need to anticipate challenges to the use of evaluation and performance data and proactively address them (Newcomer, Hatry, and Wholey, 2010). Program staff and educational participants are likely to see evaluators and researchers as part of the same group of outside people coming into their school. It is helpful for evaluators and researchers to coordinate and seek to avoid duplication of effort, and to seek to establish ongoing relationships with school partners.

External evaluators often work collaboratively with program managers who act as internal evaluators to obtain multiple sources of evaluation evidence needed for the program evaluation. It is important for researchers to be aware of this relationship and to avoid disturbing it. There may be an opportunity for researchers to build a parallel relationship with these internal evaluators, who may act as gatekeepers for access to program data and settings.

Evaluators may develop a logic model that shows the program's theory of action. It can be valuable for researchers to participate in logic model development and/or to consider how their planned research relates to the model. If they can connect the dots on how their research may contribute down the road to school improvement, it may help with earning the trust of program gatekeepers.

Evaluators may be able to help researchers maintain fidelity of implementation of their research study design in the program. However, it is important to consider beforehand what study designs are realistic in the program setting and next steps if the study cannot be carried out as planned. Evaluators and internal program gatekeepers can be valuable collaborators in this process.

The Evolving Nature of Program Evaluation

New trends in the use of learning analytics have the potential to disrupt traditional program evaluation and evaluation research activities in K-12 online and blended learning programs. Program evaluators and researchers who work with them use traditional learning analytics to provide information for school program leaders on what happened in a learning group (descriptive) and to explain why it happened (diagnostic). Advanced analytics using machine learning can tell program leaders what's likely to happen (predictive) and may suggest ways to turn things around (prescriptive) at the individual student level.

These new predictive and prescriptive capabilities let schools track the learning pathway of individual students, identify those at risk of failure, and intervene, all in real time, making data analytics a powerful new tool for personalizing learning (Microsoft, 2016; Shelton, Hung, & Lowenthal, 2017).

Evaluators need to know how to incorporate these kinds of new tools into evaluations, or how to use evaluation to compliment what school leaders can learn from these new tools. Program evaluators also need to keep pace with design-based research. Schools are using design thinking to redesign teaching and learning environments (Hennes, Sim & Croft, 2016). Developmental evaluation approaches may be more appropriate in these innovative programs than traditional formative evaluation methods (Patton, 2011). Mohammed addresses design research methods her chapter of this Handbook.

States are creating innovation zones (iZones) and districts of innovation to foster development of new learning models (Patrick & Gentz, 2016). Online charter schools and competency-based career education are both likely to emerge as a new federal focus, presenting both challenges and opportunities for evaluators. Evaluators may find themselves "in the middle" as states and authorizers seek ways to provide more oversight as full-time online charter schools grow. Competency-based online and blended career education is emerging, but currently lacks quality indicators needed to guide effective implementation (Sturgis & Abel, 2017). Evaluators might use exploratory evaluation methods that incorporate small-scale research studies to help identify quality indicators in this emerging area.

Conclusion

Evaluation and research are separate but overlapping disciplines that use many of the same tools to gather evidence. The key difference between the two may be the focus of research on developing generalizable knowledge and the focus of evaluation on the individual program. Two common dichotomies in evaluation are described, formative versus summative and internal versus external. Three strands of evaluation methods are highlighted, which focus on use, methods, and values. Researchers should be familiar with these ways of conducting evaluation, which often are combined in a single evaluation study. Examples are presented in several areas where evaluations have the potential to impact policy and practice in online and blended learning at the state, national, or multinational level. Federally funded online learning programs in the U. S. such as the Concord VHS have generated many valuable program evaluations. State and provincial evaluations in the U. S. and Canada reflect five evaluation and approval constructs. Wide variance is apparent among jurisdictions in how they are implemented. Internationally, the primary focus of programs and their evaluations is on integrating digital technologies in support of face-to-face education. However, some nation-level online learning systems are generating valuable evaluations and research studies.

There are many good reasons for researchers to work with evaluators. Funded programs may provide settings for their collaborative work. They share some perennial challenges, such as continuity and short timeframes in programs, program leadership and staff turnover, and data access. To collaborate effectively, they need to understand and respect each other's roles. Evaluators can help researchers build relationships with program staff and conduct their research effectively.

Researchers need to be aware of new trends in evaluation and research, such as advanced data analytics and design thinking. They also need to be aware of expanding areas in online and blended learning that need further study, such as iZones and districts of innovation, online and blended schools, and competency-based education.

In the following table, key takeaways from the chapter and related resources are presented.

Table 5.3. Key takeaways

Highlighted area	Feature	Related resources
Evaluation and its relationship with research	Internal <-> external Formative <-> summative Qualitative <-> quantitative	U. S. Dept. of Education (2008) Newcomer, Hatry, & Wholey (2010)
Evaluation methods	Use focused (UFE) Methods focused Value focused Participatory Empowerment	Patton (2002, 2008) Shaping Outcomes (n.d.), Mohammed (in press) Gukit (2014) Fetterman (1994)
Evaluation examples	Federal (U. S.) National and multinational State/provincial (U. S. & Canada)	Clark (2001), Kozma & Zucker (2003) Barbour et al (2011); Balanskat, Blamire, and Kefala (2006), Kim and Seo (2015) Barbour, Clark, DeBruler, and Bruno (2014)
Working with evaluators	Challenges facing evaluators Working with funded programs	Newcomer, Hatry, & Wholey (2010)
New trends in evaluation and research	Advanced data analytics Design thinking	Microsoft (2016), Shelton, Hung, & Lowenthal (2017) Hennes, Sim & Croft (2016)
Areas of interest in online and blended learning	iZones and districts of innovation Online & blended schools Competency-based education	Patrick & Gentz (2016) Molnar, et al (2015), Molnar, et al (2017) Sturgis & Abel (2017)

Program evaluators and educational researchers will continue to play a significant role in K-12 online and blended learning by improving programs, demonstrating what works, and promoting policies that help ensure that programs are high quality and that students are successful.

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9

Understanding Changes in School Culture

Niki Davis, Julie Mackey, & Nicki Dabner

Abstract

School culture can be conceptualized in the phrase "the way we do things around here", which includes the roles of the teacher and students as well as others with whom they interact such as administrators and parents. The behavior of participants in the ecosystems of education has changed with the evolution of education and of digital technologies, particularly virtual schooling. This chapter reviews such changes, moving from a traditional classroom within which a teacher worked in relative isolation, into innovative models of schooling where teaching is more collaborative and many partnerships extend beyond school campuses. When viewed in a global perspective, the influences of interacting ecosystems are far-reaching, with the most influential being the closest to the learners. Mapping a class of a virtual school within Davis' (2018a) global arena provides a better understanding of the changes in school cultures with the emergence of virtual schooling.

Introduction

There have been substantial changes to the culture of schools in the 21st century. Virtual schools first emerged at the end of the 20th century adding an online mode of teaching to traditional and correspondence schooling. Now K-12 learning online spans primary and secondary offerings, and the terminology has moved away from virtual schooling to include terms such as blended and personalized online learning (Gemin et al., 2015; Davis & Ferdig, 2018). In addition, innovative learning environments have emerged to involve teachers who cooperate to teach what would have previously been several classes. These multifunctional, flexible learning spaces are undergirded by a rich blend of technologies and pedagogies that support collaboration with others across physical and virtual spaces, thus enabling personalized and connected learning beyond the classroom (Madden & Lynch, 2015). Naturally some schools have continued to offer traditional forms of schooling that were more common in the 20th century. This increasing diversity of school cultures prompts this chapter to better understand the diversity in school cultures and the relationships between virtual, blended, and traditional schools.

The variations in the cultures of schooling, and of online and blended learning, can be confusing unless an ecological perspective is taken. Consideration of wider and embedded ecosystems, within which these new practices arise, is essential to their interpretation. For this purpose an ecological arena framework, that conceptualizes global practices within the global ecosphere, is useful because such a multi-layered framework, informed by the principles of ecology, enables the complexity to be understood holistically, as well as from local and regional perspectives (Davis, 2018a; Davis, Eickelmann, & Zaka, 2013). In this way, the complex systems involving multiple layers of education can be interpreted, and better appreciated, by teachers, leaders, and stakeholders including the learners themselves and their families.

The purpose of this chapter is to set a stage for the deeper understanding of changes in school culture that come with the digital technologies, including virtual schooling, and to provide some contrasting illustrations of such perspectives. The chapter is limited to the consideration of the culture of educational organizations and does not extend to the cultures that teachers and learners bring to their studies. Other chapters in this book provide detailed histories, and current perspectives, that may enable readers to glimpse the impact of regional and national cultures on the varieties of virtual and blended K-12 schooling in the 21st century. In contrast, this chapter focuses on school culture as a means to identify the custom and practice that evolve with online and blended learning; its illustrations include an exemplary virtual schooling service in the U.S. state of Iowa called Iowa Learning Online (ILO).

We begin by clarifying the concept of school culture, before considering the changes in the roles and responsibilities of teachers and learners that occur when virtual schooling is deployed.

School culture

Schools have organizational cultures that are continually changing in response to the social 'climate' in which they are embedded. Essentially school culture is encapsulated in the phrase "the way we do things around here". In the 20th century the aftermath of industrialization had led to the establishment of 'single cell' classrooms arranged in year levels, and each classroom containing 20-60 students was led by a teacher whose day was regulated into sessions by a timetable. While the content of the curriculum was often set out by external agencies, the culture and pedagogy in each classroom was set up and maintained by the classroom teacher. The teacher was also part of a hierarchical structure involving a head of department who reported to the school principal. This traditional 'egg crate' organization of schooling has been the context of the early virtual schooling and continues in many places.

The evolution of school architecture from 'single cell' classrooms into flexible spaces, shared by multiple configurations of learners and teams of teachers, impacts on the culture and pedagogy of the classroom because such teachers work collectively to meet learner needs (Mackey, O'Reilly, Jansen, & Fletcher, 2017; OECD, 2015; O'Reilly, 2016). As teachers' practices become visible to colleagues in these shared spaces, teachers become less autonomous in determining classroom culture and pedagogy, while the opportunities for collaboration increase. Deed and Lesko (2015) noted the generative possibilities of these open plan spaces enabled by the sense of community, flexibility, and the blurring of physical and virtual boundaries. The influence on school culture can be interpreted through current discourses describing teacher work in terms of de-privatized practice, distributed and adaptive expertise, and mutual collaboration between teachers and learners (for example, Deed & Lesko, 2015; Fletcher, Mackey, & Fickel, 2017; Hattie, 2015).

Influences on school culture also emerge from an improved knowledge about how people learn (Bransford, Brown, & Cocking, 2000), and an emphasis on student agency and personalized learning, to better address individual needs and interests (OECD, 2010). Together these factors necessitate a shift in culture to self-managed, lifelong learning for teachers and students. In these school cultures collaboration is a central theme enabled by on-going professional development, supported with evidence based practice. John Hattie's (2012, 2015) research indicates that the power of collaboration, coupled with an intense focus on evidence informed outcomes, can impact teaching strategies to improve educational outcomes. The increased collaboration in such schools extends beyond the school campus to include parents and communities in new ways that increase opportunities for authentic learning. It also leads to distributed leadership within and across schools and their partners. Virtual schooling in these schools can be much less constrained by the school culture. Changes to 21st century innovative learning are led by innovative school leaders, including the principal and governing body, not least because change requires significant shifts in the school culture that deserves investment of resources over time. Similarly, the evolution of virtual schooling services to best serve innovative schools is likely to depend on similar leadership. One illustration of such sustained leadership is described in Davis' (2018b) chapter on virtual schooling.

An increase in the availability and use of digital technologies, to support online and blended learning inside and outside of the school environment, impacts school culture by blurring the traditional boundaries between school-home and formal-informal learning environments (Plowman, 2016; Bjørgen & Erstad, 2015; Jesson, Meredith, & Rosedale, 2015). In home-school partnerships, communication between schools, parents, and students can be enhanced through the use of web tools and social media applications. Students and teachers are now more able to share snapshots of student learning with parents, and potentially a wider audience, through the use of e-portfolios, blogs, and wikis. Teachers are able to use these same online spaces to provide feedback to students beyond the school day, and these spaces enable students to continue to collaborate and communicate with peers outside of the school environment. Parents are able to communicate with teachers synchronously and asynchronously, using email and other electronic methods (e.g. texting), thus potentially increasing their involvement within their child's education and the school. The effectiveness of electronic communication strategies with parents, however, can be impacted by cultural and socioeconomic factors that may include language barriers, disability, and parental literacy levels (Harris & Goodall, 2008; Heath, Maghrabi, & Carr, 2015). Parental involvement may also increase within schools that adopt a 'bring your own device' (BYOD) policy, whereby parents purchase the digital devices that their child can use both within the school environment and at home. The choice of device may be defined by the school to minimize issues associated with compatibility with the school network, and maximize use for online or blended learning within the classroom environment (Johnson, Adams, & Cummins, 2012; Rae, 2017). Concerns have been raised, however, in relation to the provision of equitable educational opportunities for students who reside within school communities that may be sociologically, or economically, disadvantaged (Heath, Maghrabi, & Carr, 2015; Livingstone & Helsper, 2007; Cruz-Jesus, Vicente, Bacao, & Oliveira, 2016), potentially impacting a student's ability to access virtual learning environments and opportunities to extend their knowledge and skills outside of the traditional school day.

In some countries virtual schooling services are some of the external agencies and services that schools have come to depend on. For example, in New Zealand such partnership agreements are common for rural and remote schools because the courses offered by services such as Te Aho o Te Kura Pounamu/The Correspondence School (Davis, 2015), and the Virtual Learning Network communities of schools such as NetNZ, enables them to supplement the courses that are taught by the school's teachers, with others that are offered by teachers at a distance. Gemin et al (2015) describe many supplementary services available to U.S. schools, as well as a few that offer courses globally, such as the Virtual High School. A detailed illustration of one virtual schooling service is provided later in this chapter.

Changing roles and responsibilities

A course in the traditional 'single cell' classroom is delivered by a teacher who manages the curriculum, resources, and activities including assessment. Although towards the end of the 20th century many more students with special educational needs were included in mainstream classes so that teaching assistants joined the teacher to support one or more of those students, the classroom teacher continued to set the culture of his or her classroom. Figure 1 depicts a layer of single cell classrooms within a traditional school.

Key: **A** administrator; **IT** technician; **P** parent or guardian; **S** student; **T** teacher. The dotted line indicates sporadic communication, whereas the unbroken lines between the teacher and students indicate that communication is on-going.

In 21st century schools with innovative learning environments, a layer of single cell classes are merged into one flexible space where the teachers and their teaching assistants collaborate to promote self-managed learning as shown in Figure 2. In contrast to the autonomy of the teacher leader in the single cell classroom, the teacher leader in the co-teaching space promotes a culture with student autonomy, shared leadership, and reflective praxis.

Key: **A** administrator; **IT** technician; **P** parent or guardian; **S** student; **T** teacher. The dotted line indicates sporadic communication, whereas the unbroken lines between the teacher and students indicate that communication is on-going.

Teachers working in these innovative learning environments commonly adopt strategies such as alternate teaching, station teaching, parallel teaching, one teach and one observe, one teach and one assist, team teaching, complementary, and supportive co-teaching (Friend & Cook, 2010; Villa, Thousand, & Nevin, 2008). Pedagogical decisions require teachers to negotiate roles, and to balance their individual preferences with their collective responsibility to support student learning (Timperley, Wilson, Barrar, & Fung, 2007). Collaborating teachers typically share responsibility for all students' learning and well-being in the space, referring to 'our learners' rather than taking personal responsibility for smaller sub-groups (Mackey, O'Reilly, Fletcher, & Jansen, 2017; O'Reilly, 2016).

When a course is delivered online in virtual schooling there are changes in the roles and responsibilities because students are not in the same physical space as their teacher, and students are also distributed across multiple schools, as described in other chapters of this handbook. While there are many different arrangements, one of the most common is for the virtual school to set the pedagogy and culture, which is to say the culture in the online class. This is likely to involve the construction of an online course shell loaded with curriculum content and assessments by a team including an instructional designer, as

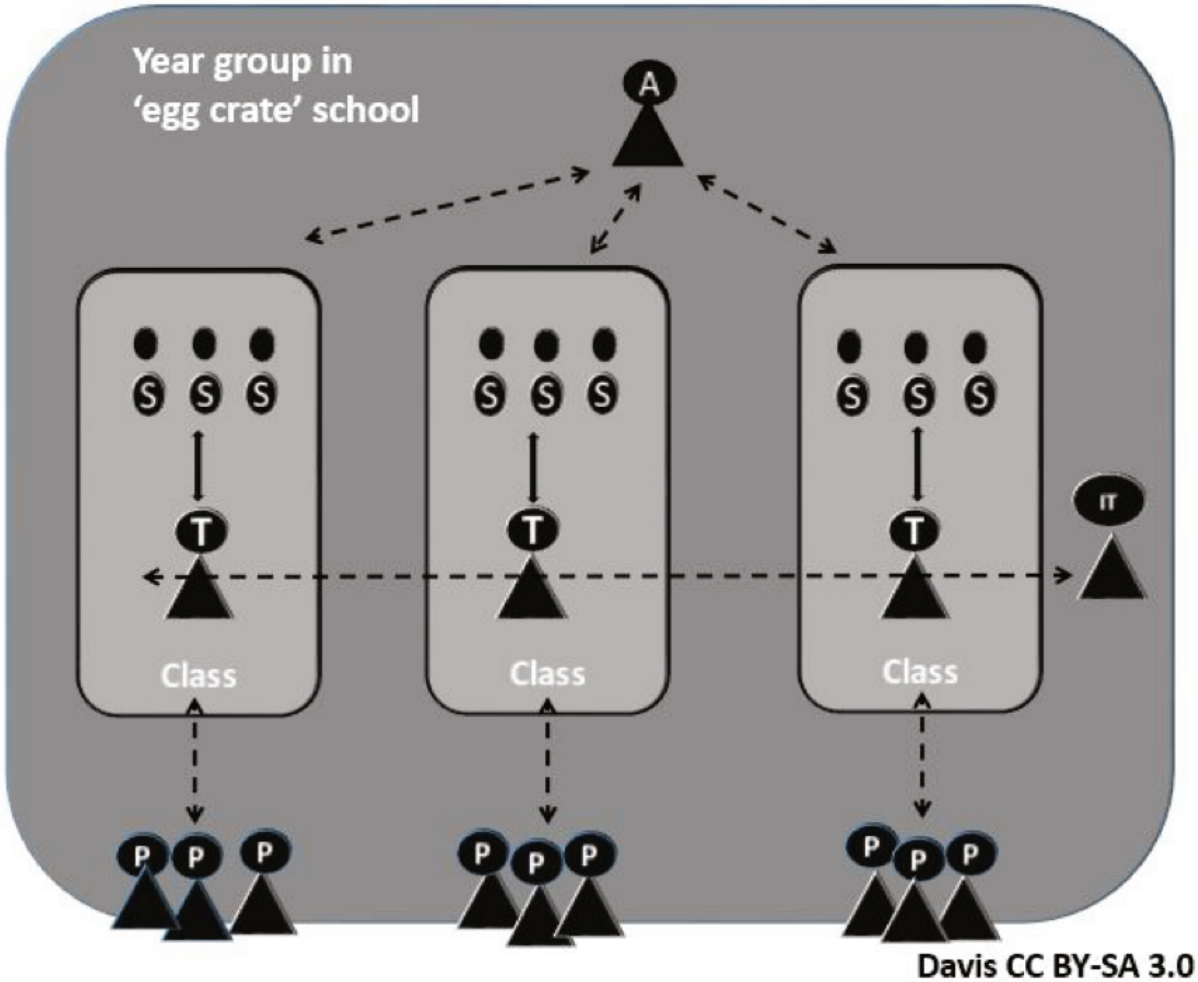

Figure 1. Roles and responsibilities in a traditional single cell classroom in a traditional 'egg crate' school.

well one or more content experts. The whole process is subject to the school's quality assurance processes. The delivery of the course is likely to involve different and/or additional teachers who rely on learning facilitators on the staff of the schools in which students are physically located, to provide front line support and liaison with parents; in the Iowa Learning Online (ILO) this role is known as an ILO Coach. Thus, the role that a teacher in a single cell classroom had in the past has become decoupled across three people: teacher(s) with content expertise, instructional designer, and a learning facilitator who may also be a teacher in the same location as one or more students in the class. Given the need for administrative leadership and technical support, those roles are also present in all of the organizations. The roles and responsibilities in a virtual class, offered by a virtual school as a supplementary course for students in other schools, is depicted in Figure 3. The solid line depicts on-going communication, while the dotted line depicts sporadic communication.

Key: **A** administrator; **C** coach; **D** instructional designer; **IT** technician; **P** parent or guardian; **S** student; **T** teacher. The dotted line indicates sporadic communication, whereas the unbroken lines between the teacher and students indicate that communication is on-going.

Niki Davis and Dale Niederhauser (2005) contrasted two case studies of online teaching of high school physics, one similar to the ILO where a service offered the course to multiple schools, and the other where schools shared one science teacher. The major difference was the imposition of an additional culture by the virtual schooling service, rather than the teacher adjusting to the culture of the school in which the students were situated. While the course involving the teacher in an

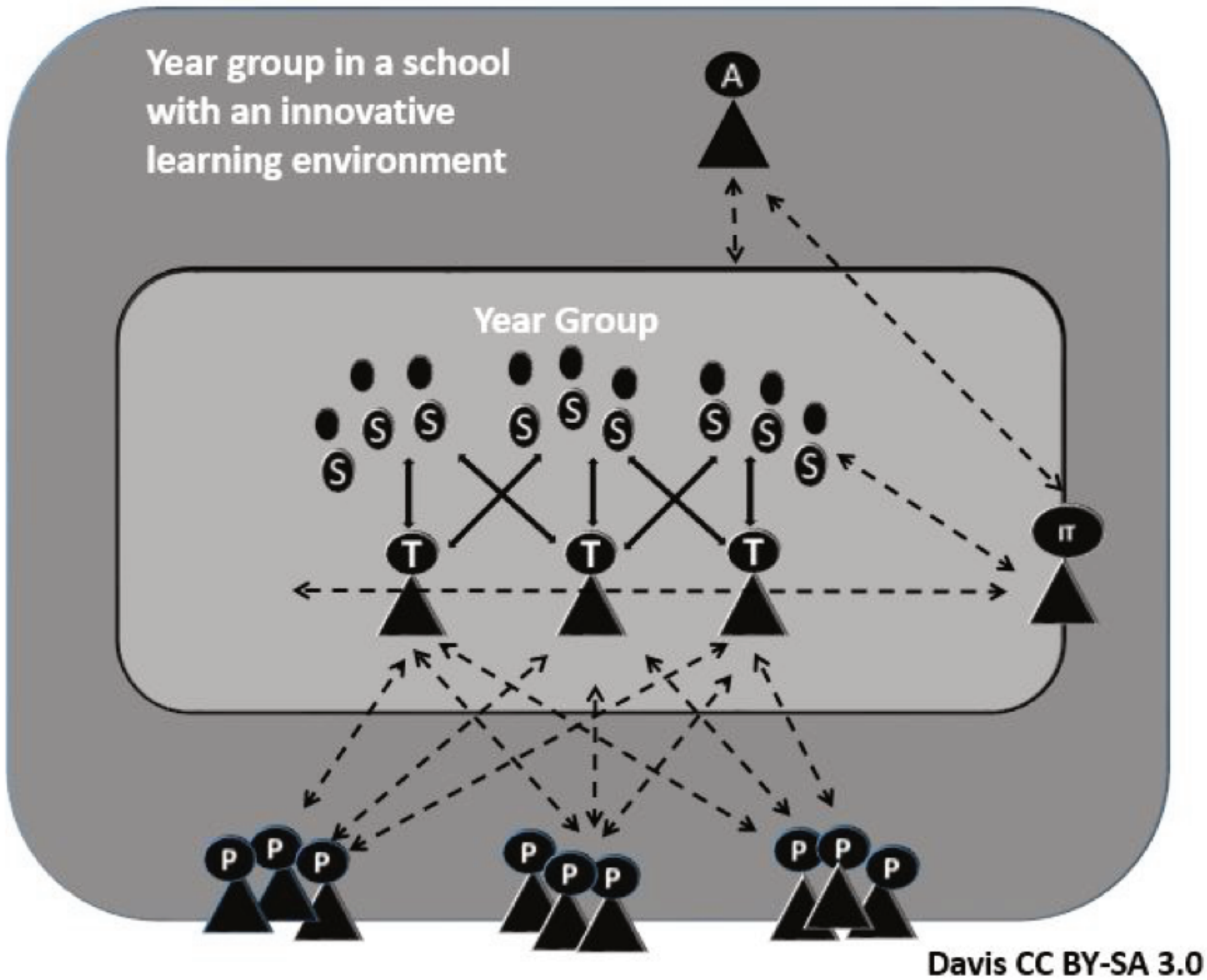

Figure 2. Roles and responsibilities in an innovative learning environment.

Australian virtual schooling service was similar to that of a 'single cell' classroom as in the ILO case, the online teacher in his Iowan classroom made great efforts to fit the culture of the distant school that he taught at a distance through video conferencing, while also retaining the culture of his own school for his face to face class. Descriptions of the practices in other virtual schools, such as the well documented Virtual High School (Zucker & Kozma, 2003), indicates that that they can vary a great deal; others may be glimpsed in the "keeping pace" reports (Gemin et al, 2015) and Bacsich et al's global review (2013). Research also indicates while the culture of administration in virtual schools may be similar to traditional schools, it could be more open to innovative approaches with more shared leadership (Beck & Maranto, 2014).

A virtual school culture illustrated

Like any educational organization, virtual schooling organizations have unique and evolving cultures. They have emerged to take advantage of virtual learning environments that can extend globally. At the same time, they are restricted by the curriculum and bureaucratic regulations that tend to be national and/or statewide, as well as local.

The emergence and evolution of innovative cultures is rarely documented so the first author was very fortunate to be able to observe the evolution of Iowa Learning Online (ILO). This evolution included leading master teacher Gail Wortmann's strategic development of the ILO culture that was founded on her passion for equity, and her exemplary teaching of anatomy and physiology (Davis, 2018a; Davis, Roblyer, Charania et al, 2007). It was the recognition of Gail's exemplary

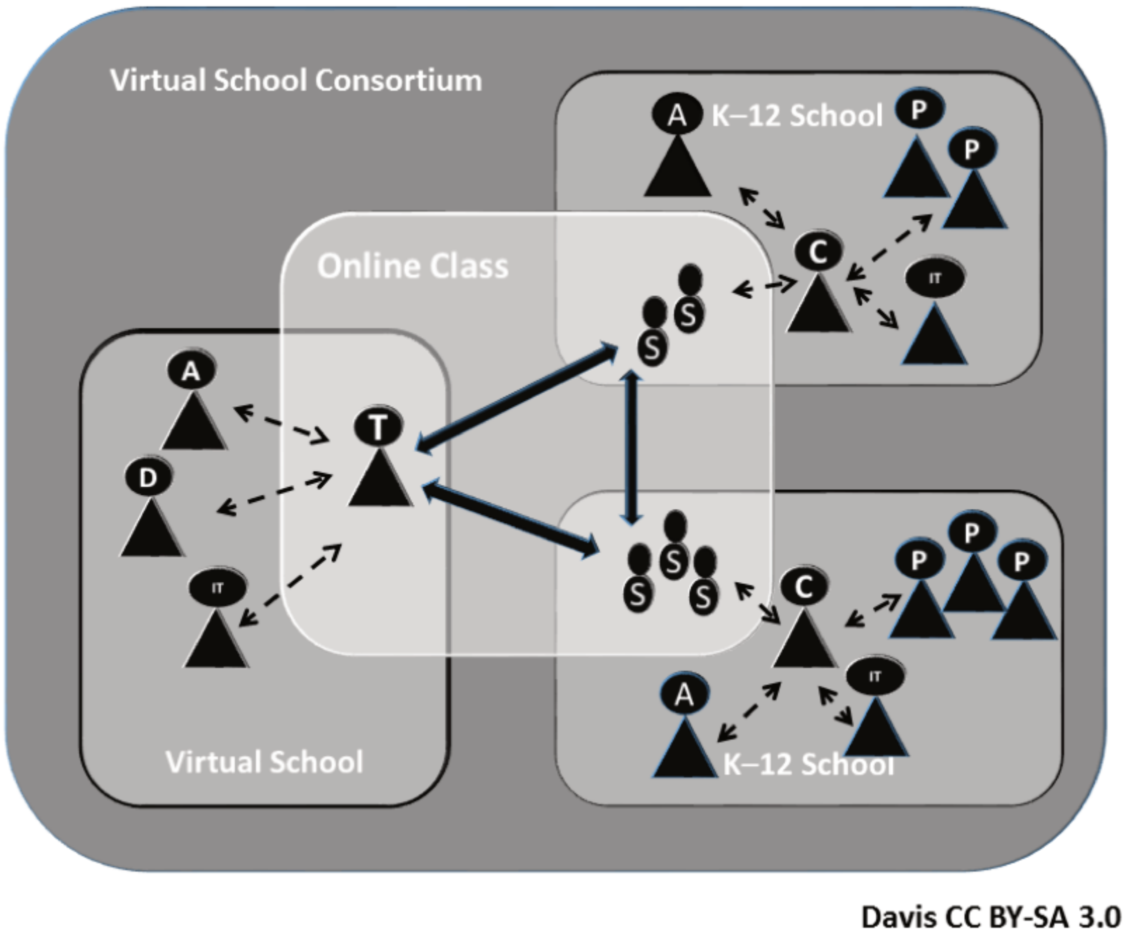

Figure 3. The roles and responsibilities for an online class offered by a virtual school as a supplementary course for students in other K-12 schools.

teaching of anatomy and physiology that gave her a year away from her school to travel the state to spread good practice as 'Iowa Teacher of the Year' in 2002. During this time, she recognized the need to make rigorous course offerings accessible to rural students, and thus mitigating the impacts of teacher shortages. This strategy could also address shortages of staff in rural hospitals and other services. Rural drift to the cities is a global issue, as is the shortage of specialist science, and foreign language teachers.

Gail created the first course in anatomy and physiology for ILO in collaboration with instructional designers in Iowa Public TV, and this course then acted as a model for later courses in the sciences, plus other content areas including Spanish. In collaboration with Pam Pfitzenmaier, in the state Department of Education, Gail also developed the administrative culture for ILO with key principles that continue to be published on the ILO's website in 2017, as follows,

> Iowa Learning Online (ILO), is an Iowa Department of Education program which partners with local schools to expand student distance learning opportunities. In addition to providing a central, credible source for online coursework, ILO benefits students and schools in other ways. It helps address increasing teacher shortages, particularly in hard-to-fill regions or subject areas. ILO makes it easy to provide a wider variety of courses available for Iowa public, accredited nonpublic, and dually-enrolled homeschooled students, allowing local schools to provide courses or advanced subjects that otherwise would not be available. Students are enrolled in ILO courses through their local school or district.

> The State Board of Education serves as the policy board for high school courses offered through ILO. ILO is identified in the Code of Iowa as the Iowa Department of Education's model online learning program (Senate file 2284, section 17). ILO works with Iowa school districts to provide teachers and curriculum for online high school courses.
>
> Guiding Principles
>
> ILO follows four principles:
>
> Iowa Learning Online is a supplemental online program that partners with local school districts, and cannot replace them. Local districts continue to award their students the credits earned upon successful completion of Iowa Learning Online courses.
>
> Iowa Learning Online serves a variety of educational needs and a broad range of learners. It is open to meeting the needs of all high school students.
>
> Iowa Learning Online collaborates to provide quality learning opportunities for students anywhere in the state.
>
> Iowa Learning Online values continuous improvement toward innovative, quality learner opportunities utilizing emerging technologies. (http://iowalearningonline.org/about-ilo)

Gail, as Master Teacher, led what Timperley et al (2007) might recognize as a delicate balance of teacher autonomy and collective responsibility when designing and delivering courses. These ILO courses were developed with a team that included instructional designers and content experts with extensive experience in high schools. Gail described ways in which she was able to share the role of ILO teacher, offering a course among a team that included K-12 teachers who had retired from teaching in high schools, and who were available for only part of the course due to their travel schedules. Such a team of teachers reflected on their teaching and used evidence from the LMS and other sources to analyze the impact of their online teaching strategies, as recommended by Hattie (2015).

It was also noteworthy that, from the start, teaching and learning was shared with staff in partnering high schools, including those who were given the job title ILO Coach. Each year the ILO publishes guidance for an ILO Coach within which there is a list of roles and responsibilities for the following people: School Administrator, ILO Coach, ILO Teacher, Guidance Counsellor, Students, and finally Parent(s) and Guardian(s) (e.g. ILO, 2017). Although the role of technology coordinator is not mentioned by name, contacting ILO for support to resolve technical issues is mentioned. ILO recognizes that it is each student's high school administrator who records the grade, recruits, pays and appraises the ILO Coach. Figure 3 above is based on the ILO approach to virtual schooling.

Gail Wortmann also collaborated with preservice teacher educators in Iowa State University as part of a federally funded innovative project called "Teacher education goes into virtual schooling" (Davis, Roblyer, Charania et al, 2007). Research of that emerging practice enabled the researchers to identify many ways in which the LMS and video conferencing tools stored content and pedagogy, including both formative and summative assessments (Compton, Davis & Mackey, 2009). Preservice teachers were able to visit the ILO class that Gail taught by using these tools too. Gail used online chat as a back channel of communication with preservice teachers who were observing her 'office hour', followed by a debriefing over the video conference after the K-12 students had left the 'room'. Preservice teachers were enrolled in the ILO LMS site and able to observe its structure, content, and student engagement; it was also possible for them to facilitate a small group of students learning in the LMS. However, the biggest challenge was to overcome preservice teachers' misconceptions of virtual schooling, which led to very few wishing to take up the opportunity for field experience in a virtual school. The preservice teachers and teacher educators have little idea how different and engaging a virtual school culture can be when a course is rigorously designed and delivered (Davis, Roblyer, Charania et al, 2007). This problem continues to persist (Kennedy, Cavanaugh & Dawson, 2013).

Virtual schooling in the global arena

There is enormous variation in the cultures of K-12 virtual schooling, and it has increased with the evolution of virtual schooling in the U.S. (Gemin et al, 2015) and in other parts of the world (Bacsich et al, 2013). Research indicates that misconceptions and over-generalizations from traditional practices are widespread despite on-going reviews such as the annual *Keeping Pace* reports in the U.S. (Gemin et al, 2015), and Canada (Barbour, 2014). Research has identified over-generalizations such as: face-to-face schooling replicated online, or the opposite, that virtual schooling would replace the teacher with a computer, and/or as limited to the most able students (Davis et al, 2007). Therefore, it is useful to take a global perspective of the interacting layers of 'climate' locally, regionally, and globally to understand the influences that interact to encourage, and sustain, particular virtual schooling services and virtual schooling nationwide ecozones.

Drawing on the increasing knowledge of human ecology, Davis' Arena Framework (Davis 2018a; Davis et al 2013) depicts the global ecosphere of education, to increase recognition that schooling cultures can be interpreted as interacting ecosystem communities that are embedded within interacting regional ecosystems that are layered within a national ecozone. Within an ecosystem, a keystone species can be recognized by its impact on the ecosystem. For example, the ecosystem will be disrupted when a keystone species is removed or changed. At the center of schooling, the ecosystems are most influenced by the teacher. A change of teacher while a class is in session is likely to disrupt the class. Therefore, the teacher can be identified as a keystone species within an educational ecosystem. The ILO is mapped in the global ecosphere in Figure 4, with one ILO teacher in his class depicted as seen through a screen at the centre. For simplicity, only two high schools are depicted but, as in Figure 3, the number of high schools partnering in one ILO class offering are more likely to be seven or more. Although the class is offered with the ILO school culture (managed by the ILO teacher), the students are also influenced by the culture of their high schools, and the management of issues arising from the interaction of those different cultures is undertaken by the ILO coach, with support from his high school colleagues. Where high school students choose to study several supplementary courses from different providers, they will have a different culture in each course that their 'coach' will also be managing.

Key: **A** administrator; **AEA** area education agency; **C** ILO student coach also known as learning facilitator; **D** instructional designer; **ICN** Iowa Communications Network; **IPTV** Iowa Public TV; **IT** technician; **LMS** learning management system; **MT** master teacher; **NACOL** North American Council of Online Learning; **P** parent or guardian; **S** student; **T** teacher; **VHS** the Virtual High School. The in-pointing triangles identify five sectors into which influences have been grouped.

Figure 4 illustrates a class offered by an ILO physics teacher in 2004, within Davis' (2018a) Arena Framework, to show the many interacting organizational cultures that impacted this class. The ecosystems communities of this teacher and his class were embedded within many layers of ecosystem communities within the global ecosphere; the ecosphere is depicted by the outermost oval. The physics teacher (T) is at the center, the figure pictured as seen through a screen by students (S) in two different schools. The teacher is embedded in the ILO school culture and, although the students and their supporting adults are embedded in their local school culture, these participants have all been guided by the ILO procedures described earlier to behave appropriately to support students studying with ILO. The ILO coach (C) in each school has the most important role in managing the interplay between the student's school culture and ILO; students benefit from mentoring to prepare for studying online, and they also need an advocate, because others in their school will be unaware of their study needs and the clashes that can occur. For example, school events may clash with course events. Similarly students may need additional technical support from the school technician (IT). The liaison with parents (P) happens via coach, rather than the classroom teacher as described earlier and in Figure 3. School administrators (A) and their area education agency (AEA), handle the administrative tasks for their students, including enrollment in ILO courses, and recording of credits in their records. The ILO's culture has developed to have an instructional designer within each course development team. Gail Wortmann, as master teacher (MT), led induction, on-going professional development, and quality assurance with support from the ILO director.

The class was also influenced by layers of the ecosphere beyond the schools and ILO. These influences have been mapped into five sectors. In the Resource sector, the video conferencing technology was provided through the Iowa

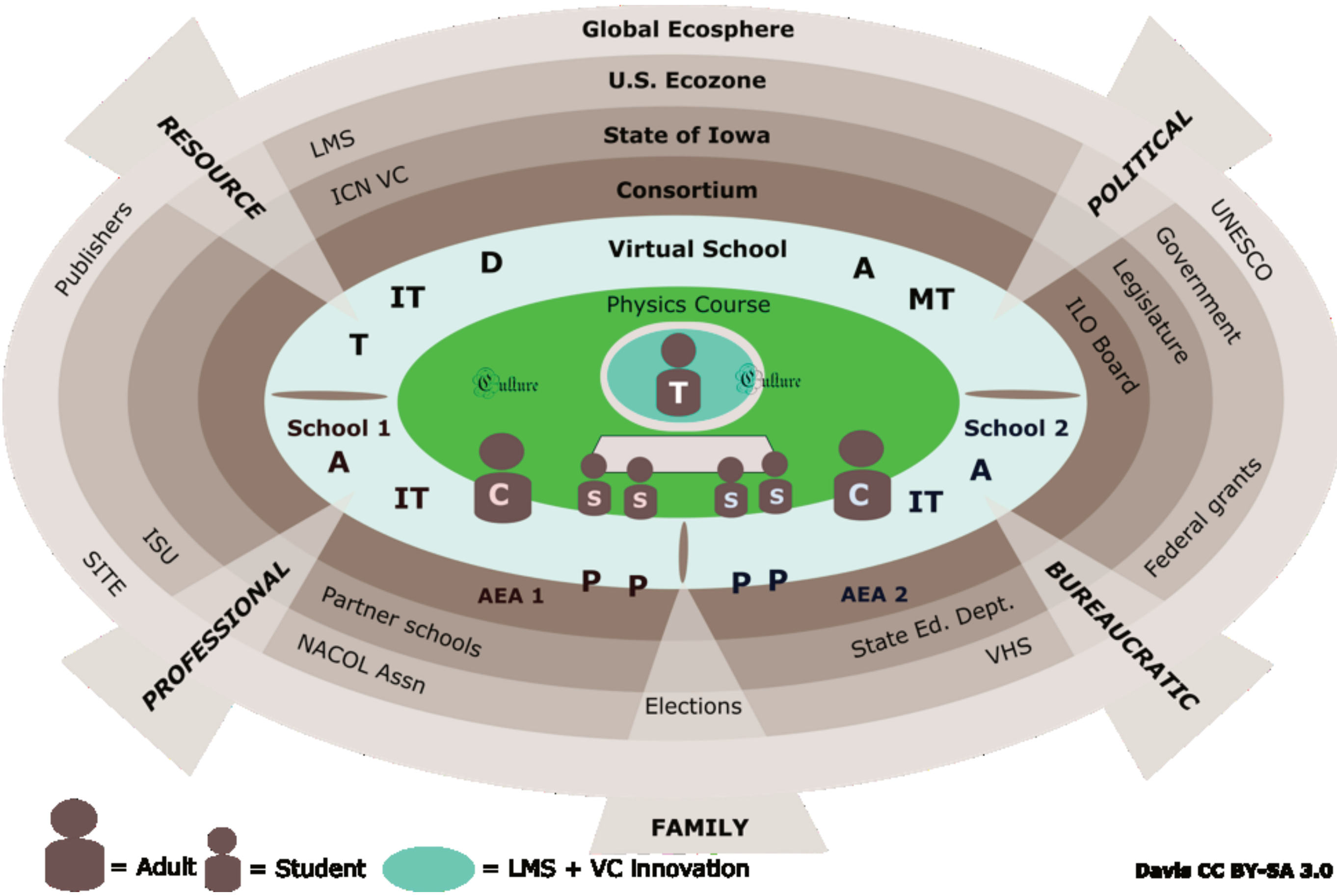

Figure 4. Iowa Learning Online's first online physics course offering in 2004. The physics teacher is at the center set within the global ecosphere. (Derived from Davis, Eickelmann, & Zaka, 2013, under a CC by SA license)

Communications Network video conference service (ICN VC), by the state Department of Education, into at least one classroom in all high schools and universities; the LMS was a provided by a nationwide for-profit company (WebCT); and the textbooks were purchased from international publishers. These technologies have evolved since 2004, so, for example, the video conferencing approach moved from room level to desktop videoconferencing (which could have been used from the start had that been compatible with the statewide policy which was to promote the ICN in 2004). As described earlier, the political sector was influential through the state legislature, and the funding for research and development by the federal government. At the global level, UNESCO and its Institute for Statistics has redesigned its survey that informs government departments. Although it has expanded its view of the modes of learning, the survey has not yet included virtual schooling, despite our recommendation in 2015 (Twining, Davis & Charania, 2015). In the bureaucratic sector, a leader in the state education department, one of the founding leaders of the ILO (along with Wortmann as master teacher) was influenced by national initiatives including the Virtual High School (VHS) that was founded with a federal research grant. Families also impact ILO's evolution through elections at local, state, and national levels; in the U.S. these elections include the superintendent of schools in each area. Finally, in the professional sector, ILO's partner schools impact its evolution, as did partnering with Iowa State University. The North American Council of Online Learning influenced the ILO as well as virtual schooling nationwide, and more recently has become iNACOL to reflect its membership overseas.

This global perspective on ILO uncovers the increase in the interaction with ecosystems beyond the campus of one school. The cultures of these organizations evolve and influence one another. By their nature, virtual schooling services partner with large numbers of schools and other educational agencies, and this drives change within and across the partnering institutions and related services.

Conclusion

How has this historical perspective set the stage for what might come next? It is important for educational leaders, including school principals and policy leaders, to have an understanding of changes in school culture that arise with online and blended learning. The emergence of virtual schooling over the last two decades has led to the emergence of new types of school services that provide online environments, and occasionally also provide courses and substitute teachers (Gemin et al, 2015). Occasionally online and blended learning may be limited to partnerships between schools who need to share teachers in order to cover the curriculum (Davis & Niederhauser, 2005). What is common to all of these collaborations, is the need to appreciate that participating students and teachers are embedded in different organizational cultures that may clash, or compete, as well as support one another. Therefore, it is essential to develop relationships between these collaborating forms of virtual, blended, and traditional school cultures, and to agree on roles and responsibilities. Those developed by Iowa Learning Online illustrate that strategy. In addition, the mapping of a virtual class in Davis' arena framework identifies that the class is influenced by organizational cultures that can stretch statewide, nationwide, and even globally. Therefore, the range of leaders and their influence also extends globally. It is noteworthy that some leaders and policymakers have not been aware of the emergence of virtual schooling within their jurisdiction (Bacsich et al, 2013).

While we recognize that this will spur evolution of educational services that stretch globally, it is important to note that this chapter was limited to the consideration of the culture of non-profit educational organizations involved in schooling. The expansion of the 'for profit' market is also likely in the future, and given the contrast between for-profit and non-profit cultures (Barbour, 2016; Gemin et al, 2015), this is likely to stimulate the evolution of additional forms of school culture and learning environments.

Online and blended learning will continue to evolve and to co-evolve with schools, their communities and partners, including online service providers within and across all levels. Rather than see change as a process of moving from one school culture to another in the 21st century, it is important to recognize that change processes include school leadership of cultural change that will be continuous, and must include increasing, self-managed, lifelong learning for students and staff. In addition, such change processes involve on-going, shared leadership that becomes deeply embedded in the culture of each classroom (blending physical space with online environments), within which teachers collaborate and partner with their communities and educational services that may stretch globally. Local changes are likely to be increasingly influenced by communities and cultures of the learners, and the community ecosystems within which they are embedded beyond the school campus. Therefore it will be important for educational leaders and policymakers to recognize and plan for these changes in school cultures and services, which will also require action to address the equity issues that will continue to emerge.

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PART II

Research on Learning and Learners

10

Introduction

Mary F. Rice

Overhauling K-12 learning with blended and online settings requires an ideological turn from the notion of teacher versus learner centering to the creation of truly egalitarian spaces that put users (regardless of their historical responsibilities in the educational process) at the forefront. In such a scenario, users would drive their own learning, their own engagement, and the roles of teacher and student are passed back forth (Beetham & Sharpe, 2013).

However, as educational systems migrate to online spaces, they bring with them much of the former suppositions about what learning and learners should look like and how they should act. Unfortunately, these systems inherit the historical injustices and inequities that have caused learners to be left out of formal educational experiences. After all, schools were never set up to be equitable places; they were set up to privilege some and disadvantage others. And so there should not be so much surprise that is exactly what they do (Hannah-Jones, 2017; Kim & Taylor, 2008).

While surprise may not be warranted, outrage is. Or at least a desire for change. Further, while moving online may not inherently resolve the issues of historical inequities, they certainly offer opportunities to confront them and move to brighter future for all. The chapters in this section focus on learners and learning in K-12 blended and online settings. While each has been assigned a topic, the authors acknowledge the multiple, simultaneous, identities of learners profiled.

In the first chapter of this section, Drexler (2018) offers a conceptualization of Personal Learning Environments in K-12 online and blended education. Her major conclusions are that Personal Learning Environments are under-utilized and research on this topic is emerging, rather than established. Further, she argues that while Personalized Learning Environments have focused on mastery and direct teaching, that is certainly not the potential of Personal Learning Environments as a paradigm for instructional delivery.

The second chapter of this section features Cox Repetto, and Spitler's (2018) updated version of their chapter on at-risk learners in K-12 online learning. In this updated version, they emphasize that services for online learning for these populations are increasing in their quantity and quality. In the past, online learning was regarded as an option of last resort or even just one of many shot-in-the-dark strategies to help at-risk students earn a diploma. Looking toward the future, online programs are recognizing that students with various academic and personal challenges are enrolling and that they deserve better than a "sink or swim" approach to their learning needs.

In the third chapter, Pytash (2018) explores the access to online learning available to incarcerated youth—a population in dire need of support. What she found as she sifted through research was that these vulnerable young people, rarely, if ever were "trusted" with advanced Internet and online technologies. When they were, they were often subjugated to a curriculum that was not tailored to the rehabilitative or any of their other needs as marginalized youth. She further emphasizes that many of the youth in these facilities have disabilities of various types. In Pytash's chapter, we see most starkly that the promise of bringing technologies into a learning space does not inherently liberate.

Next, Rice and Dykman (2018) provide a substantially rewritten version of a previous chapter on students with disabilities in online learning (Greer, Rice, & Dykman, 2014). In the chapter, Rice and Dykman review five more years' worth of research studies on this topic from their first review. They argue that although the research base is expanding, there is still much work to be done (and published in peer-reviewed journals) about transforming learners with disabilities into empowered, successful users of online and blended curriculum and instruction.

The fifth and final chapter of this section is Black and Thompson's (2018) review of research on online learning for students with severe health impairments. In the chapter, the authors raise important issues about the ways in which terms like "illness" and "disease" overlap as well as the ways in which they do not. They also state very clearly that there are no completely tidy understandings about health impairments in educational settings. However, young people with all types of health and disability statuses are enrolling in online learning courses. Therefore, it is imperative that everyone in the online or blended setting have the knowledge, skills, and dispositions to fully acknowledge and address their educational and medical needs.

The goal of this section is to better understand the range of learners in K-12 blended and online settings with an eye to learners who need additional services through federal mandate or who have been historically marginalized. From these chapters, it is evident that online and blended programs serve not only minds but bodies as well. Readers will note that there are many populations not represented here. Of course, we would welcome these chapters. For now, let us feel pride in the progress that has been made for moving learners to empowered users. But let us also commit to advancing research and practice until we have achieved educational equity in every setting.

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11

Personal Learning Environments in K-12

Wendy Drexler

Abstract

Personalization is a trending topic in educational technology. The definition is so broad, it has become a catch phrase to describe many different transformation initiatives and promote new tools. While the concept of personalization as it relates to mastery and student data is gaining traction, the actual application of student-constructed personal learning environments (PLEs) remains limited in the K-12 literature and practice. This chapter explores existing research on PLEs and networked learning in children and adults. Research-based examples in K-12 are presented along with the processes required to support student constructed personal learning environments. Implications for teaching practice, learning, and education policy are shared along with a call for additional research specific to K-12 students.

Introduction

Learners face a rapidly changing landscape in which analysis and synthesis of information and distributed human interactions are critical to effectively solve problems (Wagner, 2008). Personal learning environments (PLEs) provide students with increased control over the learning process and a level of autonomy not typically realized in the highly structured, traditional classroom setting. As such, students who construct PLEs gain practice in a number of processes required for effective networked learning and problem solving. PLEs provide the opportunity to learn how to properly vet resources, synthesize considerable amounts of information, and reach out respectfully to experts and potential learning collaborators (Drexler, 2010). Personal learning has implications for student empowerment, teacher roles, administrative leadership, and educational policy. The Horizon Report (2011) recognizes the efficiencies of personalization describing the implications for informal learning as profound. The scalability of personal learning in K-12 public education is dependent upon instructional design that scaffolds students' ability to take greater control of the learning process and administrative policies that give students greater access to Internet resources. The Horizon Report (2011) confirms that the technologies and web applications required to build PLEs currently exist. How they are used in the classroom will depend greatly on shifts in attitude toward technology, teaching, curricula, and learning. This chapter will define personal learning environments, present an overview of PLEs in the research, and discuss the implications of student constructed personal learning environments in K-12 policy and practice.

Research Synthesis

A synthesis of the research will differentiate between personalized and personal learning, define the concept of personal learning environments, provide a theoretical framework for networked learning, and explore examples in the literature.

Personalized Versus Personal Learning

Personalization is a popular topic among educators as well as educational technology designers and developers. Though it may seem subtle, there is a difference between personalized and personal. The United States Department of Education defines personalization as "instruction that is paced to learning needs, tailored to learning preferences, and tailored to the specific interests of different learners. In an environment that is fully personalized, the learning objectives and content as well as the method and pace may all vary (USDOE, 2010, p. 1)". The terms paced and tailored presume that while the student has some measure of choice, the instruction and learning objectives are still under the guidance and control of the teacher or curriculum designer. The latter portion of the USDOE definition gets closer to the concept of a personal learning environment in which objectives, content, method, and pace are under the control of the student. When educators refer to personalized learning environments, they are likely to have a different concept in mind from that of a personal learning environment as defined in this chapter. It helps to think of personalization as a continuum of teacher and student control on which personal learning environments represent the greatest measure of student control (Drexler, 2010).

A personal learning environment allows the learner more control by customizing the learning experience and connecting the learner to others (Downes, 2007). It refers to the methods students use to organize content, "the tools they choose, the communities they start and join, the resources they assemble, and the things they write" (Wilson, 2008, p.18). Zhou (2013) synthesized recent literature on Personal Learning Environments differentiating the personal, the learning, and the environment perspectives. From a personal perspective, the research supports learner control and ownership. "However, it is rarely discussed how to transfer the responsibility of facilitating learning from educational institutions to individual learners" (Zhou, 2013, p. 1162). From a learning perspective, the process of constructing an effective PLE requires mastery of certain skills and processes, including digital literacy, digital responsibility, organization of resources, synthesis of content, and knowledge construction (Drexler, 2010). PLEs may also be used to facilitate self-directed learning (Haworth, 2016). The practice of these skills may take place through the process of constructing the PLE with the support and control of a teacher or institution (Zhou, 2013). The environment is comprised of the platform and tools, the community, and resources the learner chooses to include in the PLE (Zhou, 2013).

Constructivism as a Theoretical Framework for PLEs

Constructivism (Jonassen, Howland, Moore, & Marra, 2003) serves as the theoretical framework for student construction of personal learning environments. Students are expected to access, navigate, disseminate, and synthesize large quantities of information to construct knowledge. Provided appropriate tools and guidance, students build a technology enabled environment through which they can learn. They do not learn from the technology, but through the process of applying it with the goal of constructing a custom personal learning environment (Jonassen et al., 2003). Constructivism implies that knowledge is constructed by the learner and encourages "greater participation by students in their appropriation of scholarly knowledge" (Larochelle et al., 1998).

The foundation of constructivism is attributed to Jean Jacques Piaget, but Geelen (1997) identifies at least six different forms: personal (Kelly and Piaget), radical (Glasersfeld), social (Vygotsky), social constructionism (Gergen), critical (Taylor) and contextual (Coburn). It is in the combination of these theoretical points of view and the "dialectical tension between differing emphasis" that the theory is best applied to practice (Geelen 1997). Constructivism asserts that learners construct knowledge based on their experiences and social interactions (Jonassen et al., 2003).

Jonassen (2003) views technology as a collection of tools to support knowledge construction, an information vehicle for exploring knowledge to support learning, a context to support learning by doing, a social medium to support learning by conversing, and an intellectual partner to support learning by reflecting (Jonassen et al., 2003). The key principles are knowledge construction, doing, conversing (or sharing), and reflecting. Each of these components is present in a networked learning model that supports PLEs (Drexler, 2010). Students may use RSS and social bookmarking to organize information and build upon prior knowledge with the goal of completing a task or meeting a learning objective. Social media, or Web-based applications designed for interaction with others online, promote conversations. Blogs are one example of a vehicle through which students can reflect on the learning process. All these pieces in combination support a constructive learning experience. The student's personal learning environment pulls them together.

The ill-defined process reflected in constructive learning (and networked learning) is not always comfortable for the student, especially one who has customarily "engaged in learning activities because they are required, rather than through intrinsic interest" (Jonassen et al., 2003, p. 238). Teacher roles are impacted to the extent that they relinquish some intellectual and management authority while also working to gain familiarity with the technology (Jonassen et al., 2003).

Ultimately, meaningful learning is best facilitated through knowledge construction, not reproduction; conversation, not reception; articulation, not repetition; collaboration, not competition; and reflection, not prescription (Jonassen et al., 2003). Jonassen's perspective of meaningful learning guides the design of constructivist learning environments. The design of the teacher-facilitated, student-created personal learning environment adheres to constructivist principles with the goal of developing a networked student who takes increased responsibility for his or her learning while navigating an increasingly complex content base (Drexler, 2010).

Examples of PLEs in Practice

PLEs may manifest in an infinite number of ways because the student selects the tools and communities that will best meet his or her learning objectives. In one example, a second grade teacher builds her own PLE to organize curricular resources for a curriculum-mapping project. Ultimately, she organizes units through web mixes and shares this PLE with her students (Ash, 2013). In another example, seventh grade science students study poisonous and venomous creatures using multiple online tools including Google Scholar, science-specific search engines, videos, blogs, articles, and books. They use Skype to connect with experts around the globe. Digital resources are collected and organized using an aggregating tool called Symbaloo. Their research is synthesized and evaluated via a Glogster multimedia digital poster that includes text, video, graphics, and audio (Drexler, 2010). In a high-school scenario, a librarian helps students create personal learning environments and information dashboards using Google Sites, WordPress, Symbaloo, wikis, NoodleBib, and Scoop.it (Hamilton, 2012). In a higher education example, students identify the ideal PLE as having opportunities for discussion, collaboration, organization tools, experiential learning, and effective technologies (Dabbagh & Fake, 2017). The collection of the tools students use and the human connections they make define their unique personal learning environment. New tools and technologies are constantly evolving and expanding. Considerations for selection of PLE tools include ease of use, open access, dynamic properties, and options for collaboration (Haworth, 2016). Wilson (2008) identified patterns characteristic in personal learning tools. He found that PLE tools might serve as a navigation layer, discourse manager, connection hub, time and effort manager, media creator or mixer, identity integrator, or a multi-mode multi-platform. Any combination of these patterns may be employed to build the personal learning environment.

Role of Community in PLEs

Today's PLEs leverage new technologies and networked online learning, but the concept predates the Internet as we currently know it. Ivan Illich wrote Deschooling Society in 1970, before the Internet was accessible to most people, before the World Wide Web, and before the personal computer. He identified learning webs made of avenues of learning including television, reading, peers, and relationships (Illich, 1970). "We can provide the learning with new links to the world instead of continuing to funnel all educational programs through the teacher" (Illich, 1970, p. 73). Illich recognized the importance of social connections, collaboration, and learner empowerment. He saw that a sense of community beyond the classroom could provide a foundation for deeper learning.

This sense of community is a key factor in networked learning (Goodyear, 2004), but not the only means of making connections. Networked learning is sometimes confused with computer supported collaborative learning (CSCL), computer mediated communication (CMC), and communities of practice (COP) all of which focus on social interactions (Johnson, 2008). But, the central notion of networked learning is in "promoting connections" (Johnson, 2008, p.1). What is done with those connections is at least as important. Johnson indicates a sense of savvy in the accomplished networked learner. "Once a connection is made, requisite skills might include how many connections are tenable, or how to marshal an element of affective intelligence to appreciate how even brief messages can chill or foster the network" (Johnson, 2008, p. 4). That sense of savvy extends to resources as well as people (Johnson, 2008).

Role of Digital Literacy in PLEs

A foundational understanding of digital literacy is necessary to become an effective networked learner. PLEs can serve as a means of developing critical information literacies (Hicks & Sinkinson, 2015). Contemporary digital literacy extends beyond a basic comfort with new technologies. Alkali and Amachi-Hamburger (2004) identify five major digital skills: (1) photo-visual (the ability to make sense of graphical representations), (2) reproduction (create new artifacts from existing content), (3) branching (knowledge construction from hypertext), information (evaluating content), and (4) socio-emotional (interacting effectively with others online). This list may encompass some or most of the skills required to navigate the Internet effectively today. But, the landscape continues to change. A broader definition proposed by Leu et al. (2004) offered greater flexibility.

> The new literacies of the Internet and other ICTs include the skills, strategies, and dispositions necessary to successfully use and adapt to the rapidly changing information and communication technologies and contexts that continuously emerge in our world and influence all areas of our personal and professional lives. These new literacies allow us to use the Internet and other ICTs to identify important questions, locate information, critically evaluate the usefulness of that information, synthesize information to answer those questions, and then communicate the answers to others. (pg. 43)

Unfortunately, in the US, digital literacy is neither consistently defined nor taught (Moore, 2002). Students who prefer online learning often have prior knowledge and experience using Web-based tools (Hannafin & Hannafin, 2010). However, many students, while familiar with technologies in the social context, are not necessarily prepared to use those tools for deep learning (Dahlstrom & Bichsel, 2014). Consequently, the teacher who ventures into networked learning must often take on the task of actively teaching digital literacy skills. These skills change depending upon the content, context, and tools used in the learning process.

Networked learning is student-centered. Control for the learning process shifts to the student. He or she assumes responsibility for learning goals and the means with which they are attained (Hannafin & Hannafin, 2010). Web applications and emerging technologies frequently offer new opportunities for students to access, organize, and control learning. For many students incorporating these tools aids in dissemination of knowledge shared within the global learning community or collective intelligence (McLoughlin & Lee, 2008). The traditional teacher-centered approach assumes knowledge is relatively static. However, with the creative contribution of users in networked learning, knowledge is constantly changing and being presented from different points of view. Decision-making is increasingly important as students determine what content or knowledge is worthy of adding to the PLE and the extended networked learning community (Zenios & Goodyear, 2008).

Open Educational Resources and Web Applications in PLEs

Open educational resources (OER) further add to the plethora of content through which learners sift to piece together a successful learning journey. OERs are "digitized materials offered freely and openly for educators, students, and self-guided learners to use and re-use for teaching, learning, and research" (Hylen, 2006, p. 1). They include scholarly articles, lesson plans, websites, and fully designed courses posted on the Internet for all to access. In many cases, educators have designed open educational resources, some of which include full courses. OER, along with newly available web technologies, continue to create avenues to further explore and research networked learning from a pedagogical perspective (Hylen, 2006).The convergence of increased ease of access to information and the exponential growth of open source educational resources (OER) provides a new repository of valuable content from which students can learn (Downes, 2007). The exponential growth of online information poses a challenge to the learner who must locate sources and determine credibility. An affordance of open educational resources is the accessibility of content created by experts including professors, teachers, and researchers at educational institutions. In effect, someone else has already collected the resources, put them into a viable format or course, and provided a slightly higher level of confidence that the source is reliable. The Institute for the Study of Knowledge Management in Education (ISKME) created OER Commons in February 2007 "to provide support for and build a knowledge base around the use and reuse of open educational resources" (OER Commons, 2007). OER Commons includes primary, secondary, and post-secondary resources, open textbooks, tutorials, lesson plans, and entire courses.

Emerging Web applications allow learners to organize content in new ways, create original works, build upon the works of others, and collaborate with experts or communities of learners who share a common goal (Richardson, 2008). Really Simple Syndication (RSS) offers a means for users to subscribe to changing content such as blogs, wikis, newsfeeds, podcasts, and video. Synchronous online communication such as video conferencing, microblogging (e.g. Twitter), and instant messaging provide new avenues for reaching experts in any field of study. Digital libraries and searchable repositories of open educational resources (OER) give students access to information on virtually any topic. Functionality mash-ups (Severance et al., 2008) are combinations of web tools that bring together multiple applications as well as content from multiple sources with a user-friendly interface. Such an interface becomes the personal learning environment that builds structure around the student-constructed synthesis of online content including social connections to other students or subject matter experts.

Personal page options such as iGoogle, Netvibes, PageFlakes, and Symbaloo incorporate Application Programming Interface (API) widgets to pull content from external sites and organize it based on user preference. Web applications also provide the means for users to synthesize what they have learned and create new content to share with others. For example, Glogster, a digital poster program, allows students to combine text, graphics, video, audio, and images on any topic imaginable. With so many tools available, those who can effectively apply the tools that manage the content have an advantage. Many teachers who are experimenting with the use of web-based applications in the classroom share their experience via blogs, Twitter, Facebook, and other social networking sites.

The Networked Teacher Model

Couros (2008) developed a model of the networked teacher that represents an educator's professional personal learning environment (PLE). Presumably, a teacher will be better equipped to facilitate networked learning if he or she has experienced the construction of such a model as a learner. The significant connections in Couros' view of the network include colleagues, popular media, print and digital resources, the local community, blogs, wikis, video conferencing, chat/IRC, social networking services, online communities, social bookmarking, digital photo sharing, and content development communities (Couros, 2008).

The Networked Teacher is a model by which educators begin to build professional connections to support teaching practice. Couros constructed this model based on feedback from teachers who were actively participating in networked learning for their professional development. He used their input to tweak and revise the model (Couros, 2008). It serves as an example of the numerous connections or nodes that comprise a professional network. Beyond Couros' research, little has been done to explore the impact of such a model from a student perspective, especially in K-12 education.

Processes Required to Construct a PLE

The goal of personal learning is to empower the student to independently construct rich, effective networks in support of his or her learning objectives. Effective independent inquiry does not happen automatically (Mayer, 2004). Drexler (2010) conducted a design-based research case study to determine the processes that students go through when constructing personal learning environments. Because of this research, a networked student model was developed with a focus on the learning process rather than the specific tools used to build a PLE. Technology tools are helpful as examples, but are only effective in how they support the following processes.

- Practicing digital literacy
- Practicing digital responsibility
- Organizing content
- Dealing with technology
- Collaborating and socializing
- Synthesizing and creating
- Taking responsibility and control for learning

Scaffolding these processes requires development of a supporting skillset over time rather than through a single project (Drexler, 2010). Students require the support of a teacher as they develop these skills. Students participating in this study had no prior experience with networked learning and a limited grasp of digital literacy. Most were familiar with social networking sites such as Facebook, but few considered applying technology to learn. They could conduct a simple Google search, but did not know about alternative search engines, how to dissect a URL, or how to evaluate the reliability of websites. They initially limited their search to the first page results without digging deeper or taking time to consider the credibility of the source. Most students began with an image search. They were clearly interested in images over text.

Once they found the text they wanted and captured it, they leveraged that content to search for more images or video. The teacher had to take additional time to actively teach the concept of digital literacy and provide opportunities for the students to practice.

Digital responsibility is a subset of digital citizenship (Ribble, 2004). It refers to appropriate use of all types of media, behaving responsibly when interacting with others online, and following school acceptable use policies (Ribble, 2004). The teacher in the example above was mindful of the need to actively teach these skills throughout the design and delivery phase of the project. The students had little prior instruction, if any, in appropriate online behavior. While there was a school acceptable use policy in place, few students were aware of its contents. The teacher was very open with the students and continually reminded them of the responsibility that comes with freedom of access to Internet sites. He freely relayed examples of inappropriate use of technology along with his expectations. Reading of comments on YouTube was off limits. Downloading of music was limited to those tunes the students already had purchased. They could listen to iPods, but not download music from school. Students were reminded to cite sources properly and give credit to authors.

Organization is a critical process in the students' construction of personal learning environments (Johnson, 2008). Students in the PLE project had to set up user accounts, add content widgets on Symbaloo personal pages, and rearrange the widgets to meet their needs. To synthesize the content accumulated during the research process, it is important to organize it in such a way as to maximize ease of retrieval. Organization of the Symbaloo pages differed from one student to another. Some had only a few blocks on the personal page representing only those resources to be used in school. Some had as many blocks as could fit on the page with everything from the required school widgets to CNN News. Each student had complete control over the way the content was organized. Some students arranged blocks by color. Others organized blocks by function. The teacher respected each student's organizational style and preference, empowering the learner to make decisions about the learning process. In some cases, he offered suggestions for structural layout. In others, the Web application in use provided the organizational structure.

Socializing and collaborating took many forms including whole-class discussion, conversing with individual students or online experts, helping another student, and questioning or conversing with the teacher. Students have more difficulty resuming on-task behavior when whole-class socializing is taking place. However, most examples of this are directly related to instruction. The individual responses students receive from experts around the world are the most memorable and powerful from the students' perspectives.

The artifacts students created to represent the synthesis of their research included a scientific report and a Glogster digital poster. The students used the Internet to identify subject matter experts, scientists who specialized in the animal researched. They emailed the scientist and provided a link to the digital poster asking for feedback on their work. Those students who received feedback experienced the peer-review process first hand.

The processes that support student construction of personal learning environments are complex. The development of the supporting skills is time consuming and requires considerable teacher facilitation and support. As such, students do not begin building PLEs with full control, rather they gain autonomy as the processes are practiced and mastered.

Rahimi, van den Berg, and Veen (2013) propose a roadmap for building web 2.0-based personal learning environments in educational settings. They argue "the student's control model and the teaching process should interact with each other to define appropriate technology enhanced learning activities to be accomplished by students to build their PLEs" (Rahimi et al, 2013, p. 3). The teacher and student co-develop a learning environment that recognizes the student as socializer, as decision maker, and as knowledge producer. They suggest project-based learning to build these skills. Prerequisite conditions include defining a learning project, defining the appropriate assessment and evaluation rubric, meeting technological requirements, defining an appropriate work grouping mechanism, providing initial support, and training students in the basic functionalities of the selected web tools (Rahimi et al, 2013).

One of the ultimate goals of the personal learning environment is for students to self-regulate the organization of numerous resources into meaningful learning (Turker and Zingel, 2008). Zimmerman (2008) identified the phases students go through when working toward self-regulated learning as forethought, performance, and self-reflection. The processes supporting these phases include goal setting, attention focusing, and self-evaluation (Zimmerman, 2008). Students who are just getting started with personal learning environments do not typically attain full self-regulation (Drexler, 2010). They are, in effect, networked learners in training. The teacher may facilitate goal setting, performance, and self-reflection by integrating these processes within the instructional design. Long-term goals are established at the start of the project. Short-term goals are shared each day. Students perform based on assignments and guidance from the teacher. Self-reflection may take place through student blogs or journals. Therefore, the process of taking control and responsibility for learning is scaffolded by practicing digital literacy and responsibility, organizing content, collaborating and socializing, and synthesizing and creating (Drexler, 2010).

Implications for Policy and Practice

Implications for practice include varied teacher perceptions of PLEs, the negotiation of student and teacher roles, and the challenge of scalability. Policies currently in place may not support the freedom necessary for students to effectively construct PLEs.

Teacher practice may change significantly as they facilitate student construction of personal learning environments. A seventh grade science teacher who used a PLE approach with his students reflected that he could not imagine returning to the way he previously taught (Drexler, 2010). This teacher was already known for his constructivist teaching style, at the same time, he had numerous conversations with other teachers at the school, most of whom would not consider a networked learning approach. Each expressed concern about the reliability of technology and time constraints that resulted from dealing with the technical difficulties. Teachers also worried about student behavior, access to inappropriate materials, and general lack of control (Drexler, 2010). Teacher concerns can be mitigated through a clear implementation plan that considers preparation, implementation, and reflection activities (Rahimi et al., 2015). Teachers can support students by scaffolding the PLE process across grade levels and in different subject areas (Rahimi et al., 2015).

The roles of the teacher also change drastically in this environment. There is often little, if any, lecture, considerable technology trouble-shooting, and frequent one-on-one or small group facilitation. Student success depends on his or her motivation but also greatly on the strategic guidance of the teacher, requiring teachers to establish a balance between student choice and academic rigor (Netcoh, 2017). The teacher's ability to gauge a student's understanding and progress are key to achieving the delicate balance between student autonomy and teacher intervention (Drexler, 2010). The role of the student shifts to that of content producer, socializer, and decision maker (Rahimi et al., 2015). Adopting a networked learning approach requires considerable teacher professional development and a philosophy that is often different from that of most current educators. The implications of the latter on the potential of networked learning are far reaching.

The scalability of networked learning is dependent upon changes in school policies, hiring practices, and pre-service teacher education. Some teacher concerns are the result of a system in which strict policies, high stakes testing, and a desire for control constrain teacher autonomy. Others are the result of roles that are ingrained in teachers through their personal school experiences and further reinforced in most pre-service education programs.

Current school policies often hinder the success of a PLE design. Many schools have responsible or acceptable use policies (AUP) that restrict student access to devices, tools, and social sites with learning potential. Often, many websites are blocked. Leadership support is not enough, network administrative support is critical to monitor student access to websites and support teachers who ask that certain sites be unblocked.

Applying personal learning environments on a school or district-wide basis requires sweeping changes in policy, the assumption of greater risk, and support of teacher professional development. Parents and community members should be part of the conversation leading to these changes. How does the school or district balance access with safety? What is their real liability? How are students made aware of expectations? What kind of training is effective for teachers? How much technology integration is expected as part of the job requirement?

Assessment may also pose a challenge. It is not clear how networked learners will perform on standardized tests for accountability, a complex political issue in many states. Many of today's teachers are explicitly and implicitly encouraged to build their curriculum around these standardized assessments. Even those who do not teach to the test are mindful of the need for their students to show progress. Because of the political implications, networked learning and the construction of personal learning environments may have greater chance for implementation in non-traditional schools.

A blended approach, one that combines the best of face-to-face with online instruction, may be a more effective outlet for a networked learning design. Time spent face-to-face with students can be used for collaboration with other students and individual guidance from the teacher. The student is then free to focus time outside of class on Internet research, communication with experts and peers around the globe, and building the personal learning environment. A guided approach in a blended environment facilitates independent learning (Cavanaugh, 2009). Furthermore, students learn how and when to ask for guidance creating a foundation on which 21st century students can build life-long learning skills.

One of the most important design implications is the need for deliberate scaffolding of the processes needed to construct a personal learning environment. Similar to guided inquiry (Mayer, 2004), the student construction of PLEs is best facilitated with strategic guidance from the teacher. A blended learning delivery may provide a better outlet for a networked learning design. Furthermore, most students who use their own computers in a blended or online learning environment have less restricted access to Internet resources at home than at school. While this may bring up issues of Internet safety and privacy, it also offers increased direct access to many educational applications that could be inadvertently blocked by the school network.

There is also potential for implementation of networked learning in a fully online virtual school. One benefit of online learning is the access it provides to a wider range of courses (Cavanaugh, 2009). Implementing networked learning for the student construction of personal learning environments extends study to any topic. Teacher facilitation and guidance is still a requisite part of the process, but could be conducted easily in the online environment through synchronous and asynchronous means. Again, virtual school relies on network access from a remote location. If the student is learning from home, there are fewer concerns about restrictive filtering. Parents could monitor online behavior as necessary and even support the student's efforts along with the teacher.

Implications for Research

The construction of personal learning environments, particularly in the K-12 schooling, is limited (Horizon Report, 2009). More work is needed across multiple subject areas and grade levels, including the exploration of processes that support the construction of PLEs. This research will inform the manner in which students adopt greater self-regulation and management of networked learning. Such studies have the potential to determine how design is affected by age of student or how design might change for a math or literature inquiry versus science. Longitudinal studies are needed to fully determine whether students eventually take greater responsibility for the learning process over time. Will the student become self-directed or continue to look to the teacher for guidance? At what point, if any, will a student take over full control of the learning process? Given the entire Internet for potential resources, will students seek out every learning node possible, or will they continue to revert to the easiest search method, stopping at the first answer they encounter? Without teacher intervention, will students continue to focus on the resources with which they are most comfortable? How hard will they try to form new connections? Design thinking (Brown, 2009), a concept originally conceived for business product-design shows promise in classrooms (Goldman et al., 2009) and may begin to address some of these questions.

Design thinking is human-centered, action-oriented, and mindful of process (Goldman et al., 2009). The personality traits of a design thinker include empathy, integrative thinking, optimism, experimentalism, and collaboration (Brown, 2009). The general idea is to think about design from an end-user and big picture perspective. Consider what the user needs and begin building with ongoing prototyping to test ideas and adjust. Brown (2009) refers to this as building to learn. In effect, students who design personal learning environments are building to learn, and these learning structures are easily shared online. Perhaps if students view the personal learning environment as a creative process from which others can learn, they will attend to the quality of work, be mindful of process, and explore the supporting content in greater depth. Further research is needed to determine whether applying a design thinking process has an impact on self-direction or the depth at which students apply the research process to their personal learning environments.

Assessment is another consideration. Outcomes data is frequently challenged by the means by which educators measure student success. Are standardized test scores a valid or accurate measure of the quality of personal learning or are we in need of alternative assessments that focus on the 21st century skills required to navigate in this environment? Further research is required to address this question and to determine the best means of assessment. Perhaps there is more to measure than simply content knowledge? An assessment of a student's ability to effectively execute each of the processes identified in this study may serve as a better assessment goal. Developing a set of competencies within each process and measuring the student's ability to perform is the first step toward acknowledging personal learning as a valuable 21st century skill. The student first works toward a process goal "perfecting the form or procedure that the skill involves without regard to the outcome, then shifting attention to the product goal once the procedure is more automatized" (Ormrod, 2008, p. 526).

Networked learning has implications for teacher roles and professional development. Creating a learning environment with a culture that supports student autonomy could be challenging within the cultural myths of a traditional classroom. Taylor et al. (1997) identified these myths as (1) the objectivist view that scientific knowledge embodies universal truths that can be known or discovered and (2) the perceived need to control the classroom environment and view "curriculum as a product that needs to be delivered" (Taylor et al., 1997, p. 295).

A teacher-focused perspective fails to consider the "major cultural restraints that can counteract the development of constructivist learning environments" (Taylor et al., 1997, p. 293). Taylor et al. (1997) suggest taking a critical view of constructivism that addresses the cultural perceptions of the learning environment. Open discourse between teacher and student provide a learning environment that is empowering and negotiable.

Administrators should consider whether it is even possible, practical, or prudent to require teachers to change their teaching paradigms to adopt a networked learning approach. Such a radical departure from traditional curriculum and pedagogy will require teacher buy-in. Even in an organization in which the culture supports innovative programming, teachers will need ongoing mentoring and support. A cognitive apprenticeship model in which less experienced teachers practice with the guidance of those who have already implemented networked learning is likely a more effective approach to professional development. Similar consideration is warranted for pre-service teaching programs. Providing opportunities for pre-service teachers to experiment with network learning from both a teacher and learner perspective may influence the likelihood they will apply these techniques in their future classrooms.

Research suggests pre-service teachers who experience educational technology courses designed around 21st century skillsets rather than technical skills see greater value in the use of technology for learning and are less anxious about using it in the classroom (Lambert & Gong, 2010). Pre-service and in-service teacher change requires a mindset in which technology is critical for effective student learning (Ertmer & Ottenbreit-Leftwich, 2010). Teacher education and professional development must also address knowledge of how to use technology to affect learning, confidence or self-efficacy for successfully implementing technical knowledge, pedagogical belief, and a culture in which innovation is supported (Ertmer & Ottenbreit-Leftwich, 2010).

The explosion of alternative delivery methods such as online and blended learning models offers new outlets for the networked student. If, when, and how students and teachers choose to take advantage of these opportunities will define the future of networked learning and personal learning environments within the structure of school. However, the nature of personal learning is such that students with Internet access can choose to participate without that structure. Their success may depend on how well they have been prepared in the processes that support learning in an ever-changing increasingly networked world.

Conclusion

Many K-12 schools are slow to facilitate digital literacy and digital responsibility. Some also fail to acknowledge the consequences this could have for students in a future where networked learning is crucial for success in work and life. The

Internet with its learning potential and possible pitfalls is a reality of everyday communication and work life. We do our children a disservice when we do not prepare them to responsibly navigate and harness this resource for learning. Greater access to mobile devices and wireless networks will eventually render the point of site-based filtering moot, as students will reach any content they desire directly from their smart phones. Greater restrictions are not the answer. Direct instruction, communication of expectations, and community support are critical. Yet these efforts are not possible without significant changes in pre-service teacher education, professional development, administrative policies, and community awareness.

The limited research on personal learning environments in K-12 indicates the need for deliberate scaffolding of student construction of PLEs to support learning objectives and provide a foundation for safe, responsible life-long learning beyond the classroom. The implications for delivery, student learning, teacher professional development, and policy must be considered and addressed before personal learning environments can be effectively scaled beyond the few experiments currently taking place among a limited number of classroom teachers.

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12

Research on At-Risk Learners in K-12 Online Learning

Jeanne B. Repetto, Carrie J. Spitler, & Penny R. Cox

Abstract

Students who fail to graduate high school with a diploma or its equivalent set in motion a pattern of low wages, poor health, and risk of incarceration that will impact their future quality of life. This pattern negatively impacts society with fewer wage earners, lower taxes, and less spending, along with a strong potential of needing to support these students through some form of welfare. Due to its flexible scheduling, individual mentoring, safe communities in which to learn, and varied methods of teaching, online learning has shown promise as a conduit to engage at-risk students in learning so that they stay in school and earn a diploma. In this chapter, research along with essential strategies that allow online programs to meet the needs of at-risk learners to improve their educational outcomes are presented. Additionally, implications for policy, practice, and future research are discussed.

Introduction

Students who are able to remain in high school to earn a diploma significantly increase their quality of life. Financially, high school graduates will earn $260,000 more than high school dropouts (Statistic Brain, 2017). Data collected by the National Center for Education Statistics (NES, 2016) showed that in 2015, young adults, 25-34 years of age, with a high school diploma or its equivalent, earned 22% more than youth who exited high school without a diploma. Not only will students without a high school diploma earn less, they also will have a harder time securing a job, as 90% of all jobs in the United States require, at the very least, a high school diploma (Statistic Brain, 2017).

The impact of not earning a high school diploma or its equivalent initiates a depressed economic pattern that continues to widen over time, as students who do not earn a high school diploma or its equivalent are not qualified to enter higher education to earn an advanced degree. This failure to complete school directly impacts future earning potential. Youth earning a bachelor's degree consistently have displayed a pattern of higher median incomes than those without a higher education degree (Aud, Fox, & KewalRamani, 2010; Aud & KewalRamani, 2013; NCES, 2014). Therefore, at a young age, students who do not complete school are making choices that ultimately will impact their futures.

Related factors contributing to a lower quality of life for dropouts are found in such areas as crime, poverty, and health. In fact, dropouts have committed 75% of the crimes in the United States, and subsequently, 60% of all dropouts who are black have spent time in the prison system (Statistic Brain, 2014). The rate of high school completers living in poverty is 24%, while the poverty rate for non-completers is 31% (Aud & KewalRamani, 2013). Finally, high school completers and youth with advanced degrees report an overall higher rate of good or excellent health than high school non-completers (Aud & KewalRamani).

Society also shoulders the impact of high dropout rates by fewer or lower wage earners who pay lower taxes and have less income to spend. Additionally, higher crime rates and time spent in the prison system mean that society must foot the bill to prevent the crimes and pay for the prisons. High poverty rates and poor health burden society with supporting potential welfare and Medicaid recipients. According to the Alliance for Excellent Education, non-completers experience higher unemployment, more government assistance, and greater time in the prison system than high school completers (Zvoch, 2006).

Profile of Students At-Risk of Exiting High School Prior to Graduation

McFarland, Stark, and Cui (2016) reported various statistics related to high school dropout rates. For the 2012-2013 school year, the Average Freshman Graduation Rate (AFGR) estimated that the number of 9th graders who graduated high school within four years was 82%. The status dropout rate representing the number of students, 16 through 24 years of age, who were not in school and had not earned a high school diploma or its equivalent, declined from 12% in 1990 to 6.8% in 2013. In 2013, the status dropout rates for students classified in the ethnic backgrounds of White, Black, and Hispanic were 5.1%, 7.3%, and 11.7% respectively (NCES, 2016). Event dropout rates, showing the proportion of students leaving school in any given year, for grades 9 through 12 during the 2012-2013 school year were less than 4.7%, indicating a pattern of increasing dropout as grade level increased.Graduating high school with a diploma as the reward can be navigated for the vast majority of students, even with its typical challenges. However, for some students the challenges to staying in school seemingly are too overwhelming to overcome. The National Dropout Prevention Center Network (2014) categorizes situations impacting student decisions to leave school early into four groups: (a) school related, (b) student related, (c) community related, and (d) family related. Specific examples of each type of situation are presented in Table 1. Additional risk factors that increase the likelihood of students leaving school have been identified by The Southwest Educational Development Laboratory, and include (a) being raised in a single-parent family, (b) identification as a second language learner, (c) having a disability, (d) having a teenage pregnancy, and (e) drug abuse (Tompkins & Deloney, 1994). When asked their reasons for leaving school, students with disabilities said they disliked school, did not get along with teachers, had poor work habits, and did not think school was preparing them for their future work (Dunn, Chambers, & Rabren, 2006; NLTS-2, 2005). For many students, it is often a combination of multiple risk factors occurring over time that cause them to leave school prior to graduation (Frymier & Gansneder, 1989).

Cyber learning environments appear to be a perfect venue to engage at-risk learners in school. Online learning has the potential to offer flexible scheduling, individual mentoring, safe communities in which to learn, and varied methods of teaching (Repetto, Cavanaugh, Wayer, & Liu, 2010; Rose & Blomeyer, 2007; Shore & Shore, 2009). The growth of online learning has become a standard component of K-12 schools with 75% or more of school districts having made online and blended learning options available to students for the SY 2013-14 (Watson, Murin, Vashaw, Gemin, & Rapp, 2013). In addition, many states have passed laws recommending or requiring that students must complete at least one online course prior to graduation (Kennedy & Archambault, 2012). This availability makes online and blended learning options a central component when planning dropout prevention programs.

The initial focus of online learning was on advanced placement students (Watson & Gemin, 2008). However, with a vast majority of school districts in the United States offering students online or blended courses (Picciano & Seaman, 2010), the focus has broadened to include opportunities for all students (Cavanaugh, Repetto, Wayer & Spitler, 2013). This expansion is the result of programs extending their mission to include credit recovery and closing the achievement gap, along with meeting the needs of specific groups of students, including at-risk populations (Liu & Cavanaugh, 2011; Rose & Blomeyer, 2007; Picciano & Seaman; Watson & Gemin; WestEd, 2008). Yet, foremost and fundamental to any work with at-risk students, must be their timely identification. Online school personnel have been able to identify at-risk learners in a variety of ways, including (a) assessment, (b) self-reported academic information, (c) attendance records, (d) demographic data, (e) home school referrals, and (f) teacher communication. Once identified, at-risk students may elect to enroll in online or blended courses, as they offer them the opportunity to (a) re-engage in school, (b) take state exams, and (c) meet graduation requirements (Watson & Gemin). To this end, cyber schools have begun to develop specific programs that incorporate strategies designed to support at-risk students to increase their rate of course completion, such as teacher mentors, individualized instruction, and specialized instructional strategies (Archambault et al., 2010).

The purpose of this chapter is to review the research on at-risk learners in online learning and discuss future directions needed to support at-risk learners in online learning. The following sections will review current research and evidence-based practices for students at-risk in online learning. Finally, implications for policy, practice, and future research will be discussed.

Table 1. Situations impacting student decisions to leave school early.

Type of Situation	Examples
School related	Disregard of student learning styles Ineffective school discipline system Low expectations Negative school climate
Student related	Behavior problems Dislike of school Drug use Friends who have dropped out Identified disability Low ability level Poor attendance/truancy Poor peer relations Poor school attitude
Community related	Lack of community-based support services Lack of school/community linkage
Family related	Dysfunctional home life High mobility Lack of parent involvement Low SES

(Dunn, Chambers, & Rabren, 2006; National Dropout Prevention Center Network, 2014; NLTS-2, 2005; Tompkins & Deloney, 1994) Note: SES = socioeconomic status

Research Synthesis

Including learners at-risk in online learning is in its infancy. For this reason, the research base is limited with studies just beginning to be conducted. The International Association for K–12 Online Learning (iNACOL) research committee on at-risk learners in online learning reached a similar conclusion addressing the lack of research in this area with recommendations for areas to be addressed by future researchers (Archambault et al., 2010). The limited research in this area is an indication of an emerging field of study.

Distance education advocates have stressed the importance of data collection, analysis, and reporting on the educational experiences of specific populations of online learners (e.g., at-risk students, students with disabilities) (Cavanaugh et al., 2013; Repetto et al., 2010; Rhim & Kowal, 2008). Yet, empirical research examining at-risk students in online and blended learning environments is limited. These data are critical to the future success of online and blended learning programs for students at-risk of dropping out.

A search of refereed, research-based articles was carried out by entering combinations of the following terms: at-risk students, elementary and secondary schools, virtual and/or cyber classrooms, and online learning into multiple databases, including Academic Search Premier, PsycINFO, Sage Premier and ERIC. The aforementioned searches yielded limited results ranging from zero to 24 articles. Of the 24 articles, only one covered research directly related to at-risk learners in online learning. This article reported on a case study of an at-risk student in rural Newfoundland. Data were collected through student interview and video observations. Researchers concluded from the data analysis that the student understood the tasks needed to complete the online course and was able to prioritize these tasks. However, the student often did minimal work and was hindered by limited home-based technology. Since this is a single student case study, caution should be taken not to generalize the findings (Barbour & Siko, 2012).

As previously discussed, students identified as at-risk often include students with disabilities (Repetto et al., 2010; Spitler, Repetto, & Cavanaugh, 2013). Therefore, it is relevant to discuss the limited research related to students with disabilities in K-12 online programs. Spitler et al. (2013) conducted a utilization-focused evaluation in order to determine the presence of and application of evidence-based effective practices for at-risk learners in a special education program in a public cyber charter school. Results from the study indicated that the core values of the cyber charter school, as well as the specific design of the special education program, encompassed the evidenced-based practices as a means for increasing school completion for all students, especially students with disabilities.

The purposes of the study by Spitler (2013) were to determine (a) the characteristics of transition planning practices in public cyber charter schools by exploring the extent that the transition components of the IEPs reflected compliance with the transition mandates of IDEA 2004 and incorporation of evidence-based practices in transition; (b) the impact of individual demographic characteristics (i.e., disability category, racial/ethnic background, gender, and grade level) on the transition planning practices in public cyber charter schools; and (c) the relationship between compliance with the transition mandates of IDEA 2004 and incorporation of evidence-based practices in transition. The sample for the study included 236 IEPs of students with disabilities between 14 and 21 years of age, who had attended a public cyber charter school in Pennsylvania during the 2012-2013 school year. Results provided original findings related to educating and preparing students with disabilities in online environments for post-school activities.

Although data showed that the public cyber charter schools were doing well with regard to some transition component requirements, the majority of IEPs did not meet the minimum standards, which are equivalent to full compliance. As such, Spitler recommended professional development to address specific areas of need, including but not limited to (a) writing measurable post-secondary goals, (b) describing the required transition services and how they can be provided to students, and (c) training in transition planning practices for students of culturally and linguistically diverse backgrounds, disability categories, and gender. Further findings indicated that evidence-based practices in transition have been incorporated into transition planning practices in public cyber charter schools at approximately the same level as they are in traditional school settings. Yet, some areas for special consideration emerged from the study including (a) paid/unpaid work experience; (b) functional, daily living skills training; (c) self-determination training; and (d) community/agency collaboration. A student's disability category, racial/ethnic background, gender, and grade level were found to be influencing factors that increased or decreased the probability of an IEP being compliant or incorporating evidence-based practices. A moderate correlation was found between the compliance and evidence-based practices composite scores, indicating that as the level of compliance increased, so did the level of incorporation of evidence-based practices.

Implications for Policy and Practice

Implications for policy and practice for at-risk learners in online learning will be discussed in this section. Although these topics are discussed separately they are very connected to each other. For example, expanded professional standards need to be developed before teacher education programs can include these additional competencies in their curricula.

Policy

Expansion of professional standards.

The *National Standards for Quality Online Teaching* were created, and subsequently revised by the International Association for K-12 Online Learning (iNACOL). The standards were designed to provide states, districts, online programs, and other organizations with a set of guidelines that highlight the skills educators must possess in order to effectively teach in online environments (iNACOL, 2011). Likewise, the Council for Exceptional Children (CEC) also has developed standards to guide teacher preparation programs and certification. Theses professional standards include the requisite skills for special educators to work with students with various disabilities (e.g., learning disabilities, emotional and behavioral disorders) and across disabilities (e.g., content standards, transition specialists) (CEC, 2009; Repetto et al., 2010). However, the standards fail to mention the skills needed to develop or provide accommodations for students with disabilities in online or blended learning environments. Current Professional Standards from both iNACOL and CEC should be expanded to address the needs of at-risk learners in online learning. Additionally, these two professional organizations should collaborate to develop a set of coordinated professional standards.

Support for evidence-based practices.

For students who receive special education services and supports, federal legislation has been amended to require "the use of scientifically based instructional practices to maximum extent possible" (IDEA, 2004, 20 U.S.C. § 1400 et seq.). More recently, the Every Student Succeeds Act (2015) also addresses the requirement for evidence-based instructional strategies. In addition, given the current legislative focus on accountability, it is imperative that educators take advantage of the time they have with students with disabilities by incorporating evidence-based practices into all education activities and programs (Landmark, Ju, & Zhang, 2010). Unfortunately, because many evidence-based practices have not been mandated by legislation, research has indicated that evidence-based practices have not been implemented widely, and as a result, the majority of students exiting high school remain unprepared and unsuccessful at achieving positive post-school outcomes (Landmark & Zhang, 2012). As such, these findings can inform and encourage policy-makers to create policies that will guide administrators and educators toward full and uniform implementation of all identified evidence-based practices in activities and programs designed to support specific groups of students.

Practice

To meet the needs of at-risk students, online learning environments should be designed with evidence-based strategies geared toward meeting their unique needs. However, due to the lack of studies of at-risk students and online and blended learning programs, this section begins with a review of practices that have been researched and considered evidence-based methods for engaging at-risk learners in traditional school settings, and subsequently in online settings. Reviewed next, are teacher preparation programs, professional development, and program and course design that will promote the inclusion of at-risk students in online and blended learning programs. Overall, this section of the chapter will discuss the practical implications of these topics as they relate to at-risk students.

The 5 Cs of Student Engagement Framework.

Repetto et al. (2010) considered the factors that influence school completion rates for at-risk students and classified them into five broad themes. First, students need to be able to *connect* current learning in school to the knowledge and skills they will need post-school. Second, students need to be provided with a safe and supportive *climate* for learning. Third, students need to understand and learn how they are in *control* of their own learning and behaviors. Fourth, students need an engaging *curriculum* grounded in effective instructional strategies and evidence-based practices to support their learning.

Fifth, students need to be part of a caring community that values them as learners, as well as individuals. Thus, *The 5 Cs of Student Engagement Framework* (5 Cs), depicted in Figure 1, was conceptualized as an active framework set forth to provide education personnel with a framework for determining and/or analyzing practices, grounded in research, that garners potential to improve the educational outcomes of at-risk students. These five broad themes interrelate and influence each other in order to provide a learning environment, be it face-to-face, blended, or online, equipped to support all students.

The initial conceptualization of the 5 Cs was completed through an analysis of evidence-based practices in special education literature (Repetto et al., 2010). Later, to ensure that the identified themes were supported across multiple disciplines, an analysis of the 5 Cs in general education and distance education literature was completed (Spitler et al., 2013). As a result, evidence that the 5 Cs impact practice and improve educational outcomes has been confirmed across the three literature bases. The following sections will discuss individually each of the 5 Cs in detail. Specifically, each section will include (a) a synthesis of the major findings from the special education, general education, and distance education literature, (b) a discussion of the application of the theme in an online learning environment, and (c) specific program examples.

Figure 1: The 5 Cs of Student Engagement Framework

Connect. Researchers in the field of education from both general and special education have attempted to define the goals of education (Phelps & Hanley-Maxwell, 1997). While one goal certainly is to ensure learning by all students, academic achievement is not the only measure of whether or not an education has been effective. The primary goal of education for all students is successful integration into the adult world. Therefore, researchers have determined that it is essential to the goals of education that students are able to see that there is a connection between their current concerns and/or learning objectives, as well as their post-school goals (Bradshaw, O'Brennan, & McNeely, 2008; Dunn et al., 2006; NLTS-2, 2005; Repetto et al., 2010; Cavanaugh et al., 2013; Spitler et al., 2013).

Special education literature has indicated that formal transition planning practices that incorporate "the use of scientifically based instructional practices, to the maximum extent possible" (IDEA, 2004, 20 U.S.C. § 1400 et seq.) might help students to achieve this connection through a process of evaluating future goals and developing a plan to achieve them (Kohler, 1993; Repetto, Webb, Neubert, & Curran, 2006). Likewise, general education literature has documented greater student engagement for students who perceived the future career relevance of school (Greene, 2003; Orthner et al., 2010; Perry, 2008). These findings directly link to those in distance education literature that have identified that, with higher perceived relevance, student satisfaction with school increases (Hannafin, Hill, Oliver, Glazer, & Sharma, 2003). Although it has been posited that students in any type of learning environment need to recognize why school is important, it is fundamental for the more independent task of learning online (Keller, 2008). The literature has indicated that students who believe in the relevance of school have higher motivation to remain in school (Keller).

It is feasible for instructional designers and online educators to apply the theme of *connect* to online learning environments. The relevance of learning can be enhanced for all students when connections are made between current interests, post-school goals, and the selected curriculum (Carpenter & Cavanaugh, 2012). In fact, recent research has found that public cyber charter schools have been forging connections for students to both post-school employment and education opportunities by implementing formal programs that address several of the identified evidence-based practices in transition (e.g., employment preparation program participation, general education inclusion, and self-determination training) (Spitler et al., 2013; Spitler, 2013).

Through a utilization-focused evaluation, Spitler et al. (2013) found that the theme of *connect* successfully was incorporated as part of the design of the special education program, including that current learning needs were connected with post-school needs related to transition goals. Spitler (2013) completed a document review in order to determine the characteristics of transition planning practices in public cyber charter schools. Results indicated the public cyber charter schools were providing students the opportunity to engage in employment preparation. In fact, 89% of the IEPs reviewed provided evidence that students had participated or planned to participate in a program. This finding was encouraging, as previous studies have found that students who participated in an employment preparation program had a higher probability of employment (Baer et al., 2003; Colley & Jamison; Hasazi, Johnson, Hasazi, Gordon, & Hull, 1989) or engagement in post-secondary education (Benz, Yovanoff, & Doren 1997; Wolff & Kelly, 2011). However, other results were not as positive. The results revealed a lack of annual goals that supported post-secondary goals. For the targeted outcome areas of education/training, employment, and independent living, 17%, 28%, and 48%, respectively, of IEPs did not have at least one annual goal to support the post-secondary goal. Therefore, it was concluded that the public cyber charter schools most likely have not realized the fundamental connection that needs to exist between these two types of goals, and subsequently, the connection that needs to exist between what students currently are learning and their post-school goals.

Climate. Students identified as at-risk are able to thrive in a learning environment that places emphasis on safety and support, as well as data-driven instruction. Thus, a caring climate at school might counteract a student's unstable life away from school (Repetto et al., 2010). In fact, special education literature has identified several protective factors that schools are able to provide to reduce the individual, family, and community factors that might put students at-risk for dropping out, including (a) providing a positive learning environment, (b) setting high, yet achievable, academic and social expectations, and (c) facilitating opportunities for success (Christle, Jolivette, & Nelson, 2007). For students with disabilities, encouraging an inclusive learning environment is key, as students are allowed access to the general education context (i.e., the least restrictive environment), as well as the general curriculum (Test, Fowler, White, Richter, & Walker, 2009). Cavanaugh et al. (2013) have posited that a school climate accepting of a diverse student population fosters student motivation to remain in school. In addition, researchers in the field of general education have suggested that creating a positive social-emotional learning environment allows students to develop the confidence that they need to achieve academic success (Archambault, Janosz, Morizot, & Pagani, 2009; Steinberg & Allen, 2011).

For online learning environments, a safe and supportive climate can be facilitated by fairly and uniformly enforcing rules and procedures across courses and ensuring that they meet local, state, and/or national norms (Liu & Cavanaugh, 2011). In addition, it is imperative that online learning environments cultivate a sense of community by ensuring that the needs of school administrators, educators, staff, students, and their families are met (Christle et al., 2007; Menzies & Lane, 2011; Rovai, 2002). Spitler et al. (2013) found that this theme was represented in the special education program of a public cyber charter school through the accommodations and modifications provided to students based on their individual needs. In addition, online educators routinely considered the interests of students when designing their instruction and classroom activities.

Control. At-risk students need to receive instruction on targeted academic, social, and behavioral interventions that will afford them the knowledge to take control of their learning and behaviors (Cobb, Sample, Alwell, & Johns, 2006; Institute of Education Sciences, 2008). As such, thoughtful incorporation of evidence-based practices remains fundamental in allowing students to participate actively in controlling their learning and behaviors. Self-determination (Eisenman, 2007) and cognitive behavioral interventions (Cobb et al., 2006; Deshler & Schumaker, 2006) are useful practices promoted in both special education and general education literature that have been proven to be helpful to students in all aspects of their lives.

Although self-determination training has not been mandated by IDEA 2004 as a requirement in specialized programming, Spitler (2013) found that 53% of IEPs of students from the participating public cyber charter schools indicated that students were receiving self-determination training or had appropriate self-determination skills. During self-determination training, students receive explicit instruction on a variety of skills that might include (a) decision-making; (b) problem solving; (c) goal setting; (d) self-observation, evaluation, and reinforcement; and (e) student-directed learning (Cobb et al., 2006; Deshler & Schumaker, 2006; Johnson, 1998; Wehmeyer, 2005; Wehmeyer & Field, 2007). Therefore, the theme of control can be applied to online learning environments by ensuring that all students are given access to self-determination training. With this type of training, students will develop a greater understanding of their role as online students (Ferdig, Cavanaugh, DiPietro, Black, & Dawson, 2010), as well as enhance their self-advocacy skills, allowing students the ability to take control of their learning and behaviors. However, it also is important that online educators develop their own understanding of self-determination. Online educators should receive professional development on self-determination with emphasis placed on how it can be incorporated into academic instruction.

Curriculum. Students experience improved engagement with the curriculum when courses are designed with student needs and interests in mind (Christle et al., 2007). In addition, learning opportunities are enhanced when knowledge and skills can be generalized across a variety of content areas and contexts (Bost & Riccomini, 2006; Margolis & McCabe, 2003). This is especially true for at-risk students who have an identified disability. Special education literature has indicated that students at-risk for dropping out require more frequent monitoring, as well as evidence-based interventions (Bost & Riccomini; Daniel et al., 2006).

Evidence-based instructional strategies and differentiated instruction designed to meet individual student needs must be built into the curriculum (Bost & Riccomini; Hoover & Patton, 2004; Repetto et al., 2010). The use of effective instructional strategies, including (a) increasing academic time on task, (b) focusing on teaching content, (c) employing varied student groupings, (d) scaffolding learning, and (e) assisting students in becoming independent learners has proven to produce a number of positive outcomes (Bost & Riccomini; Institute of Education Sciences, 2008). Aside from direct instruction, students also need to be challenged to connect, and remain connected, to current learning through inventive academic activities (Bost & Riccomini; Johnson, 1998).

Recent research has found that essential elements of instructional design, which directly impact course usability by students with disabilities, are present in the majority of contemporary online and blended courses (Keeler & Horney, 2007). Thus, online learning options might resolve past issues that could have prohibited participation and progress in the general curriculum for some students. For example, a curriculum that is offered on an "any pace" model will allow every student to build independence by supplying an ample amount of time to master specific learning objectives (Repetto et al., 2010). Aside from time, programs also should foster positive interaction and collaboration among students through cooperative learning opportunities incorporated into the curriculum (Beldarrain, 2007; Johnson, 1998).

In their evaluation of the presence of and application of the 5 Cs in a special education program in a public cyber charter school, Spitler et al. (2013) determined that accommodations and/or modifications to a comprehensive curriculum built around core subjects ensured the continuity of instruction for all students. Similarly, Spitler (2013) noted that the vast majority of students were provided access to the general education context and general curriculum. This is crucial to the success of at-risk students, especially those with an identified disability as previous research has shown that students served exclusively in inclusive educational settings, and who exited school with a standard diploma had higher levels of employment one year after school completion (Benz, Lindstrom, & Yovanoff, 2000; Rabren, Dunn, & Chambers, 2002; Test, Mazzotti, Mustain, Fowler, Kortering, & Kohler 2009; Williams-Diehm & Benz, 2008). Additionally, the likelihood of being enrolled full-time in post-secondary education also was greater (Flexer, Daviso, Baer, Queen, & Meindl, 2011). Students were more likely to live independently (Test, Mazzotti, et al.), and to have experienced increased community involvement (Colley & Jamison, 1998), including improved participation in recreation and leisure activities (Williams-Diehm & Benz).

Caring Community. The successful establishment of a caring community is achieved through a school-wide effort (Menzies & Lane, 2011). Research has indicated a strong correlation between learner interactions and engagement, a sense of community, and academic success (Sadera, Robertson, Song, & Midon, 2009). Special education and general education literature have stated that students learn best in an environment that acknowledges and values each student as an integral member of a community of learning (Christle et al., 2007; Repetto et al., 2010). Each student should be considered one of the most important team members, and as such, should always attend and/or contribute to the meetings during which an educational plan/program is developed in order to voice his/her individual needs and interests.

A small number of researchers have begun to examine the effect of parental involvement on student achievement in virtual schools. Distance education literature has acknowledged that students who engage in online learning not only require the support of their educators, but also their parents/family members (Black, 2009; Hasler Waters, & Leong, 2014; Kennedy & Cavanaugh, 2010; Liu, Black, Algina, Cavanaugh, & Dawson, 2010). Many fully online learning programs consider parents/family members to be instrumental in establishing a caring environment conducive to learning (Black), and rely a great deal on them as co-educators (Hasler Waters, & Leong). Recent investigations of the role of familial participation in student achievement in K-12 cyber schools have found that by assuming a shared responsibility of managing their own children that parents/family members' interactions with their children have a positive predictive effect related to improved learning habits, increased motivation, and greater student achievement (Black; Liu et al.).

Spitler et al. (2013) found that the theme of a caring community was well established in the special education program of a public cyber charter school through the existence of a collaborative partnership between the educators, parents, and other school personnel. First, the behaviors of online educators were a significant aspect of creating such an environment. All three bodies of literature have provided examples and evidence of educator behaviors that encourage a constructive learning environment (Johnson, 1998). Second, a vast body of research supports parent/family involvement as an evidence-based practice in special education that impacts student academic achievement and post-school outcomes (Cobb & Alwell, 2009; Fourqurean, Meisgeier, Swank, & Williams, 1991; Lindstrom & Benz, 2002; Test, Fowler, et al., 2009; Test, Mazzotti, et al., 2009). Fourqurean et al. additionally has noted that students whose parents were involved actively in educational planning, as measured by the percentage of IEP meetings that were attended, experienced greater post-school employment stability. Parent/family involvement in educational planning additionally has shown better community adjustment for students with various disabilities (Sample, 1998). This was confirmed in the study conducted by Spitler (2013) who found that 99% of IEPs provided evidence that a parent/guardian had attended the IEP meeting during which transition was discussed. This finding indicates that more often than not, when a parent/guardian attended a meeting, the parent/guardian contributed to the meeting in a meaningful way. Therefore, it has been concluded that at-risk students might receive a great deal of support through interpersonal support from family.

Peer behaviors and interactions are also valuable. Students need to feel a sense of cohesion and awareness of their peers, both with and without disabilities (Abedin, Daneshgar, & D'Ambra, 2010). As such, distance education literature has advocated the use of student mentors for students in online courses (Croninger & Lee, 2001; Institute of Education Sciences, 2008). The importance of interpersonal support provided by peers should not be discounted, because as potential members of a natural support network, they have the potential to contribute greatly to student achievement of post-school activities. Students also benefit from ongoing access to academic and technical support (Borup, Graham, & Drysdale, 2013; Ferdig, 2010b). On-line learning programs might provide this type of support to students through a multitude of means (e.g., academic tutors) that are available virtually, no matter the physical location of the student (Jakobsdóttir, 2008).

Teacher preparation programs.

The exponential growth in K-12 online learning opportunities has necessitated teacher education programs to prepare future educators to teach in online and blended learning environments (Archambault, 2011; Dawley, Rice, & Hinck, 2010; Ferdig et al., 2010; Kennedy & Archambault, 2012; Repetto et al., 2010). In fact, a number of states with considerable public cyber school programs now require additional endorsements that qualify educators to teach online (Repetto et al.). It has been suggested that these endorsement programs include courses that address the national standards for quality online teaching, as well as practicum experiences with educators actively teaching in online and blended learning environments (Kennedy & Archambault; Repetto et al.). Thus, it has been concluded that teacher preparation for online and blended learning environments has a limited emphasis in the preparation of educators prepared to address the needs of students with various disabilities and other learning needs (e.g., at-risk). This lack of preparation has been evidenced in the disclosure of many online educators that have reported little or no experience working with special populations of students in online settings (Rice, Dawley, Gasell, & Flores, 2008). Therefore, it is foremost and fundamental for any future educator slated to work with at-risk students that adequate training in specialized instructional strategies designed to support at-risk students to increase their rate of course completion be provided prior to entry into the cyber classroom (Archambault et al., 2010). To this end, teacher preparation programs need to include in their programs the acquisition of competencies based on Professional Standards for teaching at-risk learners in cyber settings.

Professional development.

Professional development is critical to the success of online and blended learning (Ferdig, 2010a), so much so, that it has been identified as a priority for K-12 distance education (Rice, 2009). Because state agencies and university programs have been unable to meet the growing demands of online educators, the majority of training has been provided by the program, school, or organization with which the educator is associated (Rice & Dawley, 2007). Yet, in order to maintain and expand the knowledge and skills required to effectively teach in online and blended learning environments, educators need continuing professional development while working in the field on topics such as (a) understanding different groups of students (e.g., students at-risk, students with disabilities), (b) identifying at-risk students, and (c) differentiating instruction, which typically have not been part of professional development programs for online educators (Repetto et al., 2010; Rice & Dawley; Rice et al., 2008). Therefore, training to work with special populations might begin with a presentation and description of the 14 disability categories recognized under special education law. Next, online educators might be taught the specific skills necessary to understand the individual needs of students with different disabilities and students at-risk, along with how they are accommodated in a typical brick-and-mortar classroom setting, and how they could be accommodated in an online or blended learning classroom setting. It is imperative that this type of professional development is tailored specifically to the novelty of online learning environments because there are some basic accommodations and modifications not automatically provided to students in a brick-and-mortar environment that are characteristic of education provided in online learning environments (Keeler, Richter, Anderson-Inman, Horney, & Ditson, 2007). As a collective group, online educators have requested professional development in how to customize and/or modify learning objectives and activities, as well as in innovative techniques to supplement the curriculum, more so than brick-and-mortar educators (Rice et al.). The Center on Online Learning and Students with Disabilities currently is researching how online learning can be made more accessible, engaging, and effective for K-12 learners with disabilities, and offers a number of helpful resources for a variety of online and blended learning stakeholders.

Program and course design.

Administrators responsible for online and blended learning programs need to initiate and enforce policies that foster a safe and supportive learning climate, as well as a caring community (Cavanaugh et al., 2013). Aside from the learning environment, online courses should be designed to be both accessible (i.e., all students can access the information and learning resources) and supportive (i.e., supports have been built into the course design, materials, and learning activities) (Keeler et al., 2007; Rose & Blomeyer, 2007). In fact, a lot of resources have touted best practices regarding accessibility issues and evidence-based practices for online courses (Fichten et al., 2009). Instead of designing for a specific group of students, instructional designers might opt to employ the principles of universal design for learning (UDL) (Cavanaugh et al.). The principles of UDL address providing multiple means of presenting content, allowing multiple ways for student interact with content and demonstrate learning, and employing multiple ways to motivate and engage students in learning (National Center on Universal Design for Learning, 2017). The goal of an online course designed with these principles in mind is to be proactive in accommodating the learning needs of all students who might take the course. The strategic design would meet the needs of a broad range of student needs, abilities, instructional preferences, and learning styles. Further, multiple features would be presented as options from which students or educators might select from, allowing the course to be customized for a single learner or for a group of learners (Keeler et al.; Rhim & Kowal, 2008; Rose & Blomeyer). It would be worthwhile for online and blended learning programs to research and develop an instructional tutorial for students new to this context on how to navigate and succeed in online courses (Cavanaugh et al.).

Implications for Research

As a result of the implications placed on policy and practice, the subsequent section describes important topics for future research. As noted previously, limited evidenced-based research exists currently addressing at-risk learners in online learning. Thus, all researchers in the fields of special education and distance education are invited to collaborate on case studies to distinguish the unique experiences of key stakeholders (e.g., students and personnel) in online and blended learning environments and longitudinal research.

Case Studies

Students.

Case studies that describe the educational experiences of at-risk students who have attended cyber schools or have participated in blended learning programs are needed. Specifically, studies examining how this population has been served and/or have functioned in online learning environments need to be added to the body of literature on this topic. This research might focus upon one or more educational aspects, including (a) curriculum, (b) instructional delivery/organization of learning environments, (c) student participation, (d) materials, and (e) assessment. For example, a qualitative analysis of the perspectives of at-risk students who were able to remain in school until graduation might evaluate which of the 5 Cs themes were most helpful to them and why. Additionally, research might focus specifically on peer interactions and relationships between students in online learning environments, and the impact of those relationships on educational and personal aspects of their lives at and away from school. The findings from these studies would extend the extant literature base by providing information regarding the most successful support strategies for at-risk students, some of which might be exclusive to online environments.

Personnel.

Research might investigate the daily experiences and outlooks of administrators, educators, and other school personnel who work in online or blended learning environments with at-risk students. The findings from these studies might inform online learning programs of the types of policies they need to implement, and relevant professional development opportunities that they need to provide to online educators and other school personnel. Fourth, experts need to collaborate to analyze the professional standards and ethics for the fields of special education and distance education to ensure that educators are well-prepared to support the learning of a diverse group of students in online or blended learning environments. For example, experts could review the professional standards developed by iNACOL and CEC to determine how they align with the 5 Cs. These data will ensure that online programs, including individual courses, are designed to meet the needs and interests of special populations, including at-risk students.

Longitudinal Research

Longitudinal data are needed to examine the post-secondary outcomes of at-risk students who have attended cyber schools or participated in blended learning programs. More specifically, studies should address the characteristics of successful online programs to determine if students have achieved their post-secondary goals. Post-secondary data illustrating the outcomes of at-risk students as they move from secondary school into adult roles would contribute immensely to the fields of special education and distance education. Because the number of at-risk students enrolling in cyber schools has been projected to continue to increase in the coming years, these data are crucial to educating and preparing students effectively in online environments. Additionally, information about the similarities and/or differences between the post-school outcomes of different groups of students (e.g., itinerant students vs. at-risk students) might be useful to online programs. This type of data would highlight areas of need for online learning programs regarding particular groups of students.

Research Framework

The 5 Cs Framework has been offered as a critical way for researchers who want to conduct work in this area to consider cataloging their research. This framework pulls together the evidenced-based practices for at-risk learners in brick-and-mortar schools into one overarching framework. Using the 5Cs Framework allows future researchers to compare findings gathered specifically on at-risk students in online learning to all at-risk students. This comparison will help to identify unique needs based in online learning. In addition, the 5Cs Framework can be used to guide research covering at-risk learners in online settings by offering a comprehensive set of components to study.

Conclusion

An emerging body of research indicates that there are numerous benefits to online and blended learning for students who are at-risk of leaving school early (Means, Toyama, Murphy, Bakia, & Jones, 2009; Spitler, 2013). As the popularity of such programs as an alternative to traditional schooling continues to grow, proponents of distance education have begun to look for ways to address the needs of all students in online learning environments (Rose & Blomeyer, 2007). Therefore, the opportunity to build components into these programs that can foster student retention never has been more central to the discussion concerning dropout prevention.

Research has indicated that students who stay in school and graduate with a high school diploma or its equivalent have a greater likelihood of (a) earning higher wages, (b) paying higher taxes, and (c) contributing to the human capital of the country (Alliance for Excellent Education, 2009; Cataldi, Laird, KewalRamani, & Chapman, 2009; NLTS-2, 2005). However, to realize these outcomes, students must receive an education that recognizes their individual needs. Current and future programs need to incorporate practices and strategies that have been grounded in research. In order to do so, it is imperative that online educators are provided with the education and training that they require in order to teach and reach a diverse classroom. For example, professional development that teaches educators how to differentiate instruction for varying needs and interests by employing the principles of UDL has been recommended (Cavanaugh et al., 2013). More specifically, online educators who lack experience with special populations need training that will describe the nature of different disabilities, along with the specialized practices and strategies for instruction that have been proven effective for select students (Repetto et al., 2010).

Because the current literature base is modest, future research must investigate specific aspects concerning how at-risk students are served and are functioning in online and blended learning programs. Although several topics for research previously were suggested, it is imperative that research concerning the post-school outcomes of at-risk students is carried out. For these initiatives, it has been suggested that researchers employ the 5 Cs as a systematic way to organize data. Without longitudinal data, the fields of special education and distance education will have no way of knowing how or whether students are prepared through online or blended learning environments. These data will allow such programs to be equipped better to address the needs and interests of a diverse population of students, and students will be engaged in school, so that they stay until graduation.

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13

Promises and Practices of Online and Blended Learning in the Juvenile Justice System

Kristine Pytash

Abstract

This chapter has three main purposes regarding blended and online learning in the juvenile justice system. First, the chapter provides an overview of the population characteristics of youth who often are in correctional facilities and to explore the features of correctional facilities that make these unique learning spaces. Second, this chapter synthesizes the research investigating how technology has been incorporated into formal learning instruction through computer-based instruction in correctional facilities. And, finally his chapter provides implications for research and policy to provide further directions for technology implementation for online and blended learning in correctional facilities.

Introduction

More than 130,000 adolescents, ranging from 10 to 21 years old, reside in correctional facilities in the United States. Even though recent reports document that juvenile crime has decreased, 1.5 million juveniles are arrested each year and approximately 500,000 are detained (Office of Juvenile Justice and Delinquency Prevention). While being incarcerated, detained, and confined in itself is a negative and traumatic experience, it also has long lasting consequences, particularly as it relates to youth's schooling. Researchers have noted that incarceration and detainment influences youths' school completion rates (Holman & Ziedenberg, 2006; Krisberg, 2005) prompting educators to pay more attention to youths' educational experiences, particularly when incarcerated, detained, and confined.

Correctional facilities are not typically thought of as places where youth receive an education, as the emphasis tends to focus on behavior modification. However, in reality, youth in the juvenile justice system have the same right to a publically funded education as other children. Therefore, correctional facilities for young people are obligated to provide educational opportunities commensurate to what they would receive if they were not in the correction system. While correctional facilities have worked to provide new and engaging educational opportunities, there is a significant lack of research focused about virtual, online instruction in correctional facilities.

Therefore, this chapter has three main purposes. First, to provide an overview of the population characteristics of youth who often are in correctional facilities and to explore the features of correctional facilities that make these unique learning spaces. Second, because there is no research focused on virtual schools in correctional facilities, this chapter will synthesis the research investigating how technology has been incorporated into formal learning instruction through computer-based instruction in correctional facilities. Finally, this chapter will provide implications for research and policy to provide further directions for technology implementation for online and blended learning in correctional facilities.

Youth and Correctional Facilities

Youth in Correctional Facilities

Troubling statistics plague the juvenile justice system, particularly those highlighting the societal maltreatment that surrounds youth in the system. It has been well documented that there is an overrepresentation of minority males in the juvenile justice system (Foley, 2001; Leiber & Fox, 2005; Noguera, 2003; Snyder & Sickmund, 1999; Wordes, Bynum, & Corley, 1994; Wordes & Jones, 1998). While "African Americans account for only about 16% of the total number of adolescents in the United States, they represent over 70% of the youth who are involved in school-related arrests and make up nearly 40% of the total youth currently imprisoned" (Brinkley-Rubinstein et al., 2014, p. 25). As Bernstein (2014) writes, "juvenile incarceration is … one of the most glaring examples of racial injustice our nation has to offer" (p. 8).

In addition, researchers have documented a nearly 50% increase in girls' involvement in the juvenile justice system "with girls accounting for 29% of all juvenile arrests" (Leve, Chamberlain, & Kim, 2015, p.252). Numerous studies document that girls involved in the juvenile justice system are typically victims of abuse, particularly physical and sexual abuse (Moore, Gaskin, & Indig, 2013). In fact, Chensey-Lind and Shelden (2004) described incarcerated girls as "in flight from sexual victimization at home" (p. 41).

Additional troubling statistics include the fact that approximately 50-75% of youth in detention centers have diagnosable mental illness (Liss, 2005). These issues are couple with the understanding many adolescents enter the juvenile justice system with significant life challenges, including a wide variety of academic, social-emotional, health, and behavioral needs, all of which have implications for instruction in this unique setting (Foley, 2001; Keith & McCray, 2002).

Finally, being incarcerated or detained does not usually produce the so called *correctional* effect the euphemistic name would suggest. Instead participation in the justice system influences young adults' school completion rates, as well as their recidivism rates. In order words, a likely outcome is that these individuals will be rearrested, convicted, and return to prison later in youth and in adulthood (Holman & Ziedenberg, 2006; Krisberg, 2005).

Correctional Facilities: Unique Learning Spaces

It should also be noted that the term "correctional facilities" encompasses wide range of types of facilities. These include, long-term youth prisons, short-term juvenile detention facilities, and residential treatment facilities. Each of these facilities has a unique purpose; therefore, it is important to recognize that educational experiences, challenges, and characteristics may differ based on the facility. What follows is an articular of some characteristics and challenges that may generally apply.

While all schools educate students of varying abilities, young offenders with disabilities are overrepresented. In fact, researchers have estimated that between 30% and 60% of youth in correctional facilities require special education services (Quinn, Rutherford, Leone, Osher, & Poirier, 2005). Other research has demonstrated that incarcerated youth are an average of two years behind their peers in reading (Drakeford, 2002; Foley, 2001; Harris, Baltodano, Bal, Jolivette, & Mulcahy, 2009; Houchins, Jollvette, Krezmien, & Baltodano, 2008; Malmgren & Leone, 2000; Rogers-Adkinson, Melloy, Stuart, Fletcher, & Rinaldi, 2008; Vacca, 2008). Reading text at grade level is not the only academic difficulty that these young people have been found to have. Gagnon & Barber (2010) also noted students involved in the juvenile justice system also may be below grade level in math. While correctional facilities are required to ensure that youth have access to the same resources they would in traditional schools, Gagon et al., (2009) found most administrators in correctional facilities believe grade-level expectations should not apply. This ideology is in direct contradiction of federal policies such as the Individuals with Disabilities in Education Act (IDEA, 2004) and the No Child Left Behind (NCLB) legislation that are supposed to ensure all youth have access to a rigorous education curriculum (Gagon et al., 2009).

While most educational administrators in correctional facility schools view their responsibility as helping students earn a high school diploma (Gagon, Barber, Van Loan, Leone, 2009), it has been reported that youth, both with and without identified disabilities, typically do not return to high school after being in a correctional school or earn a diploma (Criller-CIark, Rutherford, & Quinn, 2004; Haberman & Quinn, 1986). For example, Leve et al. (2013) found that only 12% of youth involved in the juvenile justice system received their high school diploma or GED as young adults, influencing their ability to gain employment (Holman & Ziedenberg, 2006; Krisberg, 2005).

In addition to the unique learning experiences and needs outlined above, youth within the juvenile justice system tend to be a transient population and their length of stay at any one space, whether it be traditional school or school within a correctional facility, education is often limited and uncertain. This means, youth are constantly navigating multiple learning spaces instead of receiving access to a consistent educational experience. Thus, teachers in correctional facilities face constant challenges as they work to provide stability to what had been the largely inconsistent educational experiences of the learners in their classrooms. Under these circumstances, it can be difficult for teachers to build relationships with students and makes it difficult for teachers to obtain records such as Individualized Educational Programs (IEPs), to move through Child Find procedures to accurately identify disability, and to attend to cognitive needs in general.

While we tend to view academic struggles as characteristics of the student and we tend to assume students are responsible for their academic experiences, it is critical to note school policies greatly contribute to students' learning outcomes and educational experiences. Educators often refer to this as the *school-to-prison pipeline* –certain policies targeted to specific populations of students so they are pushed out of school and into the juvenile justice system. Many scholars argue that the *school-to-prison pipeline* is built because schools as institutions are built to reproduce inequalities.

For example, school policies influence the type of academic instruction youth receive within their schools. The Council of State Governments supported a study in Texas in 2011 that found one-third of students, mostly minority students, received an out-of-school suspension between 7th and 12th grade. Other research confirmed that minority youth, particularly males, receive harsher punishments in school and are more likely to be suspended and expelled. This means certain populations of students, in particular minority males, may have already experienced inconsistent school attendance, academic experiences, and are more likely to have high dropout rates due to school policies. These policies pose a threat to their timely graduation and positive academic outcomes. Many educators argue that it is not coincidental that minority males, who are often the recipients of harsher school policies, are also the same population that is overrepresented within the juvenile justice system.

Considering the role of how policy influences youth's learning opportunities and their educational experiences it critical when educators consider the various spaces where youth can be educated. This is important when educators consider who is enrolled in online learning spaces and what technology youth have to access various types of learning opportunities, particularly those youth who have or were involved in the juvenile justice system.

Technology and Web-based Learning Opportunities for Incarcerated and Detained Youth

Because juveniles have the right to a publically funded education even when incarcerated or detained, correctional facilities are obligated to provide educational opportunities. Therefore, it is critical for educators to understand the current practices and research-based effective instructional practices associated with teaching and learning in these spaces.

As researchers have explored traditional and non-traditional approaches to educating youth in correctional facilities, technology is viewed as a promising practice in delivering educational experiences to those who are confined and detained. For example, in adult prisons, research has demonstrated that computer-based instruction (CBI) has been used successfully for GED, post-secondary, vocational credentials, and professional development learning. In the literature focused on juveniles who are confined and detained the literature is limited; however, the research that exists tends to focus on academic interventions and growth. Specifically, research tends to focus on computer-based instruction for literacy development.

In a systematic analysis of research, the Rand Corporation analyzed 18 studies to measure the success of academic programs for youth in correctional facilities. The studies included in their review spanned six different interventions including, Corrective Reading, CAI, personalized academic instruction, remedial academic instruction, vocational training, and GED preparation. While they did not report any of the interventions providing students Internet access, three studies examined interventions with a computer-based component, including Read 180, Fast Forword, and Tune into Reading (TiR). Read 180, published by Scholastic, combines teacher-led instruction, small group instruction, and a computer-based component. Loadman et al., (2011) investigated Read 180 with eight correctional institutions in the state of Ohio, with 1,245 youth. Students were assigned randomly to Read 180 or their typical English language arts curriculum. Students with the Read 180 intervention scored significantly higher on the Scholastic Reading Inventory than those students who only received the traditional language arts curriculum.

The other two CBI programs tested in juvenile correctional facilities, Fast Forword (Shippen, Collins Morton, Flynt, Houchins, & Smitherman, 2012) and TiR, did not show the same positive effects as the Read 180 intervention. For example, Shippen, et al. (2012) studied Fast Forword Literacy and Fast Forword Literacy Advanced. Presented in an interactive video game, these programs included exercises designed to improve language skills, phonological awareness, and listening. Shippen et al. (2012) examined the overall reading abilities, decoding skills, and spelling of 51 incarcerated males who had been identified as low performing readers. The students engaged with the Fast Forward Literacy programs in 24 session over 11-weeks. The study found no difference between the treatment and control groups for improving the reading abilities of incarcerated youth.

Calderone et al., (2009) investigated Tune In to Reading, a computer-based 1:1 intervention to explore the development of fluency through the modality of music. Students received instruction for 45 minutes, twice a week over nine weeks. The assessments included a reading assessment and students' performance on the Florida Comprehensive Assessment Test. Students showed a positive effect, however it did not approach statistical significance.

These studies are important because they highlight how technology is being used and how educators and researchers conceptualize the role of technology in correctional facilities. While Loadman's, et al., (2011) study shows the potential of computer-based instruction, these studies still demonstrate that technology is being used to reinforce discrete skills-based learning. Instead of using technology to provide rich, innovative learning opportunities, technology is being used to further reinforce particular skills (Maccini, Gagnon, Mulchy, Leon, 2006; Pytash, 2017).

One innovative learning opportunity utilizing technology that could be implemented in correctional facilities is online learning, as an estimated million K-12 students in the United States participate in some form of online learning, with this number to increase to half of all K-12 students receiving instruction via web-based platforms (Christensen, Horn & Johnson, 2008; Clark & Barbour, 2015). Despite the rapid increase of online education, there is a lack of research focused on students' learning in virtual schools (Barbour, 2014) and no research focused on virtual schooling in correctional facilities. There are reports of states partnering with youth correctional facilities, in order to provide youth within the juvenile justice facility a more stable and consistent access to education. For example, Oregon department of youth corrections partnered with Oregon Virtual Education (ORVED) and Florida Department of Corrections has partnered with Smart Horizons Career Online High School. Despite the reports that these programs exist, there is a lack of research reporting on their efficacy and sustainability, as well as students' experiences with online learning in correctional facilities.

Discussion and Implications

Technology and education have a relationship where educational initiatives often shape new technologies being developed. Conversely, technology influences the ways students are educated. Thus, as policy-makers and educators work to implement new technologies into educational spaces, it is critical to consider all the many and varying places where youth are educated.

Some correctional facilities do provide advanced technologies, however, policies and use may vary from state to state, as well as by facility (US Department of Education, 2015). The most common form of technological devices are desktop or laptop computers, followed by tablets. Typically, these are used for computer-based instruction rather than opportunities to study in an online space. In addition, some correctional facilities have SMART Boards for instructional use (Federal Interagency Reentry Council, US Department of Education, 2015). Again, these are often more for teacher use than student use as a way to provide computer-based assessments and supplemental learning materials, such as videos, podcasts, and online resources. For example, a facility in Indiana uses a SMART board with Internet access for teacher use only and a facility in Pennsylvania has computer training courses for driver's licenses.

What would have to happen for correctional facilities to include online schooling as an option for students when confined, detained, or incarcerated? Organizations, such as the Federal Interagency Reentry Council have published that "juvenile correctional facilities have successfully used technology, including the Internet, to broaden the scope of education programming while maintaining appropriate and effective safeguards" (p. 1). The Federal Interagency Reentry Council's publication, *Myth Buster*, featured facilities which utilize technological devices and support web-based learning in various forms. For example, Oregon department of youth corrections partnered with Oregon Virtual Education (ORVED) to provide access to courses and supplemental materials to students in youth correctional facilities. Similarly, Florida Department of Corrections has partnered with Smart Horizons Career Online High School so that some facilities receive online education for diplomas.

Although Oregon and Florida are advanced in their use of online schooling in correctional facilities, there is still an acknowledgement that "concerns over youth and community safety often prevent facilities from pursuing" technology (Federal Interagency Reentry Council, p. 1).

In order for widespread adoption of online education in correctional facilities, institutions would have to have a reliable infrastructure for supporting the Internet on devices. Debates regarding the reasonable and appropriate filtering of information to the incarcerated youth emerge as a debate. Specific concerns about security when youth are using technology in correctional facilities are repeatedly reported in the literature. For example, "most corrections agencies restrict the use of computing devices to only the classroom or computer lab, and have policies barring incarcerated individuals from access on the Internet" (US Department of Education, p. 7). And some facilities have the right to deny certain students access to programs, so that even if a program is available, it does not mean all students are engaged (US Department of Education, 2015). Therefore, concerns for safety, particularly when using technology, often influence the types of educational experiences youth in juvenile correctional facilities receive.

Directions for Future Research

Despite the reports that programs incorporating online learning opportunities exist in correctional facilities, there is a lack of research reporting on their efficacy and sustainability, as well as students' experiences with online learning in correctional facilities. One reason this might be is that despite the importance of education and the federal mandates to provide an education, much of the literature surrounding youth in correctional facilities focuses on behavior and recidivism (Sander, et al., 2012).

In addition, the perception of students who are in correctional facilities, might influence the educational opportunities they are afforded, and therefore, the type of research conducted in these settings. By viewing students in correctional facilities as academically struggling, disengaged, and reluctant learners, researchers and educators might be too focused on skills-based instruction used as remediation instead of engaging and challenging academic opportunities. The research that does exist tends to focus on computer-based instruction that is skills-based and intended to remediate an academic deficit, arguing that computer-based instruction is "appealing" since it can provide "intense and targeted instruction" and interventions to a population that is largely transient (Shippen et al., 2012). However, much more rigorous research is needed. For example, Wexler and colleagues (2014) argue information is needed to understand how computer programs can aid the screening and diagnosis process to implement effective instruction to meet specific adolescents' needs, in addition to more research exploring instructional delivery for flexibility and adapting instruction to meet students' specific needs.

It is critical for educators to recognize that although certain models of traditional academic instruction may be successful in correctional facilities, "there is little evidence supporting the efficacy of these previously identified practices in juvenile correctional facilities" (Wexler, Pyle, Flower, Williams, & Cole, 2014, p. 5). Therefore, instead of only targeting only specific skills, researchers should be exploring how computers can be used to introduce students to 21st century skills.

In addition, and in particular since some states are partnering with online schools, one avenue that should also be explored is how enrolling students in virtual schools can provide youth with continuous education instead of interrupted experiences due to youth's residence in multiple spaces. For example, students would not encounter a disruption to their educational services, such as IEP implementation. In addition, having students educated in an online setting could be a major benefit to researchers hoping to better understand students' learning, as it provides a stable learning environment even when youth are transient. Researchers have noted that the transient nature of youth in correctional facilities also typically serves as a barrier for conducting long-term studies; however, by studying their experiences and learning in an online environment, this limitation would be mitigated and researchers could have more information about how youth engage in education that goes across multiple contexts.

Online instruction needs to be research in correctional facilities to understand how youth engage in these educational spaces, while being detained or confined. This is particularly important as correctional facilities may not have mentors to guide students through their academics when a teacher in a virtual setting is not available or when they need additional help with coursework. Research would need to explore how correctional facilities support youth while enrolled in virtual schools. Considering students' academic support systems is important because, while online education may be effective, youth in facilities are already faced with tremendous amount of isolation. Education, such as online learning, should not serve as one more way to isolate youth from personal contact from others; therefore, researchers could explore whether online learning further isolated students or provided students more resources and support. Research could investigate the ways correctional facilities provide students opportunities for online learning or learning with technology outside of the academic classroom. For example, some correctional facilities may house libraries that are also dedicated to students' academic growth while confined and detained. Fenster-Sparber, Kennedy, Leon, and Schwartz, (2012) investigated tablets as e-readers to engage students in high-interest books and apps to support their reading development. Future research should continue to explore how technology might provide learning opportunities outside academic classrooms.

And finally, research is also needed to explore teachers' instructional practices in virtual schools to understand how they negotiate working with students in correctional facilities. Researchers could explore how students' enrollment in virtual schools also create opportunities for teachers in correctional facilities to collaborate with teachers in public school settings. This could include the sharing of pedagogical knowledge and also practical knowledge of student needs when in these facilities.

Conclusion

As educators and researchers, we must consider the commitments that we need to make to young people, even when they are in correctional facilities. It is critical that we explore our students' educational needs and how facilities are designed to serve the youth while they are confined, detained, or incarcerated. This may be a shift in thinking about education in correctional facilities, in that it is a first consideration, instead of a minor consideration.

Technology has potential for providing youth with the educational experiences that are not only federally mandated, but will allow them to continue to learn even when confined. There are programs that are demonstrating promising practices when incorporating technology; however, these cannot continue to be only computer-based programs that reinforce skills-based education. Educators, researchers, and policy-makers need to explore how are policies created to give students opportunities over "path, place, and pace" while still maintaining their stance towards safety and issues of privacy and identity while in a correctional facility.

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14

The Emerging Research Base on Online Learning and Students with Disabilities

Mary F. Rice & Bryan Dykman

ABSTRACT

Students served under federal civil rights laws (i.e., IDEA, Section 504) are entitled to enroll in the full range of online learning environments and receive mandated services. Attending to these students' needs has presented challenges for educators in online schools, but research that would inform decision-making and planning has been scarce. This chapter provides some context for serving students with disabilities online and summarizes previous research reviews this topic. In addition, this chapter updates research findings from an original chapter in the first *Handbook of K12 Online and Blended Learning Research.* New findings suggest that students with disabilities are enrolling in online courses, but gaps in understandings about student outcomes, accommodation and service delivery, and educator preparation and support persist. The chapter ends with suggestions for applying research to practice, engaging in additional research, and forming policies ensuring students with disabilities receive services.

Keywords: students with disabilities, disability plans for online learning, online disability services, IEP implementation online, disability support in virtual schools

INTRODUCTION

Online education encompasses a variety of settings, including digital learning, fully online, blended, supplemental learning opportunities (See Table 1). Within this variety of configurations, educators, and those responsible for supporting and evaluating educators at all levels (building, district, state, and national) continue to respond to the shifting educational landscape brought about by technological advancement and innovation.

Although the Individuals with Disabilities in Education Act (IDEA, 2004) identifies approximately a dozen categories of disabilities, the number of disabilities is not fixed and often encompasses a variety of conditions. Adding to these complications is the fact that different states sometimes have additional criteria for identification that are not included in the definition. The broad definitions of disability and disabilities suggest that students provided services under the IDEA mandate will have a range of needs in any educational environment, including ones where they complete work and interact with teachers and peers through the Internet and/or use web-based resources. Within these online or Internet-supported environments, identifying students, determining services, and monitoring the delivery of services is critical to the long-term viability of the program or school since schools are held to accountability standards. However, serving students with disabilities at an individual level may also be enabled through personalized learning, which is often described as a major potential benefit of learning in an online environment (see Wexler, 2017 this volume).

Table 1
Types of Online Learning

Blended Learning	Formal program where students do part of their coursework online (inside or outside of a classroom setting) and part of their coursework occurs in a supervised location away from home. In addition, students in blended learning environments have some control over the pace, path, and pace of their learning (Christensen Institute, 2013). There are many models or types of blended learning.
Digital Learning	Many schools use digital technologies to support learning. Any type of school can use online learning to achieve any range of traditional to personalized learning. Further, digital learning occurs outside of online environments where students simply use resources or applications from the Internet for an instructional unit or on a periodic basis (Governor's Office of Student Achievement—Georgia, 2017).
Fully Online Learning	Students complete all of most of their coursework over the Internet; Courses are offered through online school organizations who generate, organize, and/or pace students though lessons (Equity Matters, 2016).
Supplemental Online Learning	Supplemental online courses can be used to give students access to courses otherwise unavailable in their primary learning environment or as a means of credit recovery at the secondary level (Colorado Department of Education, 2017).

Policy Context for Serving Students with Disabilities in Educational Settings

Students with disabilities are provided Individualized Educational Programs (IEPs). These are generated by the school with the support of parents and other relevant experts. When determining disability, educators, parents, and other experts consider to what degree a given condition adversely affects the educational performance of the student. Although some educators have interpreted this to mean that the child must be failing in school to receive special education and related services, that is not the case. The language of IDEA (2004) states that school must ensure a free appropriate public education (FAPE) to "any individual child with a disability who needs special education and related services, *even if the child has not failed or been retained in a course or grade, and is advancing from grade to grade*" [§300.101(c)(1)]. Consequently, the standard for service qualification is whether the disability adversely affects educational performance. For online learning environments, what constitutes "adversely affects educational performance" may be different than the "adverse effects" in traditional schools.

IDEA (2004) ensures equal access to educational opportunity for all students with disabilities. It guarantees students with disabilities and their families FAPE, regardless of where they receive their education. Further, services delivered are determined by the needs of the child, not the convenience of the school district, whatever the configuration or instructional delivery mode (Smith, 2006). An appropriate education for students is characterized by five IDEA mandates.

- Individualized education shall meet student needs;
- Students with disabilities shall be educated with nondisabled peers to the greatest extent possible;
- Evaluation and placement procedures shall be made in accordance with appropriate procedures;
- Due process procedures shall exist for identification, evaluation, and placement; and
- Federally-funded programs must provide educational services free of charge to students and families (IDEA, 2004).

To date, no federal education laws specifically reference special education in online settings. However, the U.S. Department of Education on August 5, 2016, issued a landmark guidance document to state departments of education (Swenson & Ryder, 2016). In this "Dear Colleague letter", the Office of Special Education Programs (OSEP), identified both state educational agencies (SEAs) and local educational agencies (LEAs) as having responsibilities related to IDEA in full-time online schools. The letter focused on two key areas for providing services that include (1) supervisory responsibilities for ensuring implementation of service plans, (2) Child Find services for identifying students with disabilities before, during, and after participation in online learning environments, and assurances that every student with a disability will receive FAPE.

The federal courts have also offered some guidance as case law regarding educational service delivery to students. While this guidance grew from cases in the traditional setting, there was no restriction on the decision that exempt online learning from the need to adhere to these principles. Further, the recent Supreme Court decision *Endrew v. Douglas County* (2017), unanimously rejected the *de minimis* standard. Under this discarded standard, if children were positioned to make any type of progress, that was sufficient to meet the demands of IDEA. Instead, the court ruled that the services offered must be calculated for substantial benefit given the circumstances of the student. In his statement of opinion, Chief Justice Roberts wrote that students offered educational programs providing merely a chance for minimal progress from year to year have not been offered an education at all. What is at stake in the *Endrew* decision is the dignity of children with disabilities in all educational settings (Turnbull, Turnbull, & Cooper, 2018).

Thus, from federal guidance in the legislative, executive, and judicial branches, there is agreement that students with disabilities deserve to be educated alongside their peers and to receive accommodations and support that are likely to continue a trajectory of growth from year to year. There is no reason to expect that these guarantees do not extend into the online settings, which are freely entered and exited by their peers without disabilities.

Previous Reviews of Research about Students with Disabilities in Online Settings

Three previous reviews of online learning research focusing on students with disabilities exist. In the earliest of these, Vasquez and Serianni (2012) looked at seven research studies and concluded that there was a lack of empirical work on rural students with disabilities in online settings. They also challenged the idea that effectiveness studies should come at the expense of other important concepts, such as how to translate effective practices from brick-and-mortar settings to online ones, or how to leverage technology as a mode of instruction for rural children.

In a second review, Vasquez and Straub (2012) examined research from peer-reviewed journals as well as conference presentations, dissertations, and other sources about the achievement of students with disabilities in online learning settings. For this review, the researchers included non-peer reviewed, unpublished studies and in doing so, enlarged the corpus to 43 studies. Even so, the researchers argued that there was too little research on this topic and that the research that had been conducted was not focused on answering questions that would be truly beneficial for learning about the achievement of the target population (K–12 students with disabilities) and the target setting (online).

Finally, Greer, Rice, and Dykman (2014) conducted a comprehensive review of research on online learning and students with disabilities. They excluded non-peer reviewed items in the main body of their review, just as Vasquez and Serianni (2012) had done. In their review, Greer, Rice, and Dykman lamented the lack of studies that were available in published, peer-reviewed sources. They also noted that it seemed that there had been work presented at conferences that never made it into a manuscript form, or had never gone through formal peer-review for publication. The authors organized the few published, peer-reviewed articles in existence under the headings of (a) curriculum evaluation, (b) achievement, (c) stakeholder perceptions and experiences, and (d) policy. Their review was published in the first *Handbook of K–12 Blended and Online Learning Research* (Ferdig & Kennedy, 2014). A summary of their findings from these topics appears below in Table 2.

Table 2
Summary of Findings from Greer, Rice, and Dykman's (2014) Review by Topic

Topic	Critical Findings
Curriculum evaluation	Six studies examined whether certain instructional materials from specific vendors increased learning outcomes using mostly experimental/quasi-experimental designs; although findings were generally affirmative, they all had small sample sizes and did not distinguish between various types of disabilities.
Achievement	Four studies examined achievement for students with disabilities. These studies had no dominant research design. Although there was a larger amount of data available, it usually came from the same school or state. The studies found that instruction and feedback were critical to achievement, which was usually measured by passing the course.
Stakeholder perceptions and experiences	Four studies of perceptions using self-report data suggested that stakeholders (particularly parents) were generally satisfied with their children's educational experiences. Parents further indicated that they were the ones who brought their children into fully online learning environments and that they felt this was necessary because their children were not being served well in their traditional schools.
Policy	One study of self-reports from state directors of education revealed the wide variation in both quantity and specificity in state policies for online learners with disabilities.

In this first review, Greer, Rice, and Dykman noted that they were unable to locate studies at the that specifically addressed the use of blended learning as a K-12 online context with students with disabilities. Because of this, and the fact that blended learning is a fast-growing type of online learning (Halvorson, Spring, Huyett, Henrie, & Graham, 2017), this current review sought to identify studies of blended learning that pertain to students with disabilities as part of the process of updating the chapter.

Purpose of this Review

This chapter reviews new research that has appeared most recently in published-peer reviewed journals focusing on students with disabilities in the full spectrum of online learning settings, including, but not limited to the fully online, supplemental, credit recovery, and blended learning settings. With the chapter, the authors will also suggest new agendas for implementing practices, conducting research, and developing policies related to online learning opportunities for students with disabilities.

METHODS FOR LEARNING FROM RECENT STUDIES

The search process focused on databases with journal articles. Table 3 provides an overview of the research databases searched. The databases accessed during the search for articles were chosen because of their availability through the University of Kansas libraries and its InterLibrary Loan partners. The searches were conducted bi-weekly from August 2017 until late January 2018.

Table 3
Types and Names of Searched Databases

Type of Database	Names of Databases
Government	ERIC, EBSCO
Journal	*American Journal of Distance Education, International Journal of Open and Distance Learning, Journal of Online Learning Research, Journal of Special Education Technology, Online Learning*
Public	Academia.edu, Google Scholar, Research Gate, Center on Online Learning and Students with Disabilities publications repository
Private	Academic Search Complete, SAGE Journals Online, Psych INFO

Searching Databases

We used the terms to search the databases with the Advanced search function, toggling search fields ranging from "subject headings" to "keywords" to "all text." These terms appear in Table 4. Some databases were more flexibly searched using Boolean Operators, though these functions were often employed automatically by the advanced search function within the database. A research librarian from the University of Kansas assisted to ensure that we were aware of all the databases and how to access them through their institution or through another via inter-library loan.

Table 4
Initial Search Terms

Disability	Online Learning	K-12 Schooling	Setting Type	Anticipated Topics
Special education, disability(ies), special needs, exceptionality(ies), impairment, IEP, disability plan, section 504, at-risk	Virtual school(s), virtual classrooms, cyber school(s), online learning, online instruction, cyber school, distance education, e-learning, internet coursework, web-based instruction, technology	K-12, elementary, secondary, public school, charter school, private school, homeschool, grade school, high school, adolescent, child	Fully online, supplemental, credit recovery, blended learning (environment), hybrid, modern learning environment(s)	Attrition, persistence, achievement, teacher preparation, teacher training, accommodation(s), modification(s), legalities, policies, literacy, satisfaction, engagement, technology(ies), parents, perceptions, experiences, roles, professional development

Defining Terms

Locating articles was a multi-step process that began by deciding what terms to search and determining what databases might yield the most comprehensive search results. A final element involved deciding how the articles fit together as a conversation about the focus topics.

Strategies for conducting the review included techniques for searching databases for articles about online learning, disabilities, and K-12 students. Each of these words had a broad range of concomitant terms in the research literature. A list of keywords associated with online learning and special education formed the initial search terms. These terms were searched within database thesauri and indices for further refinement of terminology and to generate synonyms.

Additional Search Constraints

Some additional constraints were applied to returned search results. These constraints included a restriction by year (2014-Present) and by article type (peer-reviewed academic journal). Although the previous review in the previous version of this handbook (Greer, Rice, & Dykman, 2014) covered the year 2014, the main part of that review was conducted in February and March of that year. This means that a few articles may overlap between the current chapter and the previous one, but it was necessary to avoid the exclusion of articles published in the latter part of 2014.

When databases allowed, a constraint regarding the ages of children involved in the study was selected. For example, the Educational Resources Information Center (ERIC) database allowed results to be filtered by grade-level, which for this study included primary- and secondary-aged school children. When this filter was not available, results were screened by looking at the age of the participants in the abstract and/or methods section or by adding additional keyword phrasing (i.e., K-12, secondary students, primary students). Many articles were excluded because they focused on students in higher education rather than in K-12 settings. Articles focused on digital learning, but were not necessarily part of an online learning program were excluded. For instance, several studies were located where students with Autism used various applications, usually with tablets to learn social skills. If members of the research team could not tell that the learning was part of a formal effort to consistently learn using online resources, we did not include it in the review. The focus was on articles about curriculum and coursework where Internet resources and Internet-ready devices were used as a major part of overall instruction provided in that setting, rather than as a short-term intervention or brief interlude before returning to traditional instruction.

Although government reports were not included in the review, reports published within the last decade containing reference sections were searched for potentially relevant articles. Additionally, the quest for empirical, peer-reviewed, published work meant that conference presentations, master's theses, and doctoral dissertations were not included. Also, not included in the review were government or agency-sponsored pamphlets/research syntheses. The publication repository of the Center on Online Learning and Students with Disabilities (http://centerononlinelearning.org/publications/featured-publications/) contained many research-based documents with information about the focus of this review. Much of those resources were industry papers and practitioner pieces, rather than published peer-reviewed articles. The bibliographies of the excluded materials were still valuable to the review to assist in the search for articles.

Finally, articles in peer-reviewed journals that were not empirical in nature (i.e., not driven by a research question, methods/strategies, and findings) were not reviewed. We did, however, locate as many of these documents as possible so that we could search their bibliographies and reference sections for studies that were empirical. We also searched the bibliography and reference sections of each peer-reviewed empirical journal article that was located looking for additional articles. When we came on an article that was from a journal with which we were unfamiliar we looked up the journal to verify that there was a review process mentioned in the mission and that there was a review board associated with the journal. At the end of this process, 20 articles remained.

FINDINGS AND RESULTS FROM PUBLISHED STUDIES

The purpose of this review was to learn about the most recently published (2014-2017) empirical work on students with disabilities in online learning settings of various types. To learn about this research the research designs and findings were located and grouped into themes. The findings from the studies and the grouping appear below. A summary table of the findings is represented in Table 5.

Research Designs and Critical Findings

The most common type of data collected in these studies was self-report data. This type of data appeared in the most common research design, which was a survey, but also in case studies and phenomenological work where researchers used interview strategies. Other methodologies included mixed methods, descriptive statistics, and a handful of experimental designs. Content analysis also appeared as a research design in several studies. One study was a scan of state policy (Basham, Carter, Rice, & Ortiz, 2016) and the other used a scan tool developed to determine online instructional materials adherence to Universal Design for Learning (Rose, 2000) principles (Smith & Harvey, 2014). Rice and Deshler (2017) also used general content analysis techniques to analyze vocabulary difficulty and support in online learning courses and analysis of variance (ANOVA) to analyze content for text complexity. The largest sample size of human participants was (n=140) in a survey of online students—some of whom had disabilities) and their satisfaction with online coursework. Most studies only had small numbers of participants or were phenomenological views into contexts.

During these research processes, several critical ideas emerged (1) Students with disabilities can benefit from online learning, but they do not enjoy every type of positive outcome in every instance (2) Policy and practice generally do not address learning needs of students with disabilities, except in tightly controlled experimental or single subject studies, but (3) practitioners at all levels (teaching and administrative) are aware that they are presently unable to optimize the learning experiences of students with disabilities, but they indicate willingness to learn to do so.

Table 5
Summary of Findings

Authors	Year	Type of Online Learning	Research Design	Findings
Basham, Carter, Rice, & Ortiz	2016	Multiple	Policy scan	State policies for K-12 online learning and teaching have developed unevenly and many policies do not consider students with disabilities.
Basham, Hall, Carter & Stahl	2016	BLE	Case study	Personalized learning environments were highly dependent on student self-regulation, use of student data, and adhered to principles of the Universal Design for Learning
Beck, Maranto, & Lo	2014	FLE	Survey	Parents of students with disabilities at one virtual school were more satisfied with children's educational progress than parents of students without disabilities.
Carter & Rice	2016	FLE	Case study	Providing accommodations to students with disabilities required intensive collaboration from administrators, and it was a struggle for them to continually update their knowledge of what was available. Instead, accommodations in the online environments limited to what was already available to all students.
Coy, Marino & Serianni	2014	FLE	General qualitative	Teachers in a convenience sample were observed using UDL principles to varying degrees.

Table 5
Summary of Findings, cont.

Authors	Year	Type of Online Learning	Research Design	Findings
Greer, Harvey, Burdette, & Basham	2015	FLE	Survey	Interviews with 16 state directors of education revealed they were ill-prepared to address issues of FAPE and LRE in online learning environments.
Fernandez, Ferdig, Thompson, Schottke & Black	2016	FLE	Demographic analysis	The most common special health needs were asthma and/or allergies, followed by ADD/ADHD. The most common class taken was mathematics. The most often-cited reason for participating in online learning for these students was homeschool augmentation.
Greer, Smith, & Basham	2014	FLE	Survey	Respondents (n=127) recognized the importance of online learning but did not feel confident using online technologies to instruct students with disabilities.
Harvey, Greer, Basham & Hu	2014	FLE	Survey	Respondents (n=140) indicated that they enjoyed taking online classes and felt they were making progress. They also indicated low social interaction, which was the aspect of online learning students either missed much or did not miss at all.
Marino, Gotch, Israel, Vasquez, Basham & Becht	2014	BLE	Mixed methods	UDL-aligned units led to increased student engagement, but not to higher test scores when scores of students with learning disabilities were compared to students without learning disabilities.

Table 5
Summary of Findings, cont.

Authors	Year	Type of Online Learning	Research Design	Findings
Marteney & Bernadowski	2016	FLE	Survey	Respondents from one online learning management company perceived online learning provided new avenues for educational access to students with disabilities and that these students benefitted from self-paced learning and increased engagement. Teachers were concerned about cyberbullying, accommodations in the online environment, and students' failure to use all the resources available online.
McConnell, Johnston, Hall & Stahl	2017	BLE	Design based research	Data systems in the design environment were insufficiently interoperable to produce unified information about individual students.
Pace & Mellard	2016	BLE	Experimental	No difference was found in reading achievement between students with disabilities and students without disabilities.
Rice	2017a	FLA	Analysis of variance	Text from ELA courses produced by three large online learning material vendors scored high in syntactical simplicity but was highly variable in narrativity, deep cohesion, referential cohesion, and word concreteness. Text in these environments was not designed to support comprehension beyond the use of shorter sentences and words.
Rice	2017b	FLE	Phenomenological interviewing	Even though teachers had SWD in their courses and were directly responsible for SWD, most teachers and administrators described few professional development opportunities for learning to teach SWD in the online learning environment beyond giving and receiving information about legal compliance.

Table 5
Summary of Findings, cont.

Authors	Year	Type of Online Learning	Research Design	Findings
Rice & Deshler	2018	FLE	Content analysis	Vocabulary support in earth science courses from three large online learning material vendors and one district-level course developed by practicing teachers was minimal and keywords in the courses were much more than recommended for students, especially students with disabilities.
Rice, & Carter	2016	FLE	Case study	Teachers used pacing guides and warnings to the students they may be dropped from the class as the two most common strategies for supporting self-regulation in students.
Rice & Carter	2015	FLE	Phenomenological interviewing	Researchers interviewed teachers, special education case managers, and single/multi-school special education administrators to find that teachers struggled to adapt traditional schooling practices to an online environment and administrators had little to no contact with teachers or parents enrolled in their program.
Smith, Basham, Rice & Carter	2016	Multiple	Survey	Teacher educators are preparing prospective special education teachers for some responsibilities in online learning environments, such as relationship-building and collegiality, but not for other aspects such as instructional delivery and reconsidering laws and policies for online teaching and learning.
Smith & Harvey	2014	FLE	Content analysis	Khan Academy lessons in history, math, and science were not aligned to the three principals of Universal Design for Learning (UDL).

Students with Disabilities Can Benefit from Online Learning

In their review of data from other small studies, Fernandez, Ferdig, Thompson, Schottke and Black (2016) found that the most common other health impairments for students in online learning environments were allergies and/or asthma. While these are conditions that may cause gaps in attendance and make learning difficult for students, they do not have inherent cognitive implications. Further, the most common reason for coming into fully online learning was to augment a homeschool curriculum.

One notable finding in the studies was that students with disabilities perceive that they can learn online. For example, Harvey, Greer, Basham, and Hu (2014) found that students with disabilities in a fully online school perceived that they were learning and being successful. Also, parents of students with disabilities indicated satisfaction with the fully online school in a study from Beck, Maranto, and Lo (2014).

Marino, Gotch, Israel, Vasquez, Basham, and Becht (2014) found that students with learning disabilities in a blended learning environment did not perform well on traditional assessments of achievement as compared to students without learning disabilities, even though they self-reported higher levels of engagement with the UDL-aligned units that had been designed for them. Rather than consider this a sign that aligning to UDL was unnecessary, the researchers posited that designing new and interesting curriculum would also require designing more sophisticated assessments of student learning that were also aligned with UDL principles.

In a more recent study in a blended learning environment, Pace and Mellard (2016) found no significant changes in reading achievement that could be attributed solely to blended instruction for students with disabilities when they were compared to peers without disabilities. However, the researchers also noted the difficulty of attaining fidelity and other evidence of investment from the school. Essentially, they argued, the school was undertaking multiple reform efforts simultaneously and that made it difficult for the blended reading instruction to take hold in students and (potentially) for students and teachers to value it as a new practice, rather than just another initiative from the administration.

To support the point that blended learning studies require intense interaction with educators to support new dispositions, Basham, Hall, Carter, and Stahl (2016) assisted stakeholders at multiple levels in building a personalized curriculum for students with disabilities. This curriculum was also designed to meet content standards. Students with disabilities working in this blended environment made 1-year growth targets, and students in earlier grades were particularly successful. Their work suggests a need for intense data collection and analysis occurring on a near-constant basis to measure achievement in a blended learning environment.

Together, these studies illustrate the need to take the perception of achievement, measured achievement, and other outcomes such as persistence and completion into account when studying students with disabilities in online learning environments. However, taking that charge seriously also requires researchers to collect more comprehensive data sets and to work more closely with school staff. Finally, there seems to be a need to address what constitutes evidence of learning in these new environments.

Policy and Practice Generally Do Not Address Student Needs

Policies for online and blended learning have been slow to emerge because of the lack of useful data to guide decision-making (Stahl, Rank, East, Rice, & Mellard, 2016). Blended environments may be especially difficult for states to track because schools take up blended initiatives and put them down again without detailed record keeping of which teachers and students were involved, what blended models were used, and what specific strategies were adopted. Further, a lone teacher or a small group of teachers in a school could adopt certain aspects of blended learning. When this happens, schools, districts, and states cannot engage in information gathering about students with disabilities or anybody else. Further, students do not always have to apply to blended programs. Instead, they are in a classroom in a school that suddenly adopts blended learning or aspects of it.

By contrast, a fully online program is more likely to solicit a charter, go through an accreditation process, and/or be adopted by a district with administrative oversight. Students usually apply to these programs or they are moved to them by request of the student themselves, the parents, or a counselor. These varying ways of entering programs present challenges for valid data collection and analysis by schools, districts, states, and other entities. However, those making policies about fully online learning are unlikely to have extensive experience with online schools and therefore, it is difficult to conceptualize appropriate guidance for practice. These challenges are evident in research activities about policies.

When Greer, Harvey, Burdette, and Basham (2015) interviewed state directors of special education, they found that the directors felt inadequate in meeting the needs of students with disabilities. These sentiments echoed findings from a more intensive state policy scan (Basham, Carter, Rice, & Ortiz, 2015) where researchers learned that no states had anything approaching comprehensive policy guidance and most states had very little statues or administrative policies about serving students with disabilities in any type of online learning environment.

The fact that key policymakers and implementers do not feel comfortable administrating policy about online learning because they cannot acquire accurate data pictures is troubling. Consequently, students are in danger of being denied FAPE. For instance, Rice and Carter (2015) captured several understandings from fully online educators that put students at risk. One of those understandings was that the fully online environment was not for everyone; if a student cannot succeed in it, they should return to a traditional setting. Carter and Rice (2016) also found that a collaboration team of fully online administrators in a case study were unfamiliar with the affordances of an online environment for making accommodations. Instead, the administrators relied on what they regarded as the inherent strengths of working online to provide the engagement and curricular access that students with disabilities might need. Rice and Carter (2016) had similar findings when they looked at teacher work in self-regulation; that the teachers had limited skills for helping students persist in fully online learning beyond pacing guides and threats to drop them from courses.

In addition, there is evidence that the instructional materials do not meet design standards based on instructional design principles that support students with disabilities. For example, Smith and Harvey (2014) scanned supplemental online materials from Khan Academy and found that they did not adhere to UDL principles. Further, Rice (2017a; 2017b) demonstrated that the instructional materials in several online environments were not designed to support the comprehension of students with disabilities that affected their reading. Specifically, she described the large numbers of vocabulary words students were expected to learn, the minimal support offered, and the overall complexity of the text. Finally, McConnell, Johnston, Hall, and Stahl (2017) found that data systems within a fully online learning environment—even when entities and vendors were willing to cooperate—could not be merged into single profiles for individual students because of programming constraints.

Need for Practitioner Support

Online teaching requires new kinds of teacher support These needs include helping teachers conceptualize the online environment as one where students with disabilities can learn. Marteney and Bernadowski (2016) found that teachers had a generally positive view of online learning's potential for students with disabilities, even as they raised concerns about phenomena like cyber-bullying and student engagement. In terms of instruction, Coy, Marino, and Serianni (2014) found that teachers prepared to use UDL principles in their teaching implemented these principles to varying degrees. Some teachers had high fidelity and others much lower, but even so, every teacher was observed using some elements of UDL.

Although there are gaps in practitioner efficacy and knowledge around how to serve students with disabilities, there is evidence that they are more than willing to learn. In their survey of special education teacher educators, Smith, Basham, Rice, and Carter (2016) found that those preparing special education teachers were already trying to help their prospective teachers learn to have meaningful relationships with students and parents in online settings, but they were unsure of how to prepare teachers to apply federal civil rights laws like IDEA and principles of inclusion in online learning environments of any kind. Even so, these special education teacher educators were making efforts to prepare teachers to engage with the parts of practice that they felt they themselves understood well. Most recently, Rice (2017b) found that online teachers of students with disabilities sought out opportunities to learn about how to serve students, but that much of their professional development opportunities centered on legal compliance procedures for the school rather than instruction. Further, Rice found that much professional development was informal and in response to an immediate problem, rather than a formalized plan for teacher learning and growing. While there seemed to be benefits to having immediate access to support for challenges as they occurred, there also might be benefits in more holistic approaches to professional development with flexible curriculum and on-going support.

DISCUSSION

In the original review (Greer, Rice, & Dykman, 2014) there were only a handful of studies addressing students with disabilities in online learning. Further, these studies were exclusively focused on fully online or supplemental environments. Since 2014, the research base has expanded, even tripled, yet the field could benefit from much more research on this topic. What we do know is that students with disabilities are entering online learning environments, that they are engaged by the affordances of these environments and that there is no reason not to deny students with disabilities access to the full range of online options.

However, the studies reviewed in this article do not answer critical questions about student achievement and persistence or optimal educator initial preparation and on-going professional development and support. In addition, very few studies documented whether students with disabilities were actually receiving intended accommodations, modifications, and other services promised in their IEPs.

Student Achievement and other Outcomes

We do not know about the achievement patterns of students with disabilities participating in the full spectrum of online learning environments. Research studies should identify various types of programs with substantial numbers of participants with and without disabilities. Studies should look for potential moderators and mediators of achievement with an emphasis on factors that are malleable. Potential factors might include embedded comprehension support, UDL-alignment, or social interaction with teachers and peers.

Qualitative work on achievement and/or persistence might look to describe rhythms of engagement, parental support, the work of non-parental on-site mentors, and wrap-around coordination of services that provide relief from various adverse educational effects brought about by various disabilities and other health conditions protected under IDEA (2004). Finally, there are absolutely no studies about transitioning students with disabilities from online learning environments to higher education, vocational programs, or the workforce at large. This is important because successful transition is a major goal of the IEP itself as part of the inclusion mission of IDEA. Research efforts related to transition might also examine what happens as students with disabilities move back and forth between online and traditional environments.

Instructional Accommodation and Service Delivery

The studies located for this review indicate that practitioners generally do not understand how to identify and then provide support to students with disabilities in online environments. A potential starting point might be instruction for literacy development as it interfaces with technological proficiency for students with disabilities. This is important because IEPs generally have literacy goals, but the compartmentalized literacies important in the past are insufficient for the present. To attend to this issue from a research perspective, intervention design models might be helpful in identifying which accommodations from traditional settings are helpful in online learning environments. In addition, case studies and other phenomenological work might provide information for identifying new or modified accommodations. Additional research is also needed around social and emotional support. Social goals frequently appear on IEPs because of the IDEA principle focused on inclusion. However, in light of the changes (even decreases) in social interaction online, more work is needed to promote educative interactions and the self-regulation of learning and engagement.

Another issue is that teachers are not the only people who work with students with disabilities in online learning environments who interpret IEPs and provide accommodations, modifications, and other services. In addition to studies of educator preparation and professional development, more work is needed that addresses therapists and other related service providers who are implementing the stipulations of the IEPs. Mapping accommodation implementation and service delivery from a phenomenological lens may also be helpful if researchers first identify promising learning environments or contexts where they have substantial cooperation from the educators, students, and families. Finally, published empirical work about how accommodations, modifications, and services operate to fulfill the promise of FAPE or reasonably lead to a continuum of services in different kinds of online learning environments would make a tremendous contribution.

Educator Preparation and Support

While researchers have designed case studies of online learning contexts, they have not looked at educator preparation programs as cases. Such work could provide important insights into teacher preparation for students with disabilities who will teach in online environments. Professional development for teachers of students with disabilities is another area for future research. What we need to know is how to design preparation and support systems that enable teachers to develop sophisticated and nuanced knowledge of instruction that serves the range of students, but also empowers teachers with knowledge of relevant policy and procedural data that enables them to partner with colleagues and families. From these collaborations, education and service delivery plans calculated to provide the most educational benefits possible could emerge. Policy support and the accompanying research is also necessary to provide local schools and districts the language consistency they need to collaborate on designing licensure programs and engage in efficacious monitoring and evaluation activities. Additional policy support might center on identifying students with disabilities in online learning environments, especially fully online environments. It is likely that increasing numbers of children are enrolling in fully online coursework who have never attended traditional schools and therefore, would not have had the opportunity to be identified (yet).

Finally, some professionals working in online learning environments do not have teaching roles and do not directly interface with students or their IEPs, yet they play a vital role in the education of students with disabilities. For example, course designers are not responsible for directly working with students, but the accessibility features they build into the curriculum and the scaffolding they use to organize learning may be critical to the success of students with disabilities. As another example, there are parents who work directly with their own children with disabilities, but they do not play a role in how other children in the school are educated. Even so, parents might be playing substantial roles in interpreting and implementing IEPs and we know little about the extent to which this might be occurring from an empirical standpoint.

LIMITATIONS

This chapter is framed as a review of the literature. Its intent was to highlight findings from studies available that fit certain search criteria. Among these criteria were the requirements to be published in a peer-reviewed journal within a certain time frame. Articles that were published after the search window or that had restrictions on distribution due to copyright were not included and therefore, this review may not be complete, despite the best attempts of the authors.

Further, no meta-analyses or other statistical analyses were conducted on the studies located for this review. The analysis was entirely done as a subjective qualitative endeavor. In addition, work from theses, dissertations, and sponsored technical reports was not included in the review, although a few have been referenced in the introduction to provide background. Within these other sources of information, it is possible to find credible research although it did not fit the criteria for the review. Finally, there are some articles located in peer-reviewed publications that were theoretical rather than empirical. Theoretical work is important for making inferences that lead to theory-building and testing, but this review sought empirical studies.

CONCLUSION

As disability advocates who understand the history of prejudice, misinformation, and general reluctance around providing FAPE to students with disabilities in educational settings, we cannot subscribe to the notion that the online environment is going to be an inherently more equitable instructional setting. Therefore, in our view, it would be more productive for educators to use policy guidance and research to the best of their ability to secure students' rights to FAPE, rather than waiting for additional legal action or strong, even restrictive policy guidance from the federal government. It is our hope that this review will provide information that will be helpful for informing educator judgment.

While this review has provided some insight into the emerging research base about online learning and students with disabilities, we wish to invoke our previously-made injunction to those who have written technical or industry papers, presented at conferences or engaged in thesis or dissertation work to seek out suitable peer-reviewed journals and publish the work. Further, we note that although the Center on Online Learning and Students with Disabilities and their affiliated researchers published many of the studies that qualified for this review, all are welcome to take up this work. In the next update of this chapter, it is anticipated that a strong network of researchers from many institutions will take up the charge of designing studies that contribute to understandings about this important population in many types of promising environments.

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15

Students with Severe Health Impairment in K-12 Online Learning

Erik Black & Lindsay A. Thompson

Introduction

It is common for children in traditional classroom settings to fall behind in their education or experience significant absenteeism because of health, behavioral, or situational concerns (Rumberger & Lim, 2008). In some cases, illness or disease may inhibit a student's ability to learn in a traditional classroom setting (Kelly & Aylward, 2005; Sanders et al, 2009). Increasingly, online learning is perceived as a viable option for these students. While much remains unknown about the prevalence of children and adolescents with significant healthcare issues in K-12 online classrooms, considerable data exist that validate the notion that K-12 online classrooms attract significant diversity, including health diversity (Fernandez, Ferdig, Thompson, Schottke & Black, 2016; Greer, Rice & Dykman, 2014; Cavanaugh, Repetto, Wayer & Spitler, 2013; Spitler, Repetto & Cavanaugh, 2013; Thompson, Ferdig & Black, 2012). Yet, contemporary literature (Basham et al., 2015; Rice & Carter, 2015; Bernstein, 2013) describes challenges associated with K-12 online education for students with disabilities, including, the swift and expansive growth of virtual schooling institutions, inaccessibility of online content, few standards, a rapidly increasing population of students with disabilities seeking access to online classes, and miscommunication related to student Individualized Education Plans (IEPs).

According to the National Center for Education Statistics (NCES) (U.S. Department of Education 2012), more than six million students with a disability between the ages three and twenty-one participate in federally supported educational programs in the United States. Disability is a broad term that encompasses, but is not limited to learning, cognitive, speech, intellectual, emotional, sensory, and physical and disease-related limitations (Pfeiffer, 1993). Many factors combine together to affect the health of individuals. Whether people, regardless of age, are healthy or not, is predominantly determined by social circumstances and environment. Where we live, the state of our environment, genetics, our income and education level, and our relationships with others, our social determinants of health, all have considerable impacts on our well-being (Glanz, Rimer & Viswanath, 2008). Disability is highly related to social determinants of health and social justice; it is not excluded from any social strata, race, ethnicity or gender (Greer, Rice & Dykman, 2014; Braveman, Egerter & Williams, 2011).

Since the passage of the IDEA in 1975, its reauthorization in 1997 and revision in 2004 there has been a substantive and deliberate move towards classroom inclusion in the least restrictive environment for children with disabilities. Importantly, this strategy of inclusion is feasible and promotes positive outcomes for a majority of children with disabilities (Crockett & Kauffman, 2013). Among those for whom inclusion is not feasible, students who may experience a prolonged hospitalization, for example, non-technologically mediated methods of education have most frequently included hospital/homebound instructional programs (Lustig, 2009). While an important service, research provides evidence that hospital/homebound students may receive a small fraction of the instructional time and support their healthy peers receive. In some cases, unlicensed instructors, or those lacking content matter certification provide instruction. Research by Lustig (2009) estimates that the largest subset of school age children, 30%, receiving hospital/homebound instruction are associated with a category of disability termed 'other health impaired' (OHI) by the IDEA.

Since its inception, online schooling suggested the promise of a unique means by which to maintain educational progress in order to satisfy the myriad needs that children may have. Research by Greer, Rice and Carter (2015), Rice and Carter

(2015) and Burdette and Greer (2014) provides evidence that some virtual schools are actively embracing and working towards this promise, yet others, unfortunately, may not be (Muller, 2009).

Greer et al's 2014 review of literature related to students with disability in online schooling provides evidence that there is little difference in student performance between online and traditional schooling. But according to Greer et al, students with disability are more frequently raised in homes that are more affluent than their non-disabled online peers and parents, on average, are more satisfied with their child's online school learning experience. Additionally, there is a body of research that concludes that online learning provides opportunities for enhancing self-efficacy and reduced stigma that differ from traditional classrooms (Greer et al, 2014; Hipsky & Adams, 2006; Beck, Egalite & Maranto, 2014; Thompson, Ferdig, & Black, 2012).

In order to assist readers in their understanding of disability and its impact on learning in k12 online schooling, this chapter has a threefold goal: 1) describe contemporary research related to students classified as OHI; 2) discuss implications related to policy and practice and 3), discuss implications related to practice.

Given the expansive and contentious nature of the term disability, one which had often defied conventional methods of definition (Bernell, 2004), this chapter will use the Individuals with Disabilities Act (IDEA) definition of disability:

> *IN GENERAL.—The term 'child with a disability' means a child—*
>
> *(i) with mental retardation, hearing impairments (including deafness), speech or language impairments, visual impairments (including blindness), serious emotional disturbance (referred to in this title as 'emotional disturbance'), orthopedic impairments, autism, traumatic brain injury, other health impairments, or specific learning disabilities; and (ii) who, by reason thereof, needs special education and related services (Individuals With Disabilities Education Act, 2004).*

Within that broader definition, this chapter will focus on a single subset of the fourteen categories of disability, 'other health impairments'. The other health impairment (OHI) designation serves as a catchall for children and adolescents who are impacted by acute or chronic health conditions. The IDEA defines OHI as:

> *…having limited strength, vitality, or alertness, including a heightened alertness to environmental stimuli, that results in limited alertness with respect to the educational environment, that—*
>
> *(i) Is due to chronic or acute health problems such as asthma, attention deficit disorder or attention deficit hyperactivity disorder, diabetes, epilepsy, a heart condition, hemophilia, lead poisoning, leukemia, nephritis, rheumatic fever, sickle cell anemia, and Tourette syndrome; and*
>
> *(ii) Adversely affects a child's educational performance. [§300.8(c)(9)]*

It is important to note that while this definition does reference specific health conditions, the deliberate use of the words "such as" provides for wide and encompassing application and inclusion. Thus, a child, who has received a diagnosis by an appropriately licensed healthcare provider, who is experiencing limited strength, vitality or alertness because of this illness and his or her educational performance is negatively affected, could be included within this category. According to the National Center for Educational Statistics (NCES) individuals categorized as OHI composed 12% of the 2012-2013 child population making OHI the third most prevalent categorization served by the IDEA, (US Department of Education, 2014).

Contemporary Research – Common Characteristics

Multiple conditions and diseases may impair a child's health and ability to succeed in a learning environment. A condition may be chronic, that is, one that is always present or recurrent, for example, asthma, cerebral palsy or diabetes. Alternatively, the conditions may acute, characterized by sudden and severe onset but only lasting for a short period of time, such as a broken bone or mononucleosis. Unfortunately, access to accurate, descriptive data related to diagnoses that are associated with students with OHI is unavailable on a national level; we can extrapolate data from a similar population

(Children with Special Healthcare Needs between the ages of six and 17) collected by the US Centers for Disease Control (CDC) to try to describe the OHI population. For example, according to the CDC (NSHC, 2011), 80.4% of children with chronic illnesses were consistently engaged in schooling, 6.2% of these children were absent from school 11 or more days during the last calendar year and 9.1% reported repeating at least one grade. Among children with chronic health conditions, 61% were able to access necessary mental health care. Additionally, 77.2% and 84.4% of children with special healthcare respectively, reported access to preventive dental care and preventive healthcare. Nearly half of children with chronic illness had one or more parents/guardians who describe their own health as less than excellent or very good. It is a population with high needs in both education and health care.

Research teams at the University of Florida have provided several approximations of the prevalence of disability among K-12 virtual students. These estimates range from the low teens (Cavanaugh, Repetto, Wayer & Spitler, 2013; Spitler, Repetto & Cavanaugh, 2013) to 24% (Thompson, Ferdig & Black, 2012). This data is similar to estimates published by the National Association of State Directors of Special Education (Muller, 2009; Rhim & Kowal, 2008). Further complicating the epidemiological and pedagogical implications associated with these students is evidence that k12 online students with chronic health conditions are likely to have more than one diagnosis (e.g. cerebral palsy and attention deficit disorder) (Fernandez, Ferdig, Thompson, Schottke & Black, 2016). The field still lacks a comprehensive epidemiological understanding of the prevalence, scope and morbidity associated with OHI K-12 online students. Yet, even without this critical information, research indicates that students with disabilities are increasingly choosing to participate in virtual learning, and many virtual instructors, course designers and administrators are ill-prepared to address their needs (Basham et al., 2015; Burdette, Greer & Woods, 2013; Repetto, Cavanaugh, Wayer & Liu, 2010; Thompson, Ferdig & Black, 2012; Cavanaugh et al., 2011).

Contemporary Research – Socio-Cultural Notions of Disease and Illness

It is important for teachers, support staff and administrators to understand that illness and disease are separate constructs that are not mutually exclusive or inter-definable (Hofman, 2005); often they are closely related, but not always. Disease refers to a condition that adversely influences an individual. Illness refers to feelings that may, or may not accompany a disease. The experience of illness is a unique and personal one; it varies across individuals and over time and can be impacted by many non-disease related factors, such as beliefs, fears, feelings, culture and personal or other's expectations. In other words, while a child may have been clinically diagnosed with a disease and has experienced symptoms, they may not identify as sick or ill. Conversely, following the elimination of a disease, an individual may continue to identify as ill (Suris, Michaud, Viner, 2004). Our society often defines individuals with disability by their disease or diagnosis; this is an unfortunate reality that is often quite harmful to the individual's self-concept (Thomas, 2015; Munyi, 2012). For these reasons, children and parents may be reluctant to disclose a student's medical history or present challenges in the educational setting (Erickson & Larwin, 2016).

Many states have been forthright in their admission that they have been historically unprepared to address the needs of all students, Muller's 2009 report identified conclusions from 11 states including:

1. Virtual schools were opening before they had adequately prepared to serve students with disabilities;
2. Established standards were lacking for implementing special education services; •A need was recognized to revise curriculum for student accessibility;
3. Issues of the suitability for enrolling students with disabilities were identified; •Online education was serving an increasing number of students with more severe needs;
4. Miscommunication existed about persons' roles and responsibilities of IEP development and implementation;
5. Online programs were facing a challenge of accessing sufficient numbers of related service personnel; and
6. Both general and specialized technology to meet students' needs was lacking.

Today, nearly a decade since Muller's publication, effective state level policies and procedures related to students with disabilities in online classrooms remain a work in progress (Basham, Stahl, Ortiz, Rice & Smith, 2015)

Contemporary Research – Interventions and Accommodations

Rice (2015) asserts that the rigidity and structure often associated with virtual school content delivery is incompatible with the needs of individuals with OHI. Fortunately, the notion that instructor-driven pedagogical personalization will be necessary to address the needs of the increasingly diverse online classroom is not a novel concept (Archambault et al., 2010; Ferdig, Cavanaugh, DiPietro, Black & Dawson, 2009). In fact, best practices for educating students with disabilities have been identified (Repetto, Cavanaugh, Wayer & Liu, 2010), although they have not effectively diffused throughout the public state-led, public district or county level, charter, university led and private virtual schooling institutions serving the estimated 2.2 million K-12 online students (Watson & Pape, 2015).

Implementation of any practice is hindered when teachers and administrators are unaware of a students' disability (Carnahan & Fulton, 2013). Even in instances when an instructor has a copy of an IEP or 504 plan, the following questions can assist teachers, administrators and support personnel in the identification and better understanding of students who may have a disability, including those categorized as OHI (adapted from Grice, 2002).

1. Does the student have an existing IEP or 504 plan?
2. Does the student have a current health problem or history of health problems? If so, what is this health problem?
3. Does the student have limited strength, energy, or attentiveness? If not, does he or she have heightened reactions to general environmental stimuli?
4. If so, does the student's limited strength, energy, or attentiveness affect his or her ability to succeed in the educational environment? Or does the child's heightened alertness to the surrounding environment limit his or her alertness to the educational environment? If so, is the limited, or heightened, alertness due to a chronic or acute health problem?
5. If so, how is the student's educational performance affected by the limited alertness?
6. Finally, if so, does the disability create a need for special education services?

Of note, many professionals have had limited opportunity to directly communication with a person with a disability, whether this disability is classified as OHI or another. An important communication strategy to adopt whenever communicating with or about an individual with a disability is to adopt person first language. Person first language puts the person ahead of the disability. For example, instead of "the diabetic child", person first language encourages, "the child with diabetes" (Kelly, Wakeman, & Saitz, 2015).

Implications for Practice – Adapting Repetto et al's (2010) 5Cs for online students classified as other health impaired

In addition to the aforementioned screening questions, Repetto et al's (2010) "5 Cs" provide an evidence-based, simple, yet effective foundation to address the unique needs of students with OHI. The 5Cs: *connection, climate, control, curriculum,* and *caring community* have been successfully adopted and influenced graduation rates in virtual schools, including one of the five largest virtual schools in the United States. While not specifically designed for students with OHI, Repetto et al's (2010) 5C's for students with disabilities in online environments are sufficiently broad in scope. They provides a roadmap for creating high quality learning environments for students with and without disability, regardless of the categorization of impairment.

Connection

Connection describes the deliberate contextualization of the content associated with a virtual course to the students' concept of their future (Repetto, et al. 2010). Similar to the notions of context in adult instruction (Knowles, 1970), providing students with OHI the opportunity to understand how specific content will enable their growth and development is key to student resilience and success. This may require the adaption of curriculum to align with student goals and may necessitate that the instructor liaise with parents and students' healthcare providers and educational support team to understand the ecological environment associated with the student. Connection is age- and developmentally-dependent. For example, planning for the future of a seventeen year old whose medical history includes a life-threatening illness requiring high doses of intracranial radiation (side effects of which can include cognitive and emotional impairment) may include discussions about cognitively appropriate job opportunities and activities of daily living. From a generalizable perspective, among adolescents, connection planning may involve discussion of the content's applicability to developmentally appropriate opportunities for further education or employment. For younger students, connection may involve rooting content in discussions about transitions to middle school or high school.

Climate

Many online educators feel that internet-based education is inherently free from some of the biases that are prevalent in traditional face-to-face education because they cannot see the student (Rose, 2015). While the validity of this claim has not been fully explored, a safe and supportive environment can have a hugely positive impact on students' motivation regardless of disability status (Repetto, et al. 2010). For a student with OHI, the environment should promote acceptance by their peers and instructors. Person first language, respecting personal privacy and an openness to adaptation by other students and the instructor are simple but critical components of a positive climate and should be laid out as an expectations at the outset. Understanding that students with OHI may have difficulty conforming to schedules is vital; illness may necessitate frequent absence or periods of work coupled with periodic rest. Supporting individuals with OHI may demand the elimination of one-size-fits-all course calendars. Accommodation is an important attribute for success, but accommodation needs to be meaningfully combined with suitable academic and social expectations and egalitarian opportunities for student success (Repetto et al, 2010).

Control

Understanding students' daily challenges is an important first step towards providing opportunities for students with OHI to control and influence their own environment. Control and perceptions of control are highly specific in children and adolescents, perhaps more so among children who may experience frequent hospitalization, pain and regimented treatment protocols, since these required activities are often outside of their control. Introducing students with OHI to concepts such as self-determination and goal-setting aid in the development of self-concept and self-efficacy while providing opportunities for short and long-term growth and maturation. Effective strategies may include teaching methods that involve self-guided instruction, self-evaluation, social problem solving and decision-making (Wehmeyer, Agran & Hughes, 1998).

Curriculum

Bost and Riccomini (2006) and Repetto et al. (2010) describe multiple strategies for effective online curriculum including using evidence-based instructional theory, providing adequate academic supports and tailoring instructional content to the interests of students. Engaged learning strategies can be incorporated into online classrooms to promote student participation and collaboration (Bost and Riccomini 2006; Johnson 1998). Perhaps most importantly instructors should have the ability to adapt learning activities to accommodate the specific needs of the student (Adelstein & Barbour, 2016; Horn & Stalker, 2015; Packard, 2013). Simple adaptations could include flexibility related to due dates, restructuring activities for individual work, or conversely, turning individual work into group work, captioning for video presentations, and altering asynchronous content to synchronous learning sessions or vice versa (Archambault et al., 2010)

Caring Community

Establishing a supportive learning community that recognizes students as individuals is a critical component of all students' success. Modelling effective interactions, monitoring students' behaviors and developing relationships that, at a minimum, focus on students' basic needs is an important component of the online instructor's role (Borup, Graham & Drysdale, 2013). Just as in a traditional classroom, online classrooms can facilitate significant relationships amongst learners and instructors, but this notion may run against preconceptions held by many novice online students. By creating a caring community, opportunities for student-student and student- instructor relationships can flourish. Research by Chung-Do et al (2013) provides evidence that when instructors model personal disclosures online, they are frequently positively received and reciprocated (Borup, Graham & Drysdale, 2013; Ferdig, Cavanaugh, DiPietro, Black & Dawson, 2008). Methods for creating caring communities for students with OHI do not differ from the methods used to create caring communities for any learner. They include the following (adapted from Borup, Graham & Drysdale, 2013):

1. Respect student privacy (allow the student to choose how and whether to disclose disability)
2. Assess and work to counter personal preconceptions and biases related to students with disability
3. Provide timely feedback
4. Monitor student understanding
5. Monitor student online classroom behaviors
6. Provide positive feedback
7. Provide opportunities for content, assignment adaptation
8. Frequent check-in's with students (regardless of performance)
9. Provide multiple methods for instructor-student communication (e.g. text, phone, email, chat, video)
10. Attend to student and parent questions and concerns in a timely manner

Implications for Practice – Optimization of a Virtual and Blended Learning Environment for Student Success

The predominant theme associated with optimization regardless of whether the learning environment is blended or fully online with OHI is individualization. Yet Smith's 2016 broad evaluation of K-12 course content provides considerable evidence that a majority of content used in today's K-12 online learning environments is not well aligned with adaptive instructional design principles. Nor is it able to be individualized to fit the needs of the diverse students with OHI. One emergent strategy for the development of inclusive and adaptable online content is universal design for learning (UDL) (Rose & Meyer, 2002). UDL recognizes that there are no one-size-fits all methods for learners to access and interact with content. Instead, UDL necessitates multiple student-selected options centered on three principles (p. 75):

1. *Provide multiple means of representation*
2. *Provide multiple means of action and expression*
3. *Provide multiple means of engagement.*

These principles are achieved through the interrelation between UDL's four curricular components (Rose & Meyer, 2002):

1. Goals: Knowledge, concepts or skills that students need to master. These are often aligned with state standards and in the case of students with disabilities, linked to IEPs and classroom expectations.
2. Methods: Evidence-based instructional strategies employed to assist with student learning. UDL methods incorporate instruction for a variety of learning preferences, employ diverse materials and employ frequent opportunities for formative feedback (see assessment) which can be used to adjust content to support the needs of individuals.
3. Materials: Media used to deliver content. UDL emphasizes multiple media options or multiple means of representation. For example, in addition to a standard video-based lecture, content would be available with captions, in an audio only format, and as a text document with keywords highlighted.
4. Assessment: Frequent multi-method assessment of student progress. Ideal assessment should provide multiple means of engagement, action and expression and representation.

When incorporated effectively, UDL can assist in promoting self-regulated mastery learning, and inclusive learning communities (Katz, 2013).

Finally, it is worth revisiting and actively addressing the accessibility of learning materials online. Educational institutions are required maintain and management learning content so that individuals with disabilities enjoy reasonable access to services and resources required by the Americans with Disabilities Act of 1990, Section 504 of the Rehabilitation Act of 1973 and other applicable federal and state regulations. The ADA does not differentiate between online and brick and mortar institutions. Increasingly experts are recommending proactive auditing of learning environments and materials to ascertain ADA compliance (Hope, 2016a; Hope, 2016b). While audits are not free, the estimated cost pales in comparison to the legal processes associated with a lawsuit or other adjudicatory action. In addition to auditing, institutions should consider the use of tools such as UDOIT, an open-source content inspection application, to appraise accessibility of existing content and SensusAccess, a content conversion tool, to promote the development of better accessible content.

Implications for Research –

Though there is debate about when the first k-12 online school began offering classes (Watson & Murin, 2014), there is little argument that since their inception, online and blended learning represented substantial opportunity for students who may otherwise have challenges that limit their access to traditional classrooms (Thompson, Ferdig & Black, 2012). If we use 1995 as the date of genesis, k-12 blended and online is now in its second decade, yet we know relatively little about the impact that this technology can have on a population that is among our country's most vulnerable. As new therapies for chronic disease and acute conditions emerge, more children than even before will live longer and more fulfilling lives. For example, the projected median lifespan of a child born with cystic fibrosis in 2010 is estimated at 39 years; if born in 1990, that same child could only expect a median lifespan estimate of 28 years (FitzSimmons, 1993; MacKenzie et al, 2014). While prolonging life and promoting better wellness, advances in treatment do necessarily mitigate burdens that a condition places on the developing child. There are still physical limitations, treatment regiments, side effects, hospital stays and doctors visits that can hinder normalcy. Recent research provides evidence that even though cystic fibrosis is not associated with cognitive deficiencies, children living with the disease significantly underperform their peers in mathematics and reading (Hanxhiu, McKay, Singh-Grewal & Fitzgerald, 2017). Perhaps in 1990, concerns about education were more distant to concerns about the health of a child living with cystic fibrosis. Today and tomorrow, as new technologies result in increases in life expectancy, it is important to consider whether we are adequately preparing the child with disability for a long and flourishing future? What sort of impact could online learning provide to a child who will experience regular inpatient hospitalization for their entire life? Could online learning provide a bridge to equality for a child who is living with a chronic illness? Could engaging in rigorous online education have therapeutic value that is unknown and unrecognized? There are thousands of known disease and injury states; many that necessitate significant treatments that will affect participation in activities typically associated with childhood (CDC, 2010). Today we cannot estimate, with any level of confidence, the number of children with disabilities (regardless of type) that are currently enrolled in k-12 online or blended programs. Nor can we ascertain whether these children are receiving the federally mandated services and supports that can facilitate their successes. A foundational research agenda is necessary in order to better understand the epidemiology of k-12 online and blended learning. This understanding is a critical component necessary begin to comprehend the impact that technology facilitated learning may have for children with disability. This agenda includes:

1. Research must provide a valid and reliable estimate of the population of children with disability, including categorization of morbidity, that are currently participating in K-12 online and blended learning.
2. Research must explore the learning experience and outcomes of the population associated with #1.
3. Research must provide a valid and reliable assessment of the ADA mandated classroom supports that should be provided to the population associated with agenda item #1.
4. Research must provide a valid and reliable assessment of the ADA compliant services that are being provided by K-12 blended and online learning institutions for the population associated with agenda item #1.
5. Research should explore the learning experiences and educational outcomes of the population associated with agenda item #1 in comparison to peers.

Conclusion

Students with other health impairments represent a broad and complex constituency whose presence in K-12 online learning environments is certain, yet not accurately accounted for. A reliable and valid evaluation of the prevalence, epidemiology and outcomes associated with students who have been diagnosed with a disability would provide significant benefit to the field. Until such an endeavor, researcher's abilities to understand and provide guidance for practice will be limited. The recommendations provided in this chapter for researchers, K-12 online instructors, and to a lesser degree, staff and administrators are not fundamentally different from the deliberate practices and implications associated with K-12 online instruction of children without disability (Ferdig, Cavanaugh, DiPietro, Black & Dawson, 2010; Cavanaugh, Barbour & Clark, 2009; DiPietro, Ferdig, Black & Preston, 2008). Given this overlap it is worth considering an adapted quote from William Osler, "it is much more important to know what sort of a [student] has a disease than what sort of a disease a [student] has" (Gyles, 2009). That is, understanding the student as an individual and working to address their unique needs, regardless of IDEA classification, may be the ultimate 'best practice'.

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PART III

Research on Teaching

16

Introduction

Leanna Archambault

Increasing, throughout the literature, we see how essential and important the role of the teacher is to teaching and learning in K-12 online and blended environments. No matter how sophisticated technology becomes, it will never replace the role of a caring and invested highly qualified teacher. The challenge is that the role of the teacher changes in an online or blended setting. Teachers need to be prepared to succeed in this new setting and this preparation should equip them with the necessary skillsets that overlap but are distinct from how they might engage students in traditional classrooms. The chapters in this section update and address what we know about preparing K-12 educators for online and blended teaching at both the preservice and in-service levels.

In the first chapter of this section, Archambault and Kennedy confirm that the teacher education programs continue to make slow, but incremental progress when it comes to preparing preservice teachers for online teaching. This chapter provides an updated look at the state of the field as it pertains to the preparation of teachers for K-12 online and blended learning. It offers a look at how relevant frameworks, including technological pedagogical content knowledge (TPACK) and situated cognition are important when it comes to determining what K-12 online teachers need to know and be able to do when it comes the online environment. The chapter also shares ideas for future areas of research and implications for policy and practice. Despite the sluggish progress across the majority of teacher education programs, some programs are forging the way and making significant strides as they seek to prepare their teachers for online settings.

Next, Dawson and Dana examine how professional development (PD) research in traditional setting might inform what occurs in online and blended learning environments. Sadly, little new research in this area exists since the first iteration of the *Handbook*. The authors note that this is troubling as K-12 online learning has continued to expand. Also of concern are studies suggesting that virtual students underperform compared to their brick-and-mortar counterparts. Little is known about the systematic approach to professional development for K-12 online teachers. Dawson and Dana call for the field to move beyond descriptive survey and case study research. There are a multitude of opportunities for practitioners, policymakers and researchers to collaborate and work together to push forward the professional development of K-12 online teachers. They emphasize the need for K-12 online and blended learning programs to partner with university scholars in order to examine this very important topic.

In a subsequent chapter, Dawson and Dana also explore teacher mentoring in K-12 online and blended learning programs by offering a synthesis of the literature in five major areas: (1) the benefits and challenges of mentoring, (2) characteristics of effective mentors, (3) characteristics of effective mentees, (4) characteristics of effective mentoring programs, and (5) strategies to support mentoring. They use the knowledge base related to mentoring in traditional teaching and apply this knowledge as a springboard to suggest policy and research implications for the mentoring of K-12 online teachers.

Finally, Zhang, Liu, and Lin add a new topic in this area, and that is how teachers negotiate class size in K-12 online courses. The chapter examine research and trends in online learning to suggest that when it comes to class size, there is not a specific solution that should be applied universally. Because class size is an important factor to other critical contextual issues, including teaching, teacher experience, learning performance, interaction, among others, it should be studied to maximize the potential for learning success among students. Implications for and for practitioners, policy-makers, and online instructors are provided, in addition to suggestions for future research.

The goal of this section is to better understand and offer insights related to the preparation of teachers for instruction in K-12 online and blended environments. As with the previous iteration of the *Handbook*, there continue to be numerous opportunities for new authors to add to this volume by researching and writing about teacher development in this area. While progress has been made since the first publication, it has been very gradual. The field continues to benefit from the community sharing their programs, models, successes, and obstacles. We encourage additional voices to contribute to the growing scholarship in this field as a mechanism to support efforts to best prepare educators for 21st century classrooms.

17

Teacher Preparation for K-12 Online and Blended Learning

Leanna Archambault & Kathryn Kennedy

Abstract

The field of K-12 education is constantly evolving with new learning models, especially those featuring online and blended learning options. With the emergence of these learning environments, teacher education programs are posed as an ideal place for preservice and in-service teachers to gain knowledge of teaching in online and blended settings. This chapter reviews the state of the field as it pertains to the preparation of teachers for K-12 online and blended learning. It also shares ideas for future areas of research as well as implications for policy and practice.

Keywords: Teacher preparation, endorsements, professional development, field experiences, situated cognition, TPACK, online pedagogy

Introduction

While researchers have called for transformation in teacher education to address the growing need of preparation for evolving educational contexts, progress continues to be slow, incremental, and somewhat isolated. Considering the rapid rate at which society is changing due to the connected nature of modern day living, teachers today are living and working in a drastically different learning environment. Unfortunately, many teacher education programs are not adequately preparing teachers for the jobs that they will fill, particularly those in K-12 online and blending settings (Archambault, 2011).

K-12 online education is a disruptive force that has been on the brink of an exponential growth pattern (Miller & Ribble, 2010). The need for highly-qualified, classroom teachers is essential in all settings, but in the modern era, these teachers need to be prepared to meet the challenges of interacting and engaging students that are separated from them in space and/or time (Charania, 2010). To be effective, increasingly, teachers must be able to (a) convey knowledge with limited face-to-face contact, (b) design and develop course content in a technology-based environment, (c) deliver content in a way that will engage students, and (d) use assessment measures to assure that students master content. Unfortunately, however, there is a significant disconnect between the growing expectations for online education and the training of teachers expected to teach in this uniquely different environment. While some form of online learning is now available in every state (Watson, Murin, Vashaw, Gemin, & Rapp, 2011), only a small minority of current K-12 online teachers have received formal training on how to teach online during the course of their teacher education program (Archambault, 2011; Dawley, Rice, & Hinks, 2010).

To a large extent, the new expectation of a successful and effective educator in the 21st century will be one who can blend together the best technology-based resources with engaging pedagogical strategies in both online as well as face-to-face settings. To address this issue, we must design curricula and field experiences to prepare teachers with skills, strategies, and dispositions so that they are able to create independent learners who can collaborate, problem-solve, and teach themselves using all the resources that are and will be available to them (Lankshear & Knobel, 2007; Leu, Kinzer, Coiro, & Cammack, 2004). Teacher education programs must adapt existing practices in order to produce the next generation of effective teachers. This chapter presents an overview of relevant theoretical themes and existing research that influence our current understanding about the types of experiences needed for effective teacher preparation for online and blended environments. Stemming from this research, it suggests relevant implications for policy and practice and explores areas for future research.

Theoretical Framework

In order to gain a better understanding of what K-12 online teachers need to know along with the skill sets they need in order to be effective, an examination of relevant theoretical perspectives is helpful. Two specific frameworks, technological pedagogical content knowledge (TPACK) and situated cognition, provide guidance when exploring knowledge and skills pertaining to online teaching.

Technological Pedagogical Content Knowledge (TPACK)

TPACK involves an understanding of the complexity of relationships among students, teachers, content, technologies, practices, and tools (Mishra & Koehler, 2005). In examining how teachers should be prepared to teach in online and blended environments, TPACK articulates the transformation of the three major components needed to ensure quality teaching: technological knowledge, pedagogical knowledge, and knowledge specific to one's content area. Using the TPACK framework to focus on online and blended environments specifically, emphasis is centered on the technological aspects that impact the extent to which technology facilitates student learning. Teachers need to be prepared to implement teaching strategies that adapt curriculum to an online environment. While the principles of effective teaching transcend the educational environment, the methods of implementation are different. Online teachers need to learn how to encourage student interaction, how to manage the multiple roles they will play in an online environment, and how to assess student learning in an online setting. These skills, together with the principles of instructional design, including sufficiently knowing a particular content to be able to use adopted technology to develop and offer quality online teaching, are at the crux of what the TPACK framework aims to convey. The question then becomes how to train teachers to acquire and translate these skills in an online environment.

In a systematic review of the literature to determine the kinds of knowledge and skills needed for successful online teachers, Moore-Adams, Jones, and Cohen (2016) applied the TPACK framework and mapped skills necessary for online teaching. This alignment is found in Table 1 (reproduced with permission).

TPACK Knowledge Domain	Knowledge and skills extracted from the literature
Technological Knowledge (TK)	• Skilled with basic uses of technology • Ability to use a range of software • Ability to identify features of different software • Understanding of constraints and possibilities of different software • Ability to deal with constraints and possibilities of different software • Ability to create basic web pages • Ability to construct interactive web pages • Teacher has the prerequisite technology skills to teach online • Master the interfaces in which instruction will be delivered • Continually extend their content and technological knowledge • Uses technology to deliver content • Require technical knowledge to be able to function in the online environment • Understand impact of course pacing on course design and the pedagogical strategies they use • Build in course components to reflect the interests of students enrolled in the course • Knowledge of curriculum design and frameworks for online learning • Basic knowledge of course evaluation • Ability to apply curriculum design and frameworks for online (language) learning • Ability to evaluate online (language) learning course based on one or more frameworks • and to modify components accordingly • Intuitive and integrated evaluation of online (language) learning tasks based on one or more frameworks • Intuitive and integrated formative evaluations of online (language) course • Produces course requirements and timetable • Provides a comprehensive set of informational materials • Motivate students by clearly organizing and structuring content • Teacher arranges media and content to help students and teachers transfer knowledge most effectively in the online environment • Develop and deliver activities that are collaborative, highly interactive, and motivating, while encouraging engagement with the content

	• Know when to develop resources to service specific purposes • Seek out and make available a variety of supplemental support tools to meet the diverse needs of students • Ability to choose suitable technology to match online (language) learning task • Creativity in using and adapting technology for online (language) learning tasks • Creativity in using and adapting materials to create new online (language) materials • and tasks to facilitate communicative competence and online interaction • Understands how to use and select appropriate resources • Knowledge of basic programming language • Ability to troubleshoot basic browser problems • Communicates available tech support • Communicates abilities to provide tech support • Teacher has experienced online learning from the perspective of a student
Content Knowledge (CK)	• Have extensive knowledge of an appreciation for the content area they teach • Shared knowledge of content standards and curriculum resources • Has content and pedagogy knowledge • Continually extend their content and technological knowledge
Pedagogical Knowledge (PK)	• Use student and course data to self-evaluate pedagogical strategies they use • Use multiple strategies to assess student learning • Use alternative assessment strategies that allow students the opportunity to represent their knowledge in ways that are personally meaningful • Use multiple strategies to form relationships that support rich interactions with students • Use strategies to connect with students • Engage students in conversation about content and non-content related topics to form a relationship with each student • Basic knowledge of task evaluations • Has content and pedagogy knowledge • Develop and deliver activities that are collaborative, highly interactive, and motivating, while encouraging engagement with the content • Understand how and when to provide appropriate supports • Use strategies to address inappropriate or abusive behaviors of the students in public forums of the course • Monitor venues of public communications in their course to identify students in personal crisis • Outlines materials and notifies students of changes • Supports time management skills • Observes conduct and academic honesty policies • Monitors student interactions and communication • Balances structure and flexibility • Promote full participation • Establish a presence on the course to motivate students • Interact with students with quick feedback to maintain their motivation for completing the course • Model what ‘formal’ online communication looks like in discussion board and emails • Effectively monitor the tone and emotion of their communications with students • Provides multiple opportunities for communication

- Provides quick responses, meaningful feedback
- Models and participates in student discussions
- Facilitate discussion in a way that keeps students on task
- Develop co-presence in VS classroom
- Create a supportive and interactive environment with mutual support and respect
- Teacher provides online leadership in a manner that promotes student success through regular feedback, prompt response and clear expectations
- Understand how to provide opportunities for students to interact with one another and the instructor
- Encourage and support communication between students
- Facilitate the formation of community by encouraging content and non-content related conversations among students
- Knowledge of strategies to facilitate communicative competence and online interaction
- Ability to facilitate communicative competence and online interaction
- Fosters participation and collaborations
- Fosters a sense of community and interaction
- Manage student communication
- Active teacher involvement in monitoring and engaging student discussion
- Become a master of written communication
- Develops critical thinking skills
- Can make modifications to content and delivery
- Accommodates student differences
- Teacher understands and is responsive to students with special needs in the online classroom
- Know when to develop resources to service specific purposes
- Can team teach
- Ability to apply (language) learning theories for online (language) learning
- Knowledge of strategies for online (language) assessment
- Ability to assess (language) learning using different assessment methods
- Intuitive and integrated assessment of (language) learning
- Evaluate and assesses students, including student self-assessment
- Teacher demonstrates competencies in creating and implementing assessment in online learning environments in ways that assure validity and reliability of instruments and procedures
- Teachers develops and delivers assessments, projects, assignments that meet
- standards-based learning goals and assesses learning progress by measuring student achievement of learning goals
- Teacher demonstrates competencies in using data and findings from assessments and other data sources to modify instructional methods and content and to guide student learning
- Teacher demonstrates frequent and effective strategies that enable both teacher and students to complete self- and pre-assessments
- Knowledge of strategies for online community building and socialization
- Ability to foster online community and socialization
- Creativity in facilitating online socialization and community building
- Becomes a part of the learning communities
- Teacher models, guides, and encourages legal, ethical, safe and healthy behavior related to technology use
- Ability to assess (language) learning using different assessment methods
- Teacher has experienced online learning from the perspective of a student

Technological Content Knowledge (TCK)	• Use their content knowledge and knowledge of students to drive the integration of technology • Teacher arranges media and content to help students and teachers transfer knowledge most effectively in the online environment • Develop and deliver activities that are collaborative, highly interactive, and motivating, while encouraging engagement with the content • Know when to develop resources to service specific purposes
Technological Pedagogical Knowledge (TPK)	• Teacher arranges media and content to help students and teachers transfer knowledge most effectively in the online environment • Develop and deliver activities that are collaborative, highly interactive, and motivating, while encouraging engagement with the content • Knowledge of language learning theories for online (language) learning • Provides multiple opportunities for communication • Providing multiple opportunities for interaction through various media • Consider issues of student access to technology when integrating web based components into their course • Teacher models, guides, and encourages legal, ethical, safe and healthy behavior related to technology use • Understand how to provide opportunities for students to interact with one another and the instructor • Teacher has experienced online learning from the perspective of a student • Use strategies to address inappropriate or abusive behaviors of the students in public forums of the course
Pedagogical Content Knowledge (PCK)	• Monitor venues of public communications in their course to identify students in personal crisis • Outlines materials and notifies students of changes • Supports time management skills • Observes conduct and academic honesty policies • Monitors student interactions and communication • Balances structure and flexibility • Promote full participation • Outlines materials and notifies students of changes • Provides multiple opportunities for communication • Understand how to provide opportunities for students to interact with one another and the instructor
Technological Pedagogical Content Knowledge (TPACK)	• Supports time management skills • Observes conduct and academic honesty policies • Monitors student interactions and communication • Balances structure and flexibility • Promote full participation • Teacher provides online leadership in a manner that promotes student success through regular feedback, prompt response and clear expectations • Master of written communication • Participate in a field experience for online K12 learning

Table 1. Knowledge and skills by TPACK knowledge domain.

Moore-Adams et al. (2016) found that only one program in higher education designed to prepare K-12 online teachers implemented at least six of the seven knowledge domains of TPACK, with most programs focusing on specific domains rather than integrating TPACK. According to the researchers, there was a great deal of variability among the programs, particularly when it came to content or learning experiences (Moore-Adams et al., 2016). While technological pedagogical knowledge was present across programs, content knowledge was not apparent in any. Also, technical knowledge was a primary focus in four programs, but not present in the other five. Another inconsistency was the inclusion or exclusion of a field experience component, which lead us to the second theoretical framework, that of situated cognition.

Situated Cognition

According to the framework of situated cognition, value is placed on practical, hands-on experience as a primary mechanism of learning. Being in an authentic teaching environment allows preservice teachers to apply their technological pedagogical content knowledge in a real-world context. This is accomplished through the cognitive apprenticeship, an essential and central element of situated cognition that "supports learning a domain by enabling students to acquire, develop, and use cognitive tools in authentic domain activity" (Brown, Collins & Duguid, 1989, p. 39). During the cognitive apprenticeship, preservice teachers directly observe the classroom, emulate and model the practice of their mentor teacher, and then reflect on their observations and teaching. Mentor teachers are able to provide direct feedback including addressing any related misconceptions with the goal of making their expert tacit knowledge explicit, modeling effective teaching strategies, and providing scaffolded support during instruction (Collins, Brown & Newman, 1989). This apprenticeship is essential for preservice teachers to be able to translate what they learned in their teacher education programs to their future classrooms (Moore, 2003).

In teacher education, the cognitive apprenticeship takes place during a field experience component, which has long been a central and vital part of preparing teachers (Aiken & Day, 1999; Buck, Morsink, Griffin, Hines, & Lenk, 1992; Harlin, 1999; Joyce, Yarger, Howey, Harbeck, & Kluwin, 1977; Wiggins & Follo, 1999). This is because learning to teach requires a contextualized, authentic setting with the participant engaged in direct interaction and reflection within the environment (Brown, Collins & Duguid, 1989). In the 1970s, field experiences were deemed essential and, as a result, were mandated by the U.S. state departments of education as part of the teaching certification process (Moore, 1979). The field experience has become a key component of teacher education programs across the country with programs, such as Arizona State University's iTeach program, experiencing success with extending it from one semester to an entire school year.

While field experiences are considered to be a cornerstone of traditional teacher education programs, the authentic learning environment to prepare a teacher for a virtual environment needs to be an online, web-based setting. This virtual apprenticeship should occur with the cooperation of an expert online teacher who is able to make strategies, techniques, and approaches to teaching explicit. Through the cognitive apprenticeship in an online environment, the preservice teacher can observe how the mentor teacher is able to engage and motivate students who may be separated by space as well as time. The mentor teacher can also model how to evaluate students' progress, strategies for handling the volume of email, and ways to encourage self-regulation, which is an important trait for success in virtual settings (Tsai, Shen, & Fan, 2013). Student teachers in online contexts can use the opportunity to examine their beliefs about what it means to be a teacher and consider whether or not this form of instruction represents a good fit. Just as online learning is not for all students, it may not be for all teachers. Having the chance to explore this type of teaching is an important experience for future educators. Previous research related to the prevalence of K-12 online field experiences found that in 2010, only 1.3% of nationally surveyed teacher education programs offered a systematic form of field experiences in an online setting (Kennedy & Archambault, 2012a). This increased modestly to 4.1% of surveyed programs as of 2016. These studies are reviewed in further detail later in this chapter.

Relevant Standards Pertaining to Online Teaching

One of the ways that the field has sought to outline the necessary skills for quality online teaching is through the development of relevant sets of standards. Standards have been created by various professional organizations to assess effective online teaching. In chronological sequence these sets of standards include:

- Southern Regional Education Board (SREB) *Essential Principles for High-quality Online Teaching* (SREB, 2003)
- National Education Association (NEA) *Guide to Teaching Online Courses* (NEA, 2006)
- International Society for Technology in Education (ISTE) *National Educational Technology Standards for Teachers* (NETS-T) (ISTE, 2008)
- International Association for K12 Online Learning (iNACOL) *National Standards for Quality Online Teaching* (iNACOL, 2011; 2008)
- Quality Matters *Design Standards for Online and Blended Courses* (Quality Matters, 2010)

When examining desired skills and dispositions teachers should possess to become successful in the online setting, common themes become apparent. These include online pedagogy (i.e., classroom management, communication, feedback, etc.); instructional design, including accessibility and accommodation; assessment/evaluation of student learning; professionalism/ethics; and technical expertise. A crosswalk of the skills covered comes from Kennedy & Archambault (2012b) and is included here for reference (Table 2).

General Topic	Professional Organization	Standards
Qualifications, professional development, & credentials	iNACOL	• Knows and understands the professional responsibility to contribute to the effectiveness, vitality, and self renewal of the teaching profession, as well as to their online school and community; • Knows and understands the need to coordinate learning experiences with other adults involved in providing support to the student (e.g., parents, local school contacts, mentors) to support student learning; • Knows and understands the need for continuing to update academic knowledge, pedagogy, and skills; • Knows and understands the need for professional activity and collaboration beyond school (e.g., professional learning communities) to update academic skills and knowledge and collaborate with other educators; • Interacts in a professional, effective manner with colleagues, parents, and other members of the community to support students' success; • Knows and understands the participation in an online course from a student-centered approach; and • Knows and understands the subject area and age group they are teaching.
	SREB	• Meets the professional teaching standards established by a state licensing agency or the teacher has academic credentials in the field in which he or she is teaching; meets the state's professional teaching standards or has academic credentials in the field in which he or she is teaching; provides evidence that he or she has credentials in the field of study to be taught; knows the content of the subject to be taught and understands how to teach the content to students; facilitates the construction of knowledge through an understanding of how students learn in specific subject areas; and continues to update academic knowledge and skills; and • Has experienced online learning from the perspective of a student; applies experiences as an online student to develop and implement successful strategies for online teaching; demonstrates the ability to anticipate challenges and problems in the online classroom; and demonstrates an understanding of the perspective of the online student through appropriate responsiveness and a supportive attitude toward students.
Curriculum, instruction, and student achievement	iNACOL	• Knows and understands the process for aligning teacher and student expectations for the course, in general; • Knows and understands the need to create and explain objectives, concepts, and learning outcomes in a clearly written, concise format and to explain the course organization to students; • Develops and delivers assessments, projects, and assignments that meet standards-based learning goals and assesses learning progress by measuring student achievement of the learning goals; • Knows and understands the relationships between the assignments, assessments, and standards-based learning goals; • Demonstrates competency in using data from assessments and other data sources to modify content and to guide student learning; knows and understands techniques to plan individualized instruction incorporating student data; knows and understands how data is used to modify the content, instruction, and assessment to meet student needs; knows and understands how instruction is based on assessment data; • Knows and understands options to expand student thinking, address styles of learning, and provide avenues for enrichment or intervention;

		• Knows and understands a variety of methods and tools to reach and engage students who are struggling; • Knows and understands the importance of self-reflection or assessment of teaching effectiveness; and • Knows and understands the role of student empowerment in online learning.
	NEA	• Online teachers should have the facility to track student participation in the course, viewing course logs, student postings in the discussion area, and student assignments.
	SREB	• Differentiates instruction based on students' learning styles and needs and assists students in assimilating information to gain understanding and knowledge; • Exhibits the ability to assess student knowledge and instruction in a variety of ways; • Provides student-centered lessons and activities that are based on concepts of active learning and that are connected to real-world applications; and • Demonstrates growth in teaching strategies in order to benefit from current research and practice.
Online pedagogy	iNACOL	• Knows the primary concepts and structures of effective online instruction and is able to create learning experiences to enable student success; • Knows and understands the current best practices and strategies for online teaching and learning and their implementation in online education; • Knows and understands the role of online learning in preparing students for the global community they live in, both now and in the future; • Knows and understands the instructional delivery continuum (e.g., fully online to blended to face-to-face); • Plans, designs, and incorporates strategies to encourage active learning, application, interaction, participation, and collaboration in the online environment; • Knows and understands the techniques and applications of online instructional strategies, based on current research and practice (e.g., discussion, student-directed learning, collaborative learning, lecture, project-based learning, forum, small group work); and • Knows and understands differentiated instruction based on students' learning styles.
	SREB	• Plans, designs and incorporates strategies to encourage active learning, interaction, participation and collaboration in the online environment; • Demonstrates effective strategies and techniques that actively engage students in the learning process (e.g., team problem-solving, in-class writing, analysis, synthesis and evaluation instead of passive lectures); and • Leads online instruction groups that are goal-oriented, focused, project-based and inquiry-oriented.
Ethics of Online Teaching	iNACOL	• Models, guides, and encourages legal, ethical, and safe behavior related to technology use; • Knows and understands the responsibilities of digital citizenship and techniques to facilitate student investigations of the legal and ethical issues related to technology and society; • Knows and understands how the use of technology may lead to instances of academic dishonesty; • Knows and understands resources and techniques for implementing Acceptable Use Policies (AUP); • Knows and understands techniques for recognizing and addressing the inappropriate use of electronically accessed data or information; and • Knows and understands privacy standards about other students and their posting and performance that are outlined in FERPA or other similar guidelines.

	SREB	• Models, guides and encourages legal, ethical, safe and healthy behavior related to technology use; • Facilitates student investigations of the legal and ethical issues related to technology and society; • Establishes standards for student behavior that are designed to ensure academic integrity and appropriate uses of the Internet and written communication; • Identifies the risks of academic dishonesty for students; • Demonstrates an awareness of how the use of technology may impact student testing performance; • Uses course content that complies with intellectual property rights policies and fair use standards; • Provides students with an understanding of the importance of Acceptable Use Policies (AUP); and • Demonstrates knowledge of resources and techniques for dealing with issues arising from inappropriate use of electronically accessed data or information; and informs students of their right to privacy and the conditions under which their names or online submissions may be shared with others.
Communication/ Interaction	iNACOL	• Knows and understands techniques to create an environment that will engage, welcome, and reach each individual learner; • Knows and understands the need to establish and maintain ongoing and frequent teacher-student interaction, student-student interaction, teacher-parent interaction, and teacher-mentor interaction; • Knows and understands techniques to maintain strong and regular communication with students, using a variety of tools; • Knows and understands the need to define the terms of class interaction for both teacher and students; • Knows and understands the process for maintaining records of relevant communications; • Knows and understands the importance of interaction in an online course and the role of varied communication tools in supporting interaction; • Knows and understands the process for facilitating, monitoring, and establishing expectations for appropriate interaction among students; • Knows and understands the techniques for developing a community among the participants; and • Knows and understands the process for facilitating and monitoring online instruction groups that are goal-oriented, focused, project-based, and inquiry-oriented to promote learning through group interaction.
	NEA	• Be sensitive to problems of misinterpretation, and use an appropriate online tone in course design and course delivery; • Model an appropriate tone, and guide students toward an appropriate tone when they stray; • Foster appropriate online student behavior, model an effective and respectful online tone, guide discussions' tone and substance, and address problems with inappropriate online behaviors such as "flaming"; • Communicate with a number of other stakeholders through a variety of methods, some online, some not; • Foster student-to-student discussion during course design and deliver; • Build in course discussion as a feature of student assessment; • Provide instructions regarding when, where, and how students participate in online discussions; • Facilitate course discussions by intervening appropriately when discussions are either not occurring or are inappropriate;

		• Foster student-to-student collaboration through the use of online discussions, group projects, team activities, and instructional style; • Demonstrate skill at facilitating discussions, and be reliable guides to student learning; and • Demonstrate the appropriate use of both synchronous and asynchronous communications with students, using one-on-one communications when needed, and fostering and guiding group discussions.
	SREB	• Facilitates and monitors appropriate interaction among students; builds and maintains a community of learners by creating a relationship of trust, demonstrating effective facilitation skills, establishing consistent and reliable expectations, and supporting and encouraging independence and creativity; • Encourages collaboration and interaction among all students; and • Promotes learning through group interaction.
Assessment & Evaluation	iNACOL	• Demonstrates competencies in creating and implementing assessments in online learning environments in ways that ensure validity and reliability of the instruments and procedures; • Knows and understands the need to define the assessment criteria for the course; • Knows and understands adequate and appropriate assessment instruments to measure online learning that reflect sufficient content validity (i.e., that adequately cover the content they are designed to measure), reliability, and consistency over time; • Knows and understands the implementation of online assessment measures and materials in ways that ensure instrument validity and reliability; • Knows and understands multiple strategies for ensuring the security of online student assessments, academic integrity, and assessment data; • Knows and understands the reach of authentic assessments (i.e., the opportunity to demonstrate understanding of acquired knowledge and skills, as opposed to testing isolated skills or retained facts) are part of the evaluation process; • Knows and understands varied assessment strategies that address levels of ability through a variety of alternative interventions; • Knows and understands the process of continuous evaluation of students to include formative and summative assessments and student feedback, including polls and surveys that reflect student learning progress throughout the course; • Knows and understands the use of effective learning strategies data for an individual student to formulate detail-specific changes in future instruction, based on assessment results and research study (data-driven and research-based); • Knows and understands ways for teacher and students to assess student readiness for course content and method of delivery; • Knows and understands that student success (e.g., grade, level of participation, mastery of content, completion percentage) is an important measure of teaching and course success; and • Knows and understands the importance of student self-assessment.

	SREB	• Demonstrates competencies in creating and implementing assessments in online learning environments in ways that assure validity and reliability of instruments and procedures; • Creates or selects fair, adequate and appropriate assessment instruments to measure online learning that reflect sufficient content validity (i.e., that adequately cover the content they are designed to measure), reliability and consistency over time; • Implements online assessment measures and materials in ways that ensure instrument validity and reliability; • Develops and delivers assessments, projects and assignments that meet standards-based learning goals and assesses learning progress by measuring student achievement of learning goals; • Continually reviews all materials and Web resources for their alignment with course objectives and state and local standards and for their appropriateness; • Creates assignments, projects and assessments that are aligned with students' different visual, auditory and hands-on ways of learning; • Includes authentic assessment (i.e., the opportunity to demonstrate understanding of acquired knowledge and skills as opposed to testing isolated skills or retained facts) as part of the evaluation process; • Provides continuous evaluation of students to include pre- and post-testing and student input throughout the course; and demonstrates an understanding of the relationships between and among the assignments, assessments and standards-based learning goals; • Demonstrates competencies in using data and findings from assessments and other data sources to modify instructional methods and content and to guide student learning; • Assesses each student's background and content knowledge and uses these data to plan instruction; • Reviews student responses to test items to identify issues related to test validity or instructional effectiveness; • Uses observational data (e.g., tracking data in electronic courses, Web logs, e-mail) to monitor course progress and effectiveness; • Creates opportunities for self-reflection or assessment of teaching effectiveness within the online environment (e.g., classroom assessment techniques, teacher evaluations, teacher peer reviews); • Demonstrates frequent and effective strategies that enable both teacher and students to complete self- and pre-assessments; • Employs ways to assess student readiness for course content and method of delivery; • Employs ways for students to effectively evaluate and assess their own readiness for course content and method of delivery; and • Understands that student success (e.g., grade, level of participation, mastery of content, completion percentage) is an important measure of teaching and course success; and provides opportunities for student self-assessment within courses.
Feedback	iNACOL	• Promotes student success through clear expectations, prompt responses, and regular feedback; • Knows and understands techniques for using appropriate communications in support of student engagement through prompt and regular feedback, and setting and communicating high expectations; • Knows and understands the need to provide clear expectations for teacher response time to student queries; and • Knows and understands the need for timely, constructive, personalized feedback to students about assignments and questions.

	NEA	• Monitor student learning, and provide students with feedback on their performance; • Review submitted work in a timely fashion (usually within one week of submission), and should provide students with feedback; • Be active and regular participants in their classes; • Take part in class discussions, review submitted work promptly, respond to student questions on a regular and consistent basis, and schedule online meeting times, as needed; and • Attend their online class on a daily basis, and respond to student questions expeditiously.
	SREB	• Provides online leadership in a manner that promotes student success through regular feedback, prompt response and clear expectations; • Models effective communication skills and maintains records of applicable communications with students; • Encourages interaction and cooperation among students, encourages active learning, provides prompt feedback, communicates high expectations, and respects diverse talents and learning styles; • Persists, in a consistent and reasonable manner, until students are successful; • Establishes and maintains ongoing and frequent teacher-student interaction, student-student interaction and teacher-parent interaction; • Provides timely, constructive feedback to students about assignments and questions; and • Gives students clear expectations about teacher response time.
Accommodations and Diversity Awareness	iNACOL	• Is cognizant of the diversity of student academic needs and incorporates accommodations into the online environment; • Knows and understands the diversity of student learning needs, languages, and backgrounds; • Knows and understands how adaptive/assistive technologies are used to help people who have disabilities gain access to information that might otherwise be inaccessible; • Knows and understands the process for connecting with local support personnel to verify student's IEP requirements or 504 accommodations needed for student success; • Knows and understands legal mandates stipulated by the Americans with Disabilities Act (ADA), the Individuals with Disabilities Education Act (IDEA), the Assistive Technology Act, and Section 508 or other similar guidelines/requirements for accessibility; and • Knows and understands that students have varied talents and skills and make appropriate accommodations designed to include all students.
	SREB	• Understands and is responsive to students with special needs in the online classroom; • Understands that students have varied talents and skills and uses appropriate strategies designed to include all students; • Demonstrates knowledge and responds appropriately to the cultural background and learning needs of non-native English speakers; • Provides activities, modified as necessary, that are relevant to the needs of all students; and • Adapts and adjusts instruction to create multiple paths to learning objectives.
	NEA	• Demonstrate an ability to use multimedia, as appropriate, in course materials, in ways that comply with Section 508 requirements.

Management	iNACOL	• Knows and understands the need to establish criteria for appropriate online behavior for both teacher and students; • Knows and understands effective time management strategies; • Knows and understands online course management tasks; • Provide course materials to students in a timely manner, so that students have all course materials when needed. These include physical materials that may be mailed to students at school or at home, or electronic materials in the form of reference works or Internet links.
	SREB	• Provides an online syllabus that details the terms of class interaction for both teacher and students, defines clear expectations for both teacher and students, defines the grading criteria, establishes inappropriate behavior criteria for both teacher and students, and explains the course organization to students; and • Provides a syllabus with objectives, concepts and learning outcomes in a clearly written, concise format; uses student data to inform instruction, guides and monitors students' management of their time, monitors learner progress with available tools and develops an intervention plan for unsuccessful learners.
Technological knowledge	iNACOL	• Understands and is able to use a range of technologies, both existing and emerging, that effectively support student learning and engagement in the online environment; • Knows and understands the use of an array of grade-appropriate online tools for communication, productivity, collaboration, analysis, presentation, research, and content delivery; • Knows and understands the use of emerging technologies in a variety of mediums for teaching and learning, based on student needs • Knows and understands basic troubleshooting skills and the responsibility to address basic technical issues online students may have; • Knows and understands the need to continuously update their knowledge and skills for using the evolving technology tools that support online learning; • Knows and understands appropriate tools and technologies to make accommodations to meet student needs • Knows and understands critical digital literacies and 21st century skills; and • Knows and understands appropriate use of technologies to enhance learning.
	SREB	• The teacher has the prerequisite technology skills to teach online; • Demonstrates the ability to effectively use word-processing, spreadsheet and presentation software; • Demonstrates effective use of Internet browsers, e-mail applications and appropriate online etiquette; • Demonstrates the ability to modify and add content and assessment, using an online Learning Management System (LMS); • Incorporates multimedia and visual resources into an online module; • Utilizes synchronous and asynchronous tools (e.g., discussion boards, chat tools, electronic whiteboards) effectively; • Troubleshoots typical software and hardware problems; • Demonstrates the ability to effectively use and incorporate subject-specific and developmentally appropriate software in an online learning module; and • Demonstrates growth in technology knowledge and skills in order to stay current with emerging technologies.
	NEA	• Be familiar with online tools and online infrastructure, including Learning Management Systems (LMS) and Content Management Systems (CMS), and they should understand the appropriate uses of each system to support online course design and delivery; • Answer student questions on certain technical issues, including posting to discussions, submitting assignments, using the Internet, and viewing online grades; • Pay particular attention to the course enrollment process, be able to determine which students are enrolled in the online course, and know how to add and drop students from the course; • Be adept with the various platform features so that they can provide students the opportunity to submit their work online; • Demonstrate an ability to search and use Internet sites so that links to them can be incorporated into course documents; and • Employ CMS features to use and appropriately reference web sites, and have the Information Literacy skills to determine which sites are legitimate and of sufficient merit for inclusion.
Design	iNACOL	• Arranges media and content to help students and teachers transfer knowledge most effectively in the online environment.
	NEA	• Make appropriate use of the CMS platform's features, producing documents that are well organized for use by students, and that are kept up-to-date during course delivery; • Be familiar with the full range of CMS elements, and be able to select the appropriate elements while designing and teaching online courses; • Be familiar with online design and content standards, have the ability to determine which standards are appropriate for their course design and delivery needs, and be able to demonstrate use of design and content standards in course-document creation and course delivery; and • Revise course documents to keep them up-to-date and accurate.

Table 2. Cross Reference of Online Teaching Standards

Together with standards geared toward online teaching, accreditation standards, such as those developed by the National Council for Accreditation of Teacher Education (NCATE) and the Teacher Education Accreditation Council (TEAC), can also be used to inform the design and development of preparing teachers for online and blended contexts. These standards do not solely concentrate on preparing teachers for online learning; they also apply in blended settings and encapsulate the principles of effective teaching and the meaningful use of technology integration in the classroom. In general, accreditation standards focus on similar areas as those that focus on online teaching. These include a focus on the learning process, content knowledge, teaching methods or pedagogy, assessment strategies, and professional conduct/responsibilities. Both sets of standards (online and accreditation standards focused on traditional teaching) emphasize what quality teachers should know and be able to do. However, the ways in which these skills are implemented can be very different in an online setting.

Together with relevant theory, such as technological pedagogical content knowledge and situated cognition, standards play an important role in attempting to identify the necessary knowledge, skills, and dispositions teachers need in order to be successful in the online environment. Building from this foundation, we can examine relevant research literature to inform the further development of teacher education programs designed to prepare educators for 21st century classrooms.

Teacher Education in K-12 Online Learning

As early as 2003, researchers were calling for teacher preparation programs to teach preservice teachers how to teach online (Irvine, Mappin, & Code, 2003). A few years later, iNACOL pushed the field to think outside the box towards a "new vision of the future of education" (Davis & Rose, 2007). Specifically, this work advocated for teacher preparation in the areas of online pedagogy and student support strategies (Lowes, 2007). Unfortunately, research in this area is scarce and mostly consists of case studies discussing what specific programs are doing to prepare their students for K-12 online and blended learning. However, there have been a few key pioneering programs that have worked to move the field forward and establish a foundation upon which teacher education programs continue to build.

The first pioneer teacher education program was Iowa State University together with University of Florida, University of Virginia, and Graceland University. ISU brought the issue of teacher preparation for K-12 online learning to national attention in 2007 with the help of a Fund for the Improvement of Postsecondary Education (FIPSE) grant for Teacher Education Goes Into Virtual Schooling (TEGIVS; Davis et al., 2007). As part of the TEGIVS project, the ISU research team reported on a field experience in a K-12 online learning program that they conducted in the fall of 2007 (Compton, Davis, & Mackey, 2009). ISU's field experience program partnered with Iowa Learning Online (ILO) to offer preservice teachers a chance to see what it was like to be a K-12 online teacher. Two preservice teachers were paired with an online ILO teacher, who guided the preservice teachers through the learning environment. The field experience was a one-credit course at ISU, and the preservice teachers were required to reflect on their learning, engage in a discussion forum, and participate in interviews about their experience. The result of the research was that the preservice teachers' grew in their understanding of K-12 online learning and formed personal theories about this new learning environment (Compton et al., 2009).

In addition to ISU, the University of Central Florida (UCF) and the University of Florida (UF) began offering their preservice teachers field experiences in online learning programs in spring 2009. These programs lasted seven weeks and four weeks, respectively. The UCF experience catered to undergraduate-level preservice teachers, whereas the UF experience served graduate-level preservice teachers (Kennedy, Cavanaugh, & Dawson, 2013). Both institutions collaborated with FLVS. In addition to UCF and UF, the University of South Florida offered their first field experience in an online learning program in fall 2009, and by spring 2010, this pilot was expanded to a college-wide program.

Building from the awareness that Iowa State's TEGIVs project started, several teacher education programs, predominantly in Florida, began offering some form of field experience placement in a virtual school setting. However, a national survey found activity in this area to be lacking among most major teacher education programs. Kennedy and Archambault (2012a) used the Tailored Method Design (Dillman, 2010) to survey two to three contacts at each of the AACTE and NCATE-accredited teacher education program field experiences offices from across the United States. Out of a possible 1,528 respondents, 522 responded, representing a 34% response rate that is considered acceptable for web-based surveys (Manfreda, Bosnjak, Berzelak, Haas, & Vehovar, 2008; Shih & Fan, 2008). Of the teacher education programs surveyed, only 1.3% offered field experience opportunities in K-12 online learning programs (Kennedy & Archambault, 2012a). The survey also collected open-ended responses, and the results shed light on the perceptions of teacher education programs when it comes to K–12 online learning specifically and online learning in general. Below are selected teacher educator responses as to why they would not offer virtual school field experiences:

- "If we were training teachers for virtual schools, virtual field experiences would be appropriate."
- "That [online learning] isn't the way I learn. I don't understand how people can learn something without human contact—or why they would even want to."
- "Online learning isn't learning."
- "At the moment, since there does not seem to be such a thing as a virtual teaching job, only ones in actual schools with real-live students, I don't know how close a virtual school field experience would be to the real setting."
- "Good teaching must happen in person."

These statements show the uphill climb that teacher educators, who understand the need for teachers to be trained to teach online, have to scale. For respondents who indicated they were considering starting pilot programs for field experiences in K–12 online learning programs, several mentioned that they did not know of examples to follow. In response to the lack of examples, Kennedy and Archambault (2012b) published a guide focused on the design and development of field experiences in K–12 online learning environments in the open access journal, *Journal of Applied Instructional Design,* available at http://www.jaidpub.org/.

To examine what changes had occurred, Archambault et al. (2016) replicated the K–12 online field experience study and found a small expansion that includes 15 programs across nine states, representing 4.1% of responding teacher education programs. Although limited, there appears to be slow, targeted growth, especially where partnerships between teacher education programs and K–12 online providers had been created. However, while signs of progress are apparent, significant work remains with respect to K–12 online teacher preparation. During the past six years since the original study, slow expansion of teacher education programs who offer field experiences in online or blended settings, has occurred. We identified a total of 15 programs across nine states in 2016. In 2010, there were only seven programs across three states. In the more recent study, 4.1% of respondents reported offering a field experience in an online setting, up from 1.3% of programs identified in the previous study. As might be expected, teacher education programs within Florida remain consistent as the longest providers of field experiences in online learning environments. However, additional programs that have added such opportunities include Georgia, Kansas, Michigan, New York, North Carolina, Ohio, and Pennsylvania (Archambault et al., 2016).

One of the more encouraging findings was evidence that teacher educators are beginning to identify the legitimacy of online and blended instruction, with 42% of open-ended responses acknowledging the need to move in the direction of offering field experience opportunities that expose students to online/blended learning. Through revisiting and reexamining the prevalence of K–12 online and blended field experiences, it is evident that significant work is needed.

Studies in this area have focused on the need for teacher preparation related to K–12 online and blended teaching. Smith, Basham, Rice, and Cater (2016) conducted a survey of special education teacher preparation faculty that examined how much special education preservice teachers had been exposed to K–12 online education and how well their programs are aligned to the iNACOL standards. Results indicated that the majority of responding faculty had not covered key areas related to K–12 online education including instructional and curriculum design, assessment using student data, and legal issues for meeting student needs in an online setting. However, faculty indicated a willingness to use technology in their teaching and addressed many of the areas laid out by the iNACOL standards. From their research, Smith et al. (2016) concluded that while special education teacher educators may be aware of certain issues such as legal aspects to implementing Individualized Education Plans (IEP), this familiarity pertains to a face-to-face environment, rather than an online one. It appears that knowledge of the special education standards, those by the Council for Exceptional Children (CEC), which do not address learning in online environments, take priority when it comes to the design of special education teacher programs. In light of their findings, Smith et al. suggest that other teacher education faculty who are proponents of online learning should collaborate with special education faculty to assist with instructional design and assessment. The authors also highlight a need for standards such as those created by the CEC to recognize and integrate online learning, especially for students with disabilities.

Although studies have established the need for better preparation for teachers when it comes to K-12 online learning (Archambault, 2011; Kennedy & Archambault, 2012a), there has been very little in terms of longitudinal studies showing the effectiveness of preservice preparation for K-12 online learning programs. There is one qualitative study that explores the experiences of first-year virtual school teachers after taking part in a virtual school field experience in their teacher education program (Kennedy, 2013). Using a phenomenological approach, six preservice teachers were interviewed to document their lived experiences when transitioning from their preservice teacher education program into an online teaching position at a virtual school. The preservice teachers' program had a preparation program specifically geared toward preparing teachers for online teaching and learning. Findings relayed the teachers' collective view that teacher education programs need to be preparing teachers for online teaching because "this is the future of education and we have to be ready for it" (Natalie). New hires to the virtual school expressed their frustration with other teacher education programs saying that they were "behind on times" in terms of "preparing teachers for the learning environments of today and tomorrow" (Chad and Shawna). Another response came from Tom, where he said, "Wow, I feel sorry for the ones graduating from colleges that do not offer courses and/or internships specific to virtual schools. That's the only way I knew this career was even an option for me, and having the chance to explore it during my preservice education allowed me to try it, you know, try it on for size and realize I was interested in pursuing it." Ashley added, "Maybe if the colleges gave an option of which track to choose, like online, traditional, or blended, and if we could choose our own internships within these varying environments, maybe then our education would be more relevant to what we're doing now."

As is evident from the data from both studies (Kennedy, 2013; Kennedy & Archambault, 2012a;), there is currently a disconnect between what the teachers and teacher education programs feel is best when it comes to the preparation of teachers for new learning environments. This was also found in a survey of 325 online teachers conducted by Archambault and Larson (2015). While these teachers were self-motivated, had a high value for learning, and enjoyed the challenge of integrating technology, only a small minority had teacher education programs that addressed methods for teaching online. This finding, a lack of preparation within teacher preparation, was confirmed in a separate survey of 186 online teachers conducted by Zweig and Stafford (2016) as well as the Going Virtual! reports (Rice & Dawley, 2007; Rice et al., 2008, Dawley, Rice, & Hinck, 2010). Archambault and Larson found that even fewer teachers reported having the opportunity to complete a field experience in an online setting. The majority indicated that most of their preparation had been provided by the online school where they worked. Helpful elements of this training related specifically to technology integration into the online learning environment (Archambault & Larson, 2015). According to Zweig and Stafford (2016):

> The results from this survey suggest that online teachers may need additional training in multiple areas in order to best support their students—in particular, in areas such as student engagement in which effective instructional strategies may differ between online and face-to-face teaching environments and in which teachers are a critical factor in student support (p. 412).

The authors also noted the need for more personalized professional development as well as opportunities for unstructured, more flexible professional development. Options might include participating in professional learning communities (PLCs) and/or participating in an "unconference" in which teachers can designate the specific topics they need or are interested in (Zweig & Stafford, 2016).

Current Efforts in Teacher Education

To address the concern for a lack of preparation for online and blended learning environments, in recent years, various programs have implemented a variety of efforts geared either at preservice or in-service teacher audiences. These initiatives often take the form of a new or redesigned course. For example, Shepard, Bolliger, Dousay, and Persichitte (2016) describe their course, "Introduction to Online Teaching" that focused on online learning facilitation and content development within an LMS such as Canvas or eCollege. This course was developed in response to the Wyoming Professional Teacher Standards Board (PTSB) requesting professional development for preparing teachers for online course development and facilitation. The course was created as part of a larger graduate certificate program. Participants in the course, who were already teachers, created modules that included at least three aspects of multimedia. In examining the outcomes, the researchers found that sufficient preparation required additional skillsets beyond those that were introduced via a project-based approach to online course facilitation. One of the challenges was that learners needed additional instructional design skills, including visual literacy and message design in particular. Shepard et al. (2016) reported that it was difficult, given the stand-alone nature of the course, to ensure all the necessary skills teachers would need. They recommended that when developing such a course, curricula should emphasize not only effective online teaching, but also include instructional design skills as well as a relevant foundation on distance education.

In another study, Luo, Hibbard, Franklin and Moore (2017) studied a hybrid course, "Technology Applications in Education" with a total of 141 preservice teachers. The course was designed to help acquaint future teachers with K-12 online teaching as a potential career path and prepare them for upcoming field experiences in online settings. Researchers gathered pre-class surveys, post-perception papers, and focus group data. As a result of the course, preservice teachers indicated an improvement in several areas of their perceptions of online learning including viewing online education as a realistic option and seeing the capability for an interactive, student-centered online learning environment that can contain and foster positive relationships. Data from the study suggested that participants with exposure to K-12 online teaching and learning, were more open to the idea of teaching online and could consider themselves in such a setting. According to Luo et al., "Data from this study reaffirmed that preparing preservice teachers for online teaching requires a systematic approach that demands the successful implementation of online education and purposeful planning in an early stage" (p. 11).

In a more content-driven approach, Shand and Farrelly (2017) examine a blended social studies methods course for preservice teachers aimed at providing them with a blended learning experience and to help prepare them to teach in such an environment in the future. Pre-service teachers who took the course indicated that there were several aspects of the blended learning approach that supported their learning and that they intended to incorporate these support strategies in their future teaching. Through a qualitative analysis of focus group interviews, the researchers found that elements of the course could be structured into four main areas. First, organization and structure, were essential for ease of navigation and the creation of an ideal learning environment. Next, transparency and support were essential for helping students comprehend the expectations of the course. To encourage social constructivist learning in which students learned from one another, community and discourse were critical. Finally, blended learning introduced choice into the course to allow students autonomy over how, what, and where they learned. This afforded the ability to personalize student learning. According to Shand and Farrelly, "The students in the course learned many valuable lessons regarding principles and best practices of blended instructional design and implementation. The hope is that they will take these lessons and apply them to their future teaching (p. 26).

Beyond single course interventions or certificate programs, working with a state department to develop a state level endorsement in K-12 online teaching has been the focus of work centered at Boise State University (Yang & Rice, 2015). Recognizing the need for licensed teachers to be certified or endorsed in online teaching as a mechanism for working toward improving the quality of online instruction, the Idaho State Department of Education's Office of Teacher Certification convened a committee to examine the issue in 2008. To establish the criteria for the online teaching endorsement, a subcommittee was formed to create the Idaho state standards for quality online teaching. These standards were informed and developed by synthesizing existing recognized standards from national organizations including those previously discussed in this chapter such as those from NEA, ISTE, and iNACOL. The Idaho Standards for Online Teachers were approved in 2011 and form the basis of the state level endorsement. The ten standards are as follows (Yang & Rice, 2015):

Standard #1: Knowledge of Online Education

The online teacher understands the central concepts, tools of inquiry, and structures in online instruction and creates learning experiences that take advantage of the transformative potential in online learning environments.

Standard #2: Knowledge of Human Development and Learning

The teacher understands how students learn and develop, and provides opportunities that support their intellectual, social, and personal development.

Standard #3: Modifying Instruction for Individual Needs

The teacher understands how students differ in their approaches to learning and creates instructional opportunities that are adapted to learners with diverse needs.

Standard #4: Multiple Instructional Strategies

The online teacher understands and uses a variety of instructional strategies to develop students' critical thinking, problem solving, and performance skills.

Standard #5: Classroom Motivation and Management Skills

The teacher understands individual and group motivation and behavior and creates a learning environment that encourages positive social interaction, active engagement in learning, and self-motivation.

Standard #6: Communication Skills, Networking, and Community Building

The online teacher uses a variety of communication techniques, including verbal, nonverbal, and media, to foster inquiry, collaboration, and supportive interaction in and beyond the classroom.

Standard #7: Instructional Planning Skills

The online teacher plans and prepares instruction based upon knowledge of subject matter, students, the community, and curriculum goals.

Standard #8: Assessment of Student Learning

The online teacher understands, uses, and interprets formal and informal assessment strategies to evaluate and advance student performance and to determine program effectiveness.

Standard #9: Professional Commitment and Responsibility

The online teacher is a reflective practitioner who demonstrates a commitment to professional standards and is continuously engaged in purposeful mastery of the art and science of online teaching.

Standard #10: Partnerships

The online teacher interacts in a professional, effective manner with colleagues, parents, and other members of the community to support students' learning and well-being.

The aim was to create an opportunity where teachers could earn the state-level endorsement on a voluntary, competency-based way, meaning it could be earned with coursework or by demonstrating proficiency through submitting evidence, such as professional development artifacts or activities, or a combination of the two approaches. As one option, teachers could create an electronic portfolio that documents how they have mastered each of the 10 standards to gain the endorsement. However, as one of the requirements of the endorsement, teachers must document completing an eight-week online teaching internship or one year of successful online teaching in grades PreK-12th within the past three years. This connects with the importance of an authentic field experience and applying situated cognition to teacher education for online environments (Kennedy & Archambault, 2012a).

Several lessons were learned in the development and implementation of the Idaho K-12 Online Teaching Endorsement. First, programs found it difficult to build partnerships with K-12 schools along with creating appropriate coursework. Also, the state of Idaho requires background checks from interns in online settings. This can be challenging for teachers located out of state. Additionally, due to the individualized nature of competency-based evaluation, it could take a significant amount of time to review the portfolios of teachers applying for the endorsement. This was overcome, however, by developing and administering a checklist of required features based on each performance element.

The example from Idaho represents a systematic approach to how various stakeholders including faculty, policy makers, and teachers can come together to establish mechanisms for preparing effective K-12 online teachers. As Yang and Rice (2015) note:

> The development of the Idaho K-12 Online Teaching Endorsement program at BSU provides a viable example of how colleges and universities can prepare teachers to teach in online environments, building on state standards and endorsement requirements designed to ensure that online teachers have the necessary qualifications and skills to be effective (p. 112).

Researchers have also examined specific programs geared toward preparing K-12 online and blended teachers, such as the one at Boise State (McAllister & Graham, 2016). Using a content-analysis approach, the authors examined state-level endorsements pertaining to K-12 online teaching as well as the institutional programs that offered coursework leading to the endorsements. A total of nine states offered online teaching endorsements including Georgia, Hawaii, Idaho, Louisiana, Michigan, Pennsylvania, South Carolina, South Dakota, and Vermont (McAllister & Graham, 2016). However, in two states, there was currently no higher education institution that offered content toward the endorsement. The focus of these programs centered on foundations for online learning, online and blended pedagogy, and instructional design. The majority required some type of online field experience, and the most prevalent standards followed were the ISTE NETS or the iNACOL Online Teaching Standards. The authors concluded that programs lacked content that dealt with online privacy, acceptable use policies, as well as safety and legal issues related to the online environment. In addition, there appeared to be a lack of consistency when it came to resources for preparing online teachers that were widely accepted and adopted (McAllister & Graham, 2016).

Implications for Policy and Practice

Recommendations for preparing teachers for new learning environments are informed by the literature pertaining to the necessary skills online teachers need to be successful (Brennan, 2003; DiPietro, Ferdig, Black, & Preston, 2008; Ferdig, Cavanaugh, DiPietro, Black, Mulkey, Dawson, 2009; Kearsley & Blomeyer, 2004); specific recommendations for preparing teachers are needed. Curriculum for teacher preparation in online and blended settings should be aligned with standards for online teaching, as outlined in this chapter. This means designing coursework that specifically focuses on designing and implementing curriculum and instruction for online/blended settings, online pedagogy, and online assessment and evaluation. In a recent systematic literature review conducted by Oliver and Stallings (2014) centered on the teaching considerations for blended learning, there were three major areas that teachers should know and be aware of. These can be used to guide decisions regarding coursework and include contextual considerations – those that involve content choices for blending, how to meet needs of learners who may have challenges, how to create structures and supports to help students, and what blended models work best in various instructional settings. According to the literature, instructional strategies, teaching considerations, and helping teachers understand and embrace their evolved roles in a blended environment are also essential. Finally, technology considerations must also be taken into account. This includes selecting emerging technologies to fit instructional strategies (Oliver & Stallings, 2014). These areas are well aligned to how the literature and the TPACK framework characterize quality online teaching.

In addition to coursework, applying the concepts of situated cognition, any teacher preparation or professional development course designed for online teachers should include a field experience component that offers teachers the opportunity to gain experience in an authentic online learning environment. The field experience should provide teachers with an applied cognitive apprenticeship that occurs with the collaboration of an expert online teacher. This cooperating teacher should be able to model effective strategies, techniques, and approaches unique to online teaching, how to motivate online students, track their progress using real-time data, and manage the vast amount of ongoing digital communication. Not only does this type of field experience expose future teachers to the intricacies of online teaching, it also provides them with the opportunity to experience first hand the multiple roles teachers play in this environment, allowing them to decide if this form of instruction represents a career option they would like to pursue.

Being in a position to offer a field experience in an online setting requires vision on the part of teacher education programs that need to begin to create statewide and national partnerships with virtual schools and districts that have online components. Unfortunately, only a small minority of accredited teacher preparation programs offer a field experience opportunity in an online setting (Archambault et al., 2016; Kennedy & Archambault, 2012a). Currently, teacher preparation programs continue to prepare teachers in much the same way that they have done for generations (Levine, 2006). In fact, some programs perceive online learning in an unfavorable light and may not see it as a valid form of education (Kennedy & Archambault, 2012a). This value must adapt and change if we hope to have teachers prepared to be successful in both the face-to-face as well as the blended and online learning environments.

One of the obstacles is that a field experience of this kind requires extensive collaboration with virtual schools to ensure fruitful pairings of skilled online mentor teachers with novice ones. Memoranda of understanding need to be agreed upon to ensure an effective partnership and to outline the expectations and requirements of each organization. Because these placements are not location-bound, however, it is possible that online teachers from a virtual school in one state could mentor preservice teachers from another. This opens the possibilities, particularly with the number of virtual schools who are willing to work with teacher education programs, and is already happening in existing models (Kennedy & Archambault, 2012a).

One example of a successful partnership is the Idaho model in which Boise State University, the Idaho Digital Learning (IDL), and the Idaho Department of Education work together to ensure the preparation of qualified online teachers. In 2011, Idaho added its online teaching endorsement as a competency-based program requiring that teachers complete a minimum of 20 credit hours in courses directly related to online teaching and demonstrate proficiency in the Idaho Standards for Online Teaching, based on the International Society for Technology in Education (ISTE) National Educational Technology Standards (NETS) (K-12 Online Teaching Endorsement, 2013). Offered as a supplement to existing teaching certificates, the endorsement is only available to teachers who meet the Idaho professional teaching standards and/or are licensed to teach in the state. The Idaho Department of Education serves as the accrediting body, while IDL provides mentor online teachers and an authentic environment in which prospective online teachers can gain much needed skills and experience. Boise State provides the necessary coursework and crediting mechanism. This model provides an excellent example of stakeholders working together to ensure teachers who are well prepared to teach in an online environment.

As increasing numbers of students gravitate toward online learning opportunities, necessitating a larger number of teachers to meet the growing demand, states will want to consider their requirements for teaching online. While Idaho and Georgia have specific state-level endorsements pertaining to online teaching, other states, such as Wisconsin and Minnesota have tried passing state statute requiring professional development for online teaching. However, the statute in Wisconsin requiring at least 30 hours of professional development designed to prepare a teacher for online teaching was removed in 2013. In Minnesota, a law was passed in 2012 to require teacher preparation for online settings beginning for preservice teachers entering programs after June 30, 2014. This statute is relatively new, and it remains to be seen what impact, if any, it will have on the transformation of teacher preparation when it comes to online instruction. Interestingly, the law focuses on teacher preparation, which is the first attempt to mandate the inclusion of digital and blended teaching into preservice teacher preparation programs. This inclusion is needed across programs, particularly because of the growth of online and blended programs. As we progress into the 21st century, all teachers will need to be skilled in teaching online. This will require an acknowledgement of online/blended teaching as a key area of high quality teacher preparation programs, particularly by major accrediting bodies and professional organizations such as the Council for the Accreditation of Educator Preparation (CAEP) and the American Association of Colleges for Teacher Education (AACTE).

Future Research

With the ever increasing number of students taking online courses throughout the United States, there is a need on the part of states to consider the systems already in place to provide necessary training to prospective teachers and consider putting into place additional structures to prepare educators for online and blended settings. Examining theoretical and practical considerations for what teachers should know and be able to do in an online environment allows teacher education and/or professional development programs to work toward ensuring online teacher quality. To date, there is only one longitudinal study that is a qualitative view of how preservice teachers who have been involved in a program that prepares them for online learning and how they transition into future positions where these skills are used (Kennedy, 2013). Additional research is needed to determine what constitutes effective online teaching and specific practices to support this effort, along with the efficacy of such programs. Quality online teaching standards, such as iNACOL and Quality Matters, can be used to evaluate such programs to ensure program candidates are graduating with the skills they need to teach in these new environments.

Conclusion

As described in this chapter, with the rise in K-12 online and blended learning environments, there is an obvious need for preservice teacher preparation to ensure that beginning teachers have the necessary knowledge and skills to be successful in an online/blended environment. Increasingly, new teachers may be recruited directly from their teacher education programs. As a result, teacher preparation programs will need to examine what it means to prepare teachers for 21st century teaching and learning environments, providing them the necessary skills and dispositions to be quality online instructors. Along with preparation for beginning teachers, inservice teachers will also need to be provided with professional development for online teaching, especially if the school districts in which they are employed begin or expand online learning programs. Together with in-house training, teacher education programs can also be a source of this professional development. What is clear is that all stakeholders will need to consider how to help teachers achieve a greater degree of meaningful technology integration as a part of quality instruction. This includes modeling evidence-based quality online and blended teaching strategies, providing opportunities for field experiences, and mentoring teachers new to the online environment. Through these efforts and by establishing mutually beneficial partnerships, teacher education programs, school districts, virtual schools, and other online education providers will need to work together to ensure that teachers are prepared to enter online and blended classrooms of the 21st century.

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18

Professional Development for K-12 Online Teachers

Kara Dawson & Nancy Fichtman Dana

This chapter, updated for the second edition of the handbook, provides a survey of what is known about professional development for brick-and-mortar and online/blended teachers. Unfortunately, little new research has emerged in recent years related to professional development for online/blended teachers. This is particularly concerning given the continued growth in K-12 online learning, numerous states adopting enrollment in online courses as a high-school graduation requirement, and studies suggesting that virtual students underperform compared to their brick-and-mortar counterparts. The number of for-profit companies that offer PD services related to K-12 online learning also continues to grow. Yet, most of what we know about professional development for K-12 online/blended teachers comes from survey research or from case examples. Opportunities still abound for practitioners, policymakers, and researchers to make important contributions to the professional development of K-12 online/blended teachers.

Keywords: professional development, professional learning, online teachers

Introduction

Since the inception of virtual schools, online/blended learning has grown exponentially (Ferdig, Cavanaugh, Dipietro, Black, & Dawson, 2009). As online/blended learning continues to grow, so does the need to cultivate programs of professional development for these teachers (Rice, 2009). Professional development (PD), defined as "a comprehensive, sustained, and intensive approach to improving teachers' effectiveness in raising student achievement," is a necessary aspect of teachers' work throughout their professional lifetimes, so they may continue to grow, learn, and respond to the ever changing needs of the students they teach (Learning Forward, online).

Since K-12 online/blended learning is a relatively new endeavor, creating rich opportunities for continuing professional development of practicing K-12 online/blended teachers is essential for the long-term health and productivity of the online/blended movement. Knowledge that has been generated on PD from years of studying this construct in brick-and-mortar contexts can be informative to the online/blended enterprise. In addition, there is a growing body of literature on professional development for online/blended educators. The purpose of this chapter is to provide a comprehensive survey of what is known about professional development for both brick-and-mortar and online/blended teachers and use this knowledge as a springboard to suggest policy and research implications for the professional learning of K-12 online/blended teachers.

Research Synthesis Types of Professional Development

Historically, the most prominent way that professional learning for brick-and-mortar teachers has been actualized in the United States is as an event—a workshop delivered on an in-service day when teachers work but students have a holiday (Cochran-Smith & Lytle 1999, Lieberman 1995, Sparks & Hirsch 1997). In these workshops, teachers often learn about new strategies, approaches and pedagogy from an outside expert, and then they are expected to return to their classrooms and independently implement new knowledge.

Experts in the area of teacher professional development recognize the limitations of this traditional model. For example, Borko (2004) refers to such events as "fragmented, intellectually superficial" seminars (p. 4). Furthermore, Barnett (2002) asserts that such seminars do not provide ongoing guidance for teachers as they attempt to learn and change their practices. Killion and Harrison (2006) concur that "traditional professional development usually occurs away from the school site, separate from classroom contexts and challenges in which teachers are expected to apply what they have learned, and often without the necessary support to facilitate transfer of learning"(p. 8). In sum, scholars agree and research supports that when used in isolation, the prevalent 'event' model of professional development for brick-and-mortar teachers is not effective in changing classroom practice (Joyce & Showers, 1995).

Leading the way to respond to the plethora of research documenting the ineffectiveness of one-time workshop professional development experiences, the premiere professional development association in the United States, Learning Forward, (formally National Staff Development Council), has made it the organization's mission to insist that 'every educator engages in effective professional learning every day so every student achieves' (Learning Forward, online). According to Learning Forward, high quality professional development involves systematic, planned, intentional and regularly scheduled efforts to embed teacher learning within teachers' daily lives. This concept is known as job-embedded professional development (Yendol-Hoppey & Dana, 2010).

The concept of job-embedded professional development is consistant with what research suggests effective professional development that goes beyond the one-time workshop looks like (Garet, Porter, Desimone, Birman, & Yoon, 2001; Lee, 2005; Little & McLaughlin, 1993). Specifically, Desimone (2009) suggests that "a research consensus [exists] on the main features of professional development that have been associated with changes in knowledge, practice, and, to a lesser extent, student achievement" (p. 183). These core features of effective professional development include content focus, active learning, coherence, duration and collective participation, all of which are essential ingredients of strong professional development programs. *Content focus* programs emphasize both subject matter content and how students learn the content. *Active learning* in PD programs involves teachers in observing experts, participating in interactive feedback and discussion, and reviewing student work, rather than listening to a lecture. *Coherence* relates to the extent to which what is taught in the PD program aligns with state and district goals and standards for student learning. *Duration* is the time spent in PD programs, and although research has not indicated an exact amount of time, programs that include at least 20 hours of contact time are recommended. Finally, *collective participation* refers to teachers working together which can be a powerful form of teacher learning. Many models of professional learning have emerged in brick-and-mortar contexts that take into account Desimone's five core features of professional development. Among others, these models include lesson study, teacher inquiry/action research, and professional learning communities.

Lesson study, an approach to teacher professional development originally developed for and used extensively with teachers in Japan, involves teachers collaboratively examining and improving their teaching practice through "studying" lessons (Dudley, 2014). The process entails teachers creating study lessons together by planning, teaching, observing, critiquing, and revising the lessons as a group, with the goal of becoming more effective teachers. This spiraling process begins with the development of an overarching goal and a research question shaped by the group, which drives lesson plan development and revision. The process ends with the production of a report in which teachers discuss what they have learned through their study lessons in relationship to their research question.

While much of the research and literature on lesson study has focused on understanding adaptations and barriers to its implementation in the United States (Chokshi & Fernandez, 2004; Fernandez, Cannon & Chokshi, 2003; Fernandez, 2002; Perry & Lewis, 2009), several additional studies have indicated that it is a viable framework for improving teaching practice within the context of brick-and-mortar classrooms (Chokshi & Fernandez, 2004; Rock & Wilson, 2005; Dudley, 2013; Murata, 2010). The end result is not only a better developed lesson, but research indicates that typically teachers also develop a stronger understanding of the content, enhanced observation skills, stronger collegial networks, and a tighter connection between daily practice and long-term goals (Lieberman, 2009; Lewis, Perry, & Hurd, 2004). The promise of lesson study as a professional development mechanism for classroom teachers in the United States led to its use with preservice teachers. Studies examining lesson study during pre-service teacher education document challenges and benefits of effective implementation of lesson study (Chassels & Melville, 2009; Marble, 2006; Sims & Walsh, 2009), recommendations for adapting lesson study (Cohan & Honigsfield, 2006), and the ways lesson study fosters quality preservice teacher reflection (Myers, 2012).

Similar to lesson study, teacher inquiry/action research involves teachers in the systematic and intentional study of their own teaching practice (see, e.g., Cochran-Smith & Lytle, 1993; 2009). Inquiring professionals seek out change by reflecting on their practice. They do this by engaging in a cyclical process of posing questions or "wonderings," collecting data to gain insights into their wonderings, analyzing the data along with reading relevant literature, taking action to make changes in practice based on new understandings developed during inquiry, and sharing findings with others (Dana & Yendol-Hoppey, 2014; Dana, 2013).

The literature on teacher inquiry/action research indicates its long, rich history and research on the process. Rooted in the work of John Dewey (1933), Kurt Lewin popularized the process in the 1940s (Adelman, 1993) and Stephen Corey (1953) applied it to the field of education shortly thereafter. The process has been utilized by preservice teachers within initial teacher preparation programs (i.e., Cochran-Smith, Barnatt, Friedman, & Pine, 2009; Dana, Yendol-Hoppey, & Snow-Gerono, 2006; Grossman, 2005; Price & Valli, 2006; Rinke & Stebik, 2013), practicing teachers as a form of teacher professional development (i.e., Ermeling, 2010; Levin & Rock, 2003; Zeichner, 2003), and administrators to gain insights into school improvement (i.e., Dana, Tricarico, & Quinn, 2010; Jacobs, Yamamura, Guerra, & Nelson, 2013).

Research has focused on the influence of teacher inquiry on both preservice and inservice teacher learning. Findings suggest that practitioner research promotes deeper reflection about teacher identity (Levin & Rock, 2003; Rock & Levin, 2002) and can shift beliefs about instruction (Dawson & Dana, 2007; Hagevik, Aydeniz, & Rowell, 2012; Levin & Rock, 2003; Rock & Levin, 2002). In addition, practitioner research has facilitated an increase in teachers' knowledge and understanding of students (Butler & Schnellert, 2012; Dresser, 2007; Levin & Rock, 2003; Rinke & Stebick, 2013; Rock & Levin, 2002; Wallace, 2013), promoted growth and change in teaching practice (Dresser, 2007; Ermeling, 2010; Levin & Rock, 2003; Rock & Levin, 2002), increased data literacy (Athanases, Wahleithner, & Bennett, 2012), and fostered attention to social justice and diversity issues (Athanases, Wahleithner, & Bennett,, 2012; Hyland & Noffke, 2005; Martin, 2005). Practitioner research fosters teacher empowerment and transformation as teachers deepen their understanding and improve practice (Bonner, 2006; Esposito & Smith, 2006; Merino & Holmes, 2006). Studies have also looked at the positive influence inquiry has on student learning (Dawson, 2012; Esposito & Smith, 2006; Knight, Wiseman, & Cooner, 2000). In combination, these findings illustrate the power practitioner research offers educators in brick-and-mortar contexts interested in innovation that strengthens teacher and student learning.

Professional learning communities (PLCs) can serve as the "container" in which the processes of lesson study and inquiry may unfold. PLCs are defined generically as small groups of faculty and/or administrators who meet regularly to study more effective learning and teaching practices (Dana & Yendol-Hoppey, 2008). A professional learning community's time together is often structured by the use of protocols to ensure focused, deliberate conversation and dialogue by teachers about student work and student learning (McDonald, Mohr, Dichter, & McDonald, 2003). Protocols for educators provide a script or series of timed steps for how a conversation among professionals on a chosen topic will develop.

A variety of different protocols have been developed for use in professional learning communities by a number of noteworthy organizations such as Learning Forward (see, for example, Lois Brown's *Powerful Designs for Professional Learning,* 2004), School Reform Initiative, (2017) and the National School Reform Faculty (2017), who developed the version of a professional learning community called Critical Friends Groups (CFGs). The CFGs provide deliberate time and structures dedicated to promoting adult professional growth that is directly linked to student learning. When used within a professional learning community, protocols ensure planned, intentional conversation by teachers about student work, a teacher's dilemma, a lesson to be taught, or other aspects of practice. Different protocols are selected for use depending upon the topic for discussion. Recently, protocols that have been used in face-to-face professional development endeavors have also been adopted for online/blended use (McDonald, Zydney, Dichter, & McDonald, 2012). Several studies on professional learning communities and protocols show the value inherent in this professional development organizational structure for teacher learning including improved student learning, enhanced collegial relationships among teachers, increased awareness of schoolwide issues, better capacity to enact school improvement efforts, and decreased feelings of isolation among teachers (Curry, 2008; Little, Gearhart, Curry, & Kafka, 2003; McLaughlin & Talber, 2006; Phillips, 2003; Supovitz, 2002; Supovitz & Christman, 2003).

Complementing the wealth of literature on teacher professional development strategies such as lesson study, inquiry/action research, and professional learning communities in brick-and-mortar contexts, online teacher professional development (oTPD) has emerged in recent years and suggests its promise for brick-and-mortar teachers (Dede, Ketelhut, Whitehouse, Breit, & McCloskey, 2009). However, much less research exists on professional development for K-12 online/blended teachers despite the facts that the number of online and blended schools, programs and courses continue to grow (Watson, Muir, Vashaw, Gemin, & Rapp, 2012) and that states are beginning to require students take an online course prior to high school graduation (Watson, Pape, Murin, Gemin, & Vashaw, 2014).

Professional Development for Online/Blended Teachers

While growth in online and blended learning increases the need for research on professional development in these contexts (Rice, 2009), this growth also complicates the process because K-12 online/blended learning models differ widely. Some teachers work full-time in virtual schools, others teach full-time in brick-and-mortar contexts and part-time in supplemental online programs not affiliated with their full-time positions, and others teach online and face-to-face courses in a brick-and-mortar school district (Rice, Dawley, Gasell, & Florez, 2008). To further complicate matters these teachers might work in state-led, district-led, consortium-led, or charter schools (Rice & Dawley, 2009) or in for-profit online schools (Evergreen Education Group, 2016).

The Going Virtual! 2010 report (Dawley, Rice, & Hinck, 2010) is the most comprehensive effort to date to describe the landscape of professional development for online/blended teachers. A national survey of 830 K-12 online/blended teachers revealed that one-quarter of online/blended teachers received no professional development prior to their first online/blended teaching experience although most received professional development within their first five years of online/blended teaching (Dawley et. al., 2010).

The content of these professional development efforts varied widely with training on technical skills being the most common and training related to meeting the needs of online/blended students with disabilities being the topic on which online/blended teachers most desired professional development (Dawley et. al., 2010). This report is extremely useful in providing a snapshot of professional development models and practices for online/blended teachers; however, survey research is not designed to provide a deep analysis of those models and practices.

One way to more deeply review professional development for online/blended teachers is to consider this research in the context of what is already known about professional development in brick-and-mortar contexts. In the following sections, we examine literature on professional development for K-12 online/blended teachers through the lens of Desimone's (2009) five core features of professional development (discussed earlier) in an effort to build on what is already known about quality professional development and consider similarities and differences for K-12 online/blended teachers.

Content focus

This core feature emphasizes both subject matter content and how students learn the content. Some researchers have studied the practices of online/blended teachers within different content areas and have advocated for differentiating professional development for online/blended teachers, in part, based on the content and grade level they teach (Oliver, Kellogg, Townsend, & Brady, 2010; DiPietro, 2008, 2010; DiPietro, Ferdig, Black, & Preston, 2008). Other researchers have found important nuances in the instructional practices of K-12 online/blended teachers working in similar content areas. For example, a study of world languages instructors found that teachers of the Chinese language tended to act more as a knowledge provider during online/blended instruction while teachers in other world languages tended to act more as discourse facilitators (Lin & Zheng, 2015). Research on blended K-12 courses also suggests that teachers from different content areas implement the online components of their courses differently and may need content-specific PD (Wayer, Crippen, & Dawson, 2015). However, most professional development opportunities for online/blended teachers are focused on generic topics such as online teaching and learning or technical skills rather than teaching within a specific content area (Archambault & Larson, 2015; Barbour, 2012; Dawley, Rice & Hinck, 2010). The five most common concepts identified in a national survey of professional development for online/blended teachers were generic in nature (i.e., foundational knowledge, facilitation strategies, technology tools, online design and development and digital etiquette, behavior and assessment). Similarly, professional development related to generic issues such as technology, K-12 online/blended teachers mentioned communication, classroom management, and time management as essential professional development topics. Content-specific professional development only ranked seventh on the list of professional development topics K-12 online/blended teachers believe are important (Archambault & Larson, 2015). In addition, a group of K-12 online teachers from Wisconsin reported that they desired professional development on how to improve student perseverance and engagement (Zweig & Stafford, 2016). It is important to note, however, that 64% of respondents in the Going Virutal! survey reported receiving some content-specific professional development (Dawley, Rice & Hinck, 2010) although the nature of this PD is unknown.

Content focus, as interpreted through the lens of online/blended learning, may also address the need to provide focused professional development to other personnel who are critical to the success of K-12 online/blended education. For example, Davis and Rose (2007) identified three potential roles of K-12 online educators – online teachers, designers of online instruction, and facilitators of online instruction. Online teachers work directly with online students to teach particular content while designers create the courses and instructional materials used by online teachers. Facilitators typically serve as a bridge between traditional and online education by working in brick-and-mortar schools with students enrolled in online courses. Educators in each of these roles require professional development with content aligned to their particular job responsibilities. Ferdig, Cavanaugh, DiPietro, Black, and Dawson (2009) identify more roles for online educators that require content specific professional development including administrators, guidance counselors, technology coordinators, and local key contacts who handle registration and reporting issues. While this chapter is focused on K-12 online/blended teachers, it is important to consider varying roles, often unique to K-12 online learning, when planning professional development.

Active learning

This core feature involves professional development in which teachers are actively involved in the learning process and do more than listen to lectures. One way to promote active learning during professional development for online/blended teachers is to use a variety of strategies and interaction formats such as modeling, role-playing, discussions, simulations, and case studies (SREB, 2009). These strategies can be used to support teachers' active involvement in professional development related to a wide array of important skills and concepts in online/blended teaching including, but not limited to, providing online/blended teachers with an awareness of and practice with providing quality student feedback (Liu & Cavanaugh, 2011), communicating with students and parents (Davis & Rose, 2007), identifying ways to differentiate instruction for all students and those who may be at-risk (Archambault, Diamond, Coffey, Foures-Aalbu, Richardson, Zygouris-Coe, Brown & Cavanaugh, 2010), supporting community (Davis & Rose, 2007), facilitating online discussions (Rose & Smith, 2007) and online assessments (Davis & Rose, 2007). There are likely more options for active learning during professional development for online/blended teachers because of the variety of media available for use during online/blended instruction and, subsequently, for PD for online teachers.

Coherence

This core feature relates to the extent to which what is taught in the PD program aligns with state and district goals and standards for student learning. Professional development for online/blended teachers should also be aligned to standards related to online/blended teaching and learning. Standards of online teaching and learning can be found in documents such *National Standards for Quality Online Teaching* (iNACOL, 2011) and *Standards for Quality Online Teaching* (South Regional Education Board, 2006). Many schools also have their own standards for online education. In fact, over one-third of online teachers report that their professional development is based on guidelines developed by their place of employment or on no standards at all. Nearly 16% of online teachers are unsure whether standards guide their professional development (Dawley, Rice, & Hinck, 2010).

Coherence in professional development programs for online/blended teachers can also be interpreted through a technical lens. Online/blended teachers should receive professional development using the synchronous and asynchronous media with which they will be teaching (Davis & Rose, 2007). Teachers should obviously learn the technical aspects of such media but they should also experience quality modeling on what it is like to learn via this media. Decades of research in teacher education and professional development show that teachers tend to teach as they were taught (Lortie, 1973) and this appears to be holding true for professional development of online/blended teachers as well (Davis & Rose, 2007).

Duration

This core feature of professional development refers to the length of the programs. While research is not definitive on how much time is ideal, one-shot workshops are mainly ineffective for impacting change in the practices of brick-and-mortar teachers (Borko, 2004). A large percentage of online teachers participate in both ongoing professional development (81%) and one-time workshops (77%) (Dawley, Rice, & Hinck, 2010). While the high percentage of workshops may be interpreted as negative based on what is known about professional development, in some cases one-time workshops may be of more value to online teachers than to brick-and-mortar teachers because of the technical skills required to teach online. A recent survey suggests that nearly 40% of K-12 online teachers reported that they receive most of their professional development from "meetings, workshops, webinars [or] short training sessions" (Archambault & Larson, 2015, p. 67) but qualitative responses suggest that while the duration of the workshops are short, online teachers may participate in up to 40 hours of PD via short sessions.

While there is little published research about the effectiveness of professional development for online/blended teachers (whether it be ongoing or short-term), some online teachers report appreciating the flexibility, relevance and brevity of workshops; particularly workshops hosted online by other teachers and workshops that address technical aspects of their job. These same teachers also appreciated the opportunity to analyze and reflect on their practices during a year-long action research initiative (Dana, Dawson, Wolkenhauer, & Krell, 2013). These preliminary findings suggest a mix of short and long-term professional development opportunities based on the content of the sessions may be appropriate for online/blended teachers.

Collective participation

This core feature refers to teachers working together during professional development; often within professional learning communities. Over half (66%) of online teachers report participating in professional learning communities as part of their professional development activities although the specifics of such communities are not detailed (Dawley, Rice & Hinck, 2010). There are likely many more options to support collective participation by online/blended teachers because these teachers are comfortable working with technology designed to support community and are used to collaborating with geographically disparate people. In addition, some have suggested that simultaneous participation by those with different roles in the online learning process (i.e., teachers, designers, facilitators) may be advantageous (Barbour, Adelstein, & Morrison, 2014). An online/blended teacher may know strategies for how the content of her class should best be taught but know neither which tools could support these strategies nor how to operate these tools. Collective participation in this sense would take on a slightly different meaning in that the professional development would involve individuals with different responsibilities related to K-12 online learning.

Descriptive articles about professional learning communities for online/blended teachers are somewhat commonplace in the literature (see Kennedy & Archambault, 2012 and Cavanaugh & Bloymeyer, 2007), however, additional research is lacking. A recent dissertation examined online teachers' perceptions of their experience in a professional learning community and found the teachers believed the community supported their ability to help students succeed, to maintain a healthy balance between work and personal lives, and to develop professionally (Purnell, 2013). Another study of an action research-based professional learning community suggests that combining a professional learning community with action research supports online teachers in improving their practice and in illuminating their voices to identify priorities and practices across a virtual school (Dawson, Dana, Wolkenhauer, & Krell, 2013).

Implications for Policy and Practice

We know teachers make a difference in student outcomes in brick-and-mortar contexts and research on online teachers suggest that they, too, are one of the most important factors contributing to student success in online environments

(Ferdig, 2010). Thus, effective policy and practice related to professional development for K-12 online/blended teachers is imperative to the success of K-12 education.

Based on what we learned from our research synthesis of K-12 online/blended learning and Desimone's five core features of professional development, we offer additional considerations for or extensions of professional development for K-12 online/blended teachers (Table 1). It is important to note that these considerations are for all who may provide PD including those within a school or organization who provide PD or to the growing number of for-profit companies that offer PD products and training services related to K-12 online learning (Evergreen Education Group, 2016). The growing for-profit market is something to keep an eye on as work in the area of PD for K-12 online/blended teachers moves forward.

It is also important to note that all K-12 online/blended teachers should receive professional development prior to teaching online regardless of their experience teaching in brick and mortar environments. A recent dissertation study showed that there is no correlation between years of teaching experience and teachers' perceptions of their preparedness to teach online (Breichesen, 2015) suggesting that brick and mortar experience does not translate into preparedness for teaching online.

Table 1: Desimone's Core Features of Professional Development and K-12 Online/Blended Learning

Core Features	Definition	Additional Consideration for PD for K-12 Online/Blended Educators
Content focus	PD programs should emphasize both subject matter content and how students learn the content.	PD programs should also emphasize the varying roles encompassed in virtual contexts (i.e., administrators, designers, counselors, etc.).
Active learning	PD programs should actively involve teachers in the learning process.	There are likely more options for active learning during professional development for online teachers because of the variety of media typically used during online instruction.
Coherence	What is taught in the PD program should align with state and district goals and standards for student learning.	PD programs should also align with standards for online teaching (i.e., iNACOL standards) and learning, with the type of media teachers will use when teaching in their online context and with content area standards.
Duration	PD programs of longer duration should be emphasized over short-term workshops.	A mix of short and long-term professional development opportunities based on the content of the sessions may be appropriate for online teachers given the importance of preparing online teachers for the more technical, skills-based knowledge necessary to effectively teach online.
Collective Participation	Teachers should work together during PD programs.	PD programs for online teachers are particularly well-suited for development of professional learning communities because of online teachers' comfort working and collaborating in online environments and because of the geographical distance often separating online teachers.

Implications for Research

Little new research related to PD for K-12 online/blended teachers has been published since the first edition of this chapter appeared in 2014 even though practice is continuing to move forward as evidenced by the rise of for-profit companies offering PD for K-12 online/blended teachers and by new graduation requirements mandating students have online learning experiences prior to high school graduation (Watson et. al., 2014). Research lagging behind practice has been a perpetual challenge in education dating back at least 80 years (Stoddard, 1935), and it appears research on PD for K-12 online/blended teachers is not immune to the phenomenon.

Most of what we know about professional development for K-12 online/blended teachers comes from surveys or primarily descriptive articles on professional development practices for K-12 online/blended teachers (Kennedy & Archambault, 2012; Wortmann et. al., 2008; Cavanaugh & Blomeyer, 2007). While these are certainly useful contributions to the field, iNACOL has identified the need for research "into promising practices for preparing all education professionals to support learners in K-12 blended and online learning environments" as a priority.

Identifying promising practices is important but not sufficient in term of research on PD for K-12 online/blended teachers. Research associated with implementation and outcomes would add substantially to our knowledge base about PD for K-12 online/blended teachers. Research on implementation may explore which media is best suited for which learning goals or how research-supported PD models such as lesson study, action research, and professional learning communities may transfer to PD for K-12 online/blended teachers. Research on outcomes may look at teacher knowledge and practice and student performance.

Novel research methods may also contribute to research on PD for K-12 online/blended teachers. For example, the data available through learning management systems (LMS) where PD initiatives are housed can provide insights into how and when teachers participate in different kinds of PD, help identify inherent strengths and weaknesses in the designs and identify the types of PD that may be most advantageous for different teachers. The data available within the LMS could also be a potential topic for PD as teachers could learn to leverage data available to them to individualize their online teaching practices.

Mutually beneficial partnerships between practitioners, K-12 online and blended organizations, and university scholars would also enhance our knowledge of PD for K-12 online/blended teachers. The Michigan Virtual Learning Research Institute (MVLRI) is a prime example of such partnerships and the field would benefit from similar initiatives across the country.

Conclusion

As K-12 online/blended learning continues to grow, there is evidence that virtual students tend to underperform compared to their brick-and-mortar counterparts (Barbour, Miron & Huerta, 2017). This is a multifaceted problem and effective preparation of online/blended teachers is one of the viable strategies to remedying it (Molnar et. al., 2017). Yet, little research progress related to professional development for K-12 online/blended teachers has been made since the first publication of this handbook. It is imperative that such research keeps pace with the growth of K-12 online/blended learning so that students receive the experiences they deserve during their K-12 education regardless of the modality by which they receive it.

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19

Mentoring for Online Teachers

Kara Dawson & Nancy Fichtman Dana

The purpose of this chapter is twofold. First, we provide a synthesis of what is known about mentoring in general, mentoring for K-12 brick-and-mortar teachers and mentoring for K-12 online teachers. In order to synthesize this literature we have divided it into the broad categories of (1) the benefits and challenges of mentoring, (2) characteristics of effective mentors, (3) characteristics of effective mentees, (4) characteristics of effective mentoring programs, and (5) strategies to support mentoring. Second, we use this knowledge as a springboard to suggest policy and research implications for the mentoring of K-12 online teachers.

Keywords: professional development, mentoring, online teachers

Introduction

Mentoring in K-12 education is a specialized form of professional development typically designed to meet the unique needs of new teachers or teachers transitioning from a brick and mortar setting to a virtual school or online context. While the previous chapter reviewed literature on professional development in general, we devote an entire chapter to mentoring because it is "one of the most important strategies to support novices' learning to teach and, thus, to improve the quality of teaching" (Wang, 2001, p. 52). It is also an important strategy to support continued professional development throughout an educator's career.

The concept of mentoring can be traced back to Homer's myth of Odysseus when the king entrusts his son to Mentor during his time in battle. The name Mentor has since been adopted to refer to someone with a strong knowledge base and extensive experience who teaches and guides others with less knowledge and/or experience (Kram, 1985). The less knowledgeable and/or experienced other is often called a protégé or mentee. While the concept of mentoring dates back to Homer, mentoring in K-12 contexts began in earnest in the 1980s and escalated in the 1990s with governmental policies to guide and mandate the spread of mentoring practices for new teachers (Hobson, Ashby, Malderez & Tomlinson, 2009). The rise of K-12 virtual schools and other opportunities for teachers to teach and students to learn in online environments has increased the need for professional development opportunities like mentoring for K-12 online teachers (Kennedy & Archambault, 2012).

First, we provide a synthesis of what is known about mentoring in general and about mentoring for K-12 brick and mortar teachers. In the next section we discuss mentoring for K-12 online teachers. Finally, we use this knowledge as a springboard to suggest policy, practice, and research implications for mentoring K-12 online and blended teachers.

Mentoring in general and specifically for K-12 teachers

Mentoring is a highly complex and contextual process; however, research across mentoring programs and contexts is relatively consistent. In order to synthesize the mentoring literature, we have divided it into the broad categories of (1) the benefits and challenges of mentoring, (2) characteristic of effective mentors, (3) characteristics of effective mentees, (4) characteristics of effective mentoring programs, and (5) strategies to support mentoring. In the following sections we synthesize literature within each of these categories using general mentoring literature as well as literature on mentoring in K-12 brick and mortar contexts.

Benefits and challenges of mentoring

Mentoring can be instrumental to the socialization of new employees and to the transfer of tacit knowledge within organizations and disciplines (Swap, Leonard, Shields & Abrams, 2001) and has been demonstrated as effective across numerous disciplines including social work, entrepreneurship, business, and education (Perren, 2003).

Mentoring has been shown to elevate job performance, improve career outcomes and advancement opportunities, lead to salary increases, increase job satisfaction, increase career committee, and decrease turnover across a variety of disciplines including education, business, and medicine (Allen, Eby, Poteet, Lentz, & Lima, 2004; Chao, Walz, & Gardner, 1992; Fagenson, 1989; Koberg, Boss, & Goodman, 1998; Mullen, 1994; Noe, 1988; Scandura, 1992; Underhill, 2006; Whitely, Dougherty, & Dreher, 1991).

Mentoring in K-12 brick and mortar contexts has been shown to lead to similar outcomes for mentees including improved behavior and classroom management skills, ability to manage time and workloads and ability to adapt to the standards and expectations of the teaching context (Wang & O'Dell, 2002; Evertson & Smithey, 2000; Ballantyne, Hansford, & Packer, 1995). In addition, research suggests mentoring for K-12 brick and mortar teachers can lead to reduced feelings of isolation, increased morale and job satisfaction, increased confidence and self-esteem, professional growth, and improved reflective and problem solving abilities (Fletcher, Strong & Villar, 2009; Hobson et. al., 2009; Mathur, Gehrke & Kim, 2013; Yendol-Hoppey & Dana, 2008). While less conclusive, research has also suggested a link between mentoring and student achievement in mentees' classrooms (Hobson et. al., 2009; Fletcher, Strong & Villar, 2009).

Research in K-12 contexts also suggests benefits for mentors including, but not limited to, increased self-reflection on their own practice, increased opportunities for collaboration with other teachers, improved communication skills, increased confidence in their own abilities, improved relationships with their own students and increased professional satisfaction (Hanson & Moir, 2008; Simpson, Hastings, & Hill, 2007).

While the majority of literature on mentoring in K-12 environments reports positive results, several challenges, referred to as "the dark side of mentoring," are also noted for both the mentor and the mentee (Long, 1997). Challenges for mentees including ineffective or insensitive mentors, mentors unable or unwilling to devote sufficient time to the mentoring process, a lack of opportunities to reflect and critically examine their practices, and increased stress levels due to the time and energy required of them during the mentoring process. Challenges for mentors are similar and include lack of time and/or incentives to participate in the mentoring process, unmanageable workloads because mentoring is added to a full-time teaching assignment, lack of proper preparation to be a mentor, and insecurities caused when the mentor's own teaching practices are place under scrutiny by mentees (Hobson et. al., 2009). While these challenges are very real and have the potential to influence any mentoring situation, the literature also identifies characteristics of effective mentors, mentees, and mentoring programs, as well as strategies to support mentoring, many of which could lessen or alleviate these challenges.

Characteristics of effective mentors

Successful mentors tend to exhibit the following characteristics regardless of the context in which the mentoring occurs (Daloz, 1986; NASA, 2003; Ramani, Gruppen & Kachur, 2006; Swap et. al., 2001):

- *Expertise*. Mentors should recognize patterns, synthesize information to solve complex problems, and readily access additional knowledge and information when needed.
- *Confidence*. Mentors should be secure in their own positions and abilities so they are willing and able to support the development of others. Mentors lacking confidence may be concerned with their personal welfare at the expense of helping to fully develop mentees.
- *Interpersonal Skills*. Mentors should have a genuine interest in helping mentees. They should have good listening skills, the ability to give both positive and constructive feedback and the ability to resolve conflicts when necessary. Mentors also must be compassionate.
- *Self Awareness*. Mentors should be aware of the way their own experiences have shaped their personal and

professional lives. They should be aware of any gender or cultural biases and work to ensure they do not adversely impact their mentoring.
- *Commitment*. Mentors should be willing and able to commit the time necessary to serve. Individuals with hectic personal or professional lives may not be able to give adequate time and attention to mentoring even if they wish to do so.
- *High yet Reasonable Expectations*. Effective mentors balance the need to support, challenge, and help provide a vision for mentees' future. They provide reasonable challenges with adequate support and assist the mentee in developing a vision for his future.

Research on mentoring in brick and mortar educational contexts support this more broad research. For example, in an extensive research study comparing mentor teachers in the United States, United Kingdom, and China, Wang (2001) found that:

> Relevant teaching experience, though important, is not a sufficient condition for a teacher to be a professional mentor. Mentors who are practicing or moving toward practicing the reform-minded teaching may not develop the necessary conceptions and practices of mentoring that offer all the crucial opportunities for novices to learn to teach in a similar way. Thus, when selecting mentor teachers, not only is it important to consider the relevant teaching experiences of mentors but it is also important to identify how mentors conceptualize mentoring and their relevant experience in conducting the kind of mentoring practices expected (p. 71-72)

In addition, literature on K-12 mentoring suggests that effective mentors also have the following characteristics (Hobson et. al, 2009; Yendol-Hoppey & Dana, 2007; Rippon & Martin, 2006):

- *Student-centered approach to teaching*. Mentors with a student-centerd approach to teaching are more likely to have a mentee-centered approach to mentoring, are more likely to encourage mentees to reflect on their practice, and are more likely to be able to demonstrate effective teaching practices for their mentees.
- *Comfort with being observed in their classrooms:* Mentors need to be confident in their own teaching abilities so that mentees can observe their practices and ask questions.
- *Strong work ethic.* Teaching is hard work and mentors should demonstrate that work ethic through their daily practices.
- *Commitment to educating all students.* Mentors should be committed to equity, meeting the needs of all students, and social justice. Mentees should see explicit examples of how this plays out in the mentors' classroom and be able to articulate to the mentor how she strives for the same.
- *Commitment to inquiry.* Inquiry involves teachers studying and reflecting on their practice in order to improve it. Mentors should be committed to such an inquiry stance and strive to facilitate that stance in their mentees.

Characteristics of effective mentees

Mentees are also important in the mentoring process and are also responsible for actively participating in and facilitating the mentoring process. Mentees with the following characteristics increase the likelihood of successful mentoring across contexts (Bierema & Merriam, 2002; NASA, 2003) including K-12 environments (Hobson et. al., 2009; Yendol-Hoppey & Dana, 2007):

- *Respect for Others*. Mentees likely to gain the most from mentoring have a general respect for others and recognize their need to learn and grow in the profession.
- *Eagerness to Learn*. Mentees should have a strong desire to learn and grow. They should be motivated and able to take initiative both on the job and within the mentoring relationship.
- *Ability to Accept Feedback*. Mentees must be able to accept feedback with grace and humility. They must also be able to discuss and enact that feedback in positive ways.
- *Commitment.* Mentees should be willing and able to commit the time necessary to serve. Individuals with hectic personal or professional lives may not be able to give adequate time and attention to mentoring even if they wish to do so.

Characteristics of effective mentoring programs

Mentoring programs can take a variety of forms. *Traditional one-to-one mentoring* occurs when a more knowledgeable and experienced person guides and teaches a less knowledgeable or experienced other. *Group mentoring* occurs when a more knowledgeable and experienced person guides and teaches a group of less knowledgeable or experienced others. *Team mentoring* occurs when several more knowledgeable and experienced people guide and teach a group of less knowledgeable or experienced others. *Supervisory mentoring* occurs when a person in a position of power mentors subordinates. *Situational or special projects mentoring* occurs for a brief period of time with clear and concise goals. *Peer mentoring or coaching* occurs when individuals of about the same knowledge, experience and rank support each other (Bierema & Merriam, 2002; MENTOR, 2009).

There is also a wealth of literature on the characteristics of successful mentoring programs that are relevant regardless of the format of the program (Morrison, Ross & Kemp, 2007; Biereman & Merriam, 2002; Forret, 1996; Kogler Hill & Gant, 2000; NASA, 2003: Perren, 2003; Ramani, Gruppen & Kachur, 2006). These include:

- a strong instructional design that includes clearly stated expectations and goals
- a focus on mentees' individual growth and development as opposed to a sole focus on performance
- clearly articulated expectations for communication between the mentor and mentee (or mentees)
- the ability for mentors and mentees to self-select each other as much as possible
- incentives for mentors and mentees to participate and plans for evaluating success
- continuous improvement of the mentoring program

In general, effective mentoring programs for K-12 teachers combine instructional support, technical support, emotional support, and opportunities for mentors and mentees to work collaboratively to improve teaching practices and student learning (Fieman-Nemser, 1998). More specifically, literature in K-12 environments suggests the following characteristics for successful mentoring programs in addition to the general characteristics mentioned above (Hobson et. al., 2009; Yendol-Hoppey & Dana, 2007; Harrison, Dymoke, & Pell, 2006):

- situating mentoring programs in schools characterized by collegiality and peer learning,
- providing appropriate mentor preparation,
- developing a community of practice for mentors and for mentees who can support each other regardless of whether they reside in the same school (possibly through technology),
- utilizing intentional strategies to develop a strong relationship between mentor and mentee(s) to provide the emotional support often needed by novice teachers,
- utilizing a multidimensional approach to mentoring that includes emphasis on curriculum, pedagogy, content, student learner, context, and classroom management without negating the necessary emotional support,
- using intentional strategies to promote self and critical reflection during the mentoring process,
- providing opportunities for the mentoring to take place during the school day; possibly through release time for mentor and mentee(s),
- providing opportunities for the mentors to be involved in the design and evaluation of the mentoring program,
- pairing mentors and mentee who teach in the same or similar disciplines,
- ensuring that mentors have neither supervisory nor evaluative responsibilities for the mentee(s),
- providing opportunities for either mentor or mentee to request a new pairing without fear of consequence, and
- jointly developed and written goals that are evaluated periodically by the mentor and mentee(s).

Strategies to support mentoring

Strategies for effective mentoring have been identified across contexts including K-12 environments. Six of the most common strategies include: (1) working within the mentee's zone of proximal development, (2) encouraging metacognition, (3) employing active learning strategies, (4) learning by observing, (5) learning through participation and (6) implementing adult learning principles.

Working within the mentee's zone of proximal development

A zone of proximal development represents the difference between what a mentee can do and understand on his own versus what he can do and understand with help and support from a more knowledgeable other (Vygotsky, 1978). Novices often have fragmented or incomplete understandings while experts tend to recognize patterns. Experts make complex inferences from situations and have extensive experience that may make it difficult for them to understand how mentees may be thinking. Given that novices often lack foundational knowledge and experiences and, thus, may not have appropriate schema to learn from the mentor, mentors must work to scaffold the mentee from the place where they currently are to increasingly advanced places of higher understanding. This requires that mentors possess strong listening skills and continuously work to ensure mentees are operating from developmentally appropriate contextual and conceptual understanding. Many of the strategies described below can help mentors scaffold mentees to higher levels of understanding.

Encouraging metacognition

Encouraging metacognition and self-monitoring during the mentoring process is important for the development of mentees. Metacognition is essentially the ability to be self-aware of one's own thinking (Flavell, 1976; Hartman, 2001). Those who are metacognitive are able to self-monitor their thinking, determine what information they have, what information they need, and whether their line of reasoning is plausible when solving a problem. Mentors can encourage such self-monitoring by asking relevant questions that scaffold a mentee toward higher levels of understanding. Feedback from the mentor regarding the mentees answers is also an important part of the process. In essence, the mentor wants to try to give the mentee a glimpse into his/her thinking. Mentors want to focus on the task at hand and not on the mentee as a person because an emphasis on the latter is frequently harmful to learning when mentees interpret this as a judgment of competence (Kluger & DeNisi, 1992).

Employing active learning strategies

Active learning supports learner-centered strategies that allow mentees to take responsibility for their own learning (Bonwell & Eisen, 1991; Gagne, 1966). Active learning may refer to behavioral or cognitive activity (Kirschner, Sweller, & Clark 2006). This may occur through active dialogue where the mentor encourages the mentee to ask questions, embark on authentic experiences, demonstrate a technical skill, or simulate a company or school protocol (i.e., how to greet a customer or how to organize a parent-teacher conference). This may also occur through case studies, vignettes, or simulations. Some active learning strategies such as dialoguing with a mentor may also encourage metacognition as described above.

Learning by observing

Observation is a powerful mentoring strategy (Bandura, 1977; Brown, Collins & Deguid, 1989), and providing mentees opportunities to observe mentors and knowledgeable others in action may greatly enhance mentee growth and development. Within the context of K-12 online learning this could mean that mentees are given access to the online environments where mentors teach and are able to observe how the mentor communicates with students and parents and gives feedback on assignments.

Learning through participation

While observation may be an initial first step in the mentoring process, mentors may want to provide mentees with scaffolding opportunities for increasingly complex participation within the organization or school. This process, often referred to as legitimate peripheral participation, is often a successful strategy for enculturating members into the organization's community of practice (Wenger, 1998).

Implementing adult learning strategies

Adult learning strategies encompass much of what has been discussed in the previous sections. In addition, mentors should respect mentees as adult learners and recognize their need for self-direction, relevance, and practicality. Mentors should also recognize that mentees will bring their personal experiences (past and present) to the mentoring relationship and likely desire goal-oriented planning as part of the mentoring process. Mentees will also appreciate it when mentors are in tune with their concerns as novice K-12 online teachers (Hobson et. al., 2009).

Clearly, much is known about mentoring in general and about mentoring for K-12 brick and mortar teachers. However, much less is known about mentoring K-12 online and blended teachers.

Research Synthesis: Mentoring for K-12 Online and Blended Teachers

In a previous section we reviewed literature related to the benefits of mentoring. Mentoring can also be effective in virtual organizations (Lavin Colky & Young, 2006) and for K-12 online teachers (Kennedy & Archambault, 2012). The characteristics of mentor and mentees and effective strategies for mentoring hold true in online contexts; however, the geographical distances associated with such mentoring typically require increased levels of trust, self-motivation, flexibility, communication skills, and technical skills (Lavin Colky & Young, 2006). In addition, the traditional notion of more experienced teachers mentoring less experienced teachers may not hold true when experienced brick-and-mortar teachers are transitioning to online teaching. In fact, a recent dissertation study showed a weak correlation between years of traditional classroom teaching experience and teachers' perceptions of being prepared to teach online (Breichesen, 2015). It is plausible that a teacher with fewer total years of teaching experience but more years teaching online may serve as a mentor to a teacher with more overall teaching experience when it comes to teaching in an online environment.

The variety of different models for online learning, the variety of different contexts in which online teachers teach, and the lack of research-based literature make it difficult to succinctly describe how mentoring occurs for K-12 online and blended teachers (Kennedy & Archambault, 2012). However, over 60% of online teachers report participating in peer mentoring or coaching as part of their professional development (Dawley, Rice, & Hinck, 2010). A more recent survey shows these percentages as much lower with only about 16% of K-12 online teachers reporting they receive professional development through mentoring (Archambault & Larson, 2015) so the availability of mentoring likely varies across contexts. Mentoring is, however, an important component of professional development according to recent surveys where K-12 online teachers reported that they preferred mentoring to other, more structured professional development efforts (Zweig & Stafford, 2016) and identified mentoring as an important professional development strategy for new K-12 online teachers (Archambault & Larson, 2015).

There is a small but growing body of literature describing how mentoring occurs for K-12 online teachers who work for virtual schools. The majority of this literature is published through iNACOL (International Association for K-12 Online Learning) in books such as *Lessons learned in teacher mentoring: Supporting educators in K-12 online learning environments* which devotes several chapters to describing mentoring programs in various virtual organizations (Kennedy & Archambault, 2012) and *Online teacher support programs: Mentoring and coaching models* (Wortmann, Cavanaugh, Kennedy, Bledarrain, Letourneau, & Zygouris-Coe, 2008) which briefly summarizes mentoring models at selected virtual organizations. Other models are also described in journal articles (See, for example, Barbour, Kinsella, Wicks & Toker, 2010).

Most of the models described in these books consider mentoring as one component of their larger professional development program. In some cases, new teachers enroll in a professional development course prior to teaching their first online course and then proceed through multiple, formal levels of mentoring where scaffolding is decreased as the teacher becomes more experienced and demonstrates her competence as an online teacher. In other cases, virtual organizations implement a one-to-many program where mentors are formally trained and assigned to a group of mentees in order to ensure adequate mentor preparation and to promote community within the organization. Other organizations implement a model that includes one-to-one mentoring as well as situational (or just-in-time) mentoring that allows mentees to take advantage of the wealth of expertise within the organization. Some virtual organizations also provide mentor preparation to experienced teachers interested in mentoring new K-12 online teachers. In almost all cases, the mentoring programs are described as works in progress that evolve based on the goals of continuous improvement and improved student performance (Kennedy & Archambault, 2012).

While there are few published descriptions of mentoring programs for K-12 online teachers, they far outnumber research on the topic. In one instance, university researchers served as mentors to a group of online teachers embarking on action research for the first time. Research from this work elicited recommendations for mentoring online during the various stages of the action research cycle (Dana, Dawson, Wolkenhauer & Krell, 2012). This research led to another initiative in which the same university researchers prepared online teachers to become action research mentors within the virtual school. These online teachers participated in professional development offered by the university researchers about mentoring action research and simultaneously mentored a group of online teachers through the action research process (Krell, Wolkenhauer, & Dana, 2012). Results from this work demonstrate that when action research mentors are prepared to support online teachers through the process, it can benefit the virtual organization as well as the individual teachers who have an opportunity to carefully examine their own beliefs and practices (Dana & Dawson, 2012).

Another study explored the practices used by online teachers in ninth grade English courses through the lens of Keller's Attention, Relevance Confidence Satisfaction (ARCS) model (Carpenter, 2011). Results suggest that the attention and relevance aspects of the model are likely influenced by course design while the confidence and satisfaction dimensions of the model are more heavily influenced by instructors. Recommendations for mentoring programs designed to increase student motivation were extrapolated from this study and included having mentors provide direct instruction on giving feedback, opportunities for deliberate practice, and reflection (Carpenter & Cavanaugh, 2012).

Finally, in one study, practicing online teachers were prepared to mentor preservice teachers with an interest in online teaching (Kennedy, Cavanaugh, & Dawson, 2013). While this study focused on the experiences of the preservice teachers, it was clear that attention to the mentoring process is essential for designing such experiences.

While there is limited research on mentoring for or by online or blended teachers, there is evidence to suggest that it is one of the most effective strategies for improving instruction in online environments (Farley & Lare, 2012). The online environment is conducive to supporting effective mentoring strategies (i.e., working within the mentee's zone of proximal development, encouraging metacognition, employing active learning strategies, learning by observing, and learning through participation) and supporting a variety of mentoring approaches (i.e., traditional one-on-one, peer, group, team, supervisory and situational). However, for mentoring to reach its potential for K-12 online teachers, more research is needed to guide practice.

Implications for Policy and Practice

Mentoring falls under the larger umbrella of professional development, and many of the recommendations we made in the previous chapter on professional development hold true for mentoring. In addition, policy and practice for the mentoring of K-12 online and blended teachers should consider the following:

- Ensure mentoring programs are designed using research-based best practices from other contexts and from mentoring for K-12 brick and mortar teachers.
- Ensure a selection process that considers the characteristics of effective mentors and mentees is in place to identify participants.
- Ensure mentors and mentees are given adequate time and incentives to effectively participate in mentoring programs.
- Ensure mentors are prepared for their mentoring roles.
- Ensure mentoring is provided to all teachers whether they are teaching online or moving their brick and mortar classes to a blended model.
- Ensure mentoring is provided to all teachers new to online or blended teaching whether they have previous teaching experience in brick and mortar contexts or not.
- Ensure opportunities to participate in mentoring are available for all teachers, not just those who are new to teaching in online environments.
- Promote mutually beneficial collaborations between those leading mentoring efforts and university scholars studying in this area.
- Ensure mentoring programs include robust evaluation plans and that data collected is used to inform future iterations of the programs.

Implications for Research

As stated in the previous chapter, research on professional development for K-12 online and blended teachers is scarce. However, research on mentoring K-12 online and blended teachers is almost non-existent. A first step to developing a research agenda in this area might be to study the variety of mentoring programs currently underway across a variety of contexts and develop a taxonomy or way of describing categories or types of mentoring programs. It is possible that the types of mentoring programs described earlier (i.e., traditional one-to-one, group, team, supervisory, situational or peer) will hold true, but so little is known about mentoring practices for K-12 online and blended teachers that this is not certain.

Similarly, there is a need to identify commonalities and distinctions between mentoring for K-12 brick and mortar teachers and mentoring for K-12 online and blended teachers. For example, mentoring for brick and mortar teachers typically occurs between a younger mentee (i.e., new teacher) and older mentor (i.e., experienced teacher). However, it is possible to have an experienced brick and mortar teacher who is a novice online teacher or an experienced online teacher who has little to no brick and mortar experience which could change the dynamic of the partnership. It is also likely that online teachers from the same virtual school live in different geographic locations which could change the mentoring dynamics.

There is a need to study the outcomes of these programs including their influence on teaching practices and student performance. These mentoring programs should also be studied through the lens of mentors, mentees, and mentor trainers. In addition, research on the design of these programs is necessary to identify core features of effective mentoring programs and to identify strategies and technologies most well-suited to different contexts and teachers. A variety of methods should guide these studies, and it would be very helpful to have a portal within which all these studies could be readily accessed such as the Research Clearinghouse for K-12 Blended and Online Learning (http:// http://k12onlineresearch.org/).

Conclusion

Mentoring is a very important component of a robust professional development plan for virtual schools and organizations, but there is little to no research to guide the development and implementation of mentoring programs for K-12 online teachers. There is also little to no research on the effectiveness of these programs. However, there is a strong research base for mentoring across other contexts, including brick and mortar K-12 education. The chapter begins a conversation about how to apply this research to the mentoring of K-12 online teachers.

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Research on Class Size in K-12 Online Learning

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Abstract

Class size is a crucial environmental factor for online administrators and educators to consider when designing K-12 online courses. Based on an examination of previous research on online class size in both K-12 and postsecondary settings, this chapter analyzes trends and research gaps in this area, and shows that there is no one-size-fits-all solution to the ideal class size question. It suggests that it is vitally important to combine effects of class size and other critical contextual factors (e.g., teaching, teacher experience, learning performance, interaction, subjects) in online learning to maximize students' learning success. The study also provides practical and research recommendations for practitioners, policy-makers, and online instructors.

1. Introduction

In the United States, K-12 online enrollment has been increasing steadily over the last decade (Barbour, 2017; Kennedy & Archambault, 2012; Watson, Murin, Vashaw, Genin, & Rapp, 2013; Watson, Pape, Murin, Gemin, & Vashaw, 2015). During the 2004-05 school year, some half a million K-12 students enrolled in online learning (Zandberg & Lewis, 2008), as compared to 2.2 million K-12 students taking various forms of online classes in 2014-15 (Watson et al., 2015).

Class size is a crucial environmental factor for online administrators and educators to consider when designing K-12 online courses (Sorensen, 2015; Taft, Perkowski, & Martin, 2011). The explosive growth in K-12 online learning enrollment has resulted in significant concerns about the quality of online courses (Barbour & Reeves, 2009), and among all these concerns, class size (or student-teacher ratio) has been receiving increasing scholarly attention, as it may help to explain the relatively weak performance of K-12 online learners (Miron & Gulosino, 2016). Class size is strongly correlated with many variables in online teaching and learning, including but not limited, to teacher workloads (Tomei, 2006), teaching approaches and practices (Taft et al., 2011), class interactions (Taft et al., 2011), and perhaps most importantly, student achievement (Lin, Zheng, & Freidhoff, 2016). Therefore, it is urgent that we work toward a clear, well-rounded understanding of class size effects, and of the combined effects of class size and other critical factors in online learning outcomes. This will enable us to pinpoint the optimal online class sizes that will maximize students' learning success.

Most prior studies on online class size have examined its relationship with some other factor(s) essential to online learning in an attempt to arrive at the ideal class size for online learning in general. Such efforts have yielded mixed findings and no strong consensus, with some scholars arguing that small class sizes have clear benefits for all types of learning (e.g., Arzt, 2011; Burruss, Billings, Brownrigg, Skiba, & Connors, 2009; Qiu, Hewitt, & Brett, 2012; Sorensen, 2015; Tomei, 2006). Others have found that small class sizes are essentially irrelevant to online classrooms, which should transcend the physical limits of traditional learning and enroll as many students as possible, or enroll no fewer students than their face-to-face counterparts (Mupinga & Maughan, 2008). Notably, most studies on online class size have been conducted exclusively in post-secondary settings and have ignored the issue of ideal class sizes for the burgeoning K-12 online learning population. This dearth of K-12 data and analysis was highlighted in the most recent annual report of the National Education Policy Center (NEPC; Miron & Gulosino, 2016)

Accordingly, based on an examination of previous research on the topic of K-12 online class size, the present chapter analyzes trends and research gaps in this area and provides practical recommendations for practitioners, policy-makers, and online instructors.

2. K-12 Class Size in Traditional Settings

Class size is a key educational issue that "has been debated by educators for centuries" (Finn & Achilles, 1999, p. 97). In face-to-face educational settings, researchers have conducted numerous studies aimed at identifying ideal class sizes for the promotion of teaching quality, academic achievement, and student satisfaction (Burruss et al., 2009). The majority of such studies have suggested that in traditional face-to-face K-12 settings, small classes are desired by teachers, students, and parents, and that small classes are beneficial to student learning outcomes (for a review, see Hattie, 2005).

K-12 teachers have consistently been proponents of smaller classes, and in one study, even reported that they would rather teach a small class than have a higher salary (Education Next, 2007). Conversely, large classes have been identified as a major reason for teacher attrition (Loeb, Darling-Hammond & Luczak, 2005; Isanberg, 2010). This may relate to a number of advantages that small classes offer, including more teacher-student interactions (Brühwiler & Blatchford, 2011), which in turn can lead to higher chances of learning (Konstantopoulos & Sun, 2014). Smaller classes can also dramatically reduce students' disruptive behavior (Babcock & Betts, 2009; Bascia, 2010) and increase their positive social and learning behaviors (Finn, Pannozzo & Achilles, 2003). Moreover, the teaching styles and strategies that teachers adopt may differ when classes are smaller. For example, they may tend to devote more time to individualized teaching with the aim of improving class engagement (Brühwiler & Blatchford, 2011). Other changes in teaching styles linked to class-size changes have included "teacher-student interaction patterns, classroom organization, the establishment of classroom rules, and the teachers' use of humor" (Harfitt, 2013, p. 330). Teachers of smaller classes also tend to have more contact with parents which leads to better relationships with them (Bascia, 2010) as well as better evaluations from them (Bohrnstedt & Stecher, 1999).

Students prefer small classes on the grounds that they allow more individual attention from their teachers, and more frequent interactions with them (Blatchford, Bassett, & Brown, 2011; Blatchford, Russell, Bassett, Brown, & Martin, 2007; Ehrenberg, Brewer, Gamoran, & Willms, 2001). Blatchford et al. (2011), for example, demonstrated that the larger classes became, the more students' classroom engagement declined. This was especially true for low-attaining students. It could be because the challenges of active learning – i.e., the demand for more interaction and the accommodation of students' diverse learning needs – increase as class size grows (Burruss et al., 2009). Like individual attention, frequent interactions and high student engagement often positively influence student achievement (Zyngier, 2014).

In sum, the available evidence suggests a close relationship between small class size and improvements in learning (Hattie, 2005). Specifically, students in small classes have been found to be more active in their learning, more engaged, and higher achieving than those in large classes (Brühwiler & Blatchford, 2011). Moreover, the positive effects of small class size appear to persist from kindergarten through third grade, and lead eventually to increases in college attendance and college completion rates (Chetty et al., 2010; Dynarski, Hyman, & Schanzenbach, 2011), chances of landing highly paid jobs (Dynarski et al., 2011), and salaries at age 27 (Chetty et al., 2010).

Despite this considerable body of evidence, however, we should be cautious about overgeneralizing the benefits of small class sizes. As Borland, Howse, and Trawick (2005) noted, "the relationship between class size and student achievement is not only non-linear, but non-monotonic" (p. 73). In fact, several studies that reported positive correlations between small class size and high achievement were found under certain conditions. For example, Krueger and Whitmore (2001) showed that gaps in achievement were between white and nonwhite students when they were in small classes. Similarly, Konstantopoulous and Sun (2014) summarized that the advantages of small classes were more apparent in the early elementary grades, in classes with fewer than 20 students, and among certain minorities and students of low socioeconomic status.

3. K-12 Class Size in Online Settings

This section covers scholarly perceptions of the importance of online class size, the online class size status quo, and attempts that have been made to determine the optimal online class size. As mentioned earlier, research on these topics has primarily been conducted in higher education settings, and except where otherwise noted, the participants in all studies mentioned were college students.

3.1 The Importance of Online Class Size

Online class size has sometimes been called a myth, because the number of students in an online class is not a stand-alone factor, but intertwined with other aspects of online learning, which in turn affect student learning behavior (Tomei, 2006). This subsection sets forth three important reasons why a better understanding of online-class size is needed: 1) false expectations about online class size; 2) potential decreases in learning outcomes related to class size; and 3) the possibly non-linear relationship between online class size and student achievement.

First, in contrast to traditional face-to-face settings, online learning has few physical limits, and this has led naturally to an expectation among higher education administrators that online courses should enroll more students than face-to-face ones (Sorensen, 2015), in part due to a temptation to reduce educational costs through economies of scale (Tomei, 2006). Interestingly, undergraduates have rarely expressed objections to their online courses being large. Roby, Ashe, Singh, and Clark (2013), for example, reported that a key student objection to large classes was that they increased the odds of being distracted by other students – a risk that is absent from virtual learning spaces. More than half of Roby et al.'s participants identified 50 students or more as the optimal online class size, while the average perceived optimal class size reported by instructors who participated in the same study was 30.

Second, the literature includes some preliminary findings on the risks associated with a large class size. Specifically, Lin et al. (2016) found that increasing the size of K-12 online classes to above 45 students led to a decrease in final scores. This finding might be explained by the hindrance of teacher-student and student-student communication that has been ascribed to large online courses (Arzt, 2011; Orellana, 2006; Taft et al., 2011). This is hardly surprising as online instructors normally need to spend more time on grading and giving feedback to students than traditional classroom teachers do, and this increased workload can result in decreases in teaching quality (Sorensen, 2015; Tomei, 2006).

Third, the relationship between class size and student learning outcomes may not be linear in that students in small online classes may not necessarily have higher scores (Borland et al., 2005). Lin, Bae, and Zheng (2016) identified a reverse-U-shaped relationship between class size and final scores among online students taking high-school level courses in a virtual school. Lin et al. speculated that extremely small classes could make student-teacher and student-student communication less effective, and that this might have negative effects on learning performance.

This research highlights the importance of understanding the impact of online class size on learning outcomes. Studying class size in the context of K-12 online learning is especially urgent (Lin et al., 2016; Miron & Gulosino, 2016). Miron and Gulosino pointed out that the lack of research and even of basic data on class sizes in K-12 online learning is particularly unfortunate, given that virtual schools' investment plans tend to revolve around savings in facilities, transportation, and staff costs, relative to brick-and-mortar schools.

3.2 Online Class Size: The Status Quo

Published empirical evidence implies that higher education institutions may not be sensitive to the issue of online class size. Mupinga and Maughan (2008), for example, found that a majority of institutions simply set the optimal sizes of their online classes at the same level as their traditional ones, and that the ways online class size were determined was remarkably inconsistent. The same study reported that one common method was to preset a limit – usually 20, 25, 30, 36, or 50, with the modal size being 25. Mandernach, Hudson, and Wise (2013) reported an average class size of 20, based on a survey of 80 online university faculty members. Through a survey of 131 teachers across the U.S., Orellana (2006) found that online class sizes ranged from four to 81, with a mode of 20 and a mean of 22.8. Sorensen (2015) reported that the upper limit for online class enrollment was 30 students in his sample of undergraduate- and graduate-level online courses at a large for-profit university.

Two studies have reported a wide range of online class sizes in K-12 settings (Lin et al., 2016; Miron & Gulosino, 2016). Miron and Gulosino (2016) found that the student-teacher ratio in virtual schools for the 2013-14 school year was approximately 35:1, which was more than twice that of traditional public schools (16:1). However, the same authors identified wide variances across virtual schools: with for-profit ones having the highest ratio, 44:1, and non-profits the lowest, 19.5:1. All other types of schools that they looked at, including charter and blended schools, had ratios between 23:1 and 29:1. All such figures also tend to mask large variations in actual class sizes: from a minimum of 1.3 to a maximum of 356 across all virtual schools.

A study of the effects of K-12 online class sizes by Lin et al. (2016) examined 12,032 students enrolled in 233 courses in six subjects taught by 155 instructors in one of the largest virtual schools in the U.S. It found a broad range of online class sizes, from just one student to 60. Around 29% of the classes in the sample had five students or fewer; 18% had six to 10 students; 20% had 11 to 20 students; and 33% had 21 or more students. The average class size across all six subjects was 15, with a standard deviation of 12.

3.3 Determining the Optimal Online Class Size

In light of what is known regarding current K-12 online class sizes, it is worth asking how an optimal size could be determined. The approaches in the literature to determine optimal online class size can be classified into four types. The first is to adjust the class size to suit teachers' workloads, levels of teaching experience, and pedagogical approaches (e.g., Tomei, 2006). The second determines the ideal class size based on students' learning performance (e.g., Lin et al., 2016; Qiu, Hewitt, & Brett, 2012). The third determines ideal class size based on the quantity of online learning interactions (e.g., Arzt, 2011); and the last recommends that, whichever other approach or combination of approaches is used, online class size must be tailored to each academic subject (Lin et al., 2016). Each approach is described in more detail below.

3.3.1 Through Teaching and Teacher Experience

Tomei (2006) pointed out that an online higher education course required a total of 155.83 teaching hours per semester, as compared to 136.5 hours for a traditional face-to-face course. Based on teaching load data and an analysis of teaching components (i.e., instructional content, counseling and advising, and student assessment), Tomei calculated the ideal online class size as 12, and the ideal traditional class size as 17. The author concluded that, due to the limited contact time that each online instructor had with his or her students, it was unrealistic to expect that online classes should be larger than others. Similarly, Sorensen (2015) noted that larger class sizes in higher education required teachers to devote more time to grading and that beyond a certain point, teachers of online classes "might be tempted to water down the quality of instruction so that they can complete their teaching duties (i.e., grading assignments) in a timely manner" (p. 143).

In addition to teachers' workload, it has been argued that their level of teaching experience should be considered when determining the ideal online class size – though the evidence in support of doing so is not conclusive (Arzt, 2011; Orellana, 2006; Sieber, 2005; Visser, 2000). Visser found that teachers' experience could affect the time they devoted to teaching and to developing online courses, with less experienced teachers spending more time in preparation, and thus preferring smaller classes. Similarly, Sieber and Arzt both recommended that teachers with little or no prior experience of online teaching should start with small classes of no more than 12 students, and take on larger ones as their online experience increased. However, Orellana found no relationship between instructors' perceptions of optimal class sizes and their level of experience (i.e., years teaching, years teaching online, and level of expertise). Clearly, the relationship between teaching experience and class size requires further investigation.

In addition to teacher workload and teaching experience, it has been argued that pedagogical approaches should be taken into consideration when seeking to determine optimal sizes for online classes. Taft et al. (2011) proposed that careful consideration should be given to whether each class uses a constructivist or an objectivist approach. Constructivism implies requiring students to take an active role in their learning through communication with teachers and one another, deep reflection on the knowledge they have, and construction of new knowledge based on it. Objectivism means that students learn passively through simply receiving knowledge from their instructors. As such, the latter approach – which is usually applied to scientific or factual topics – requires little or no communication, with learning taking place independently and individually. Taft et al. concluded that if an online course is designed on objectivist lines, its size need not have any upper limit. Where the constructivist approach is used, on the other hand, Taft et al. recommended that classes contain no more than 25 students.

Online class sizes have also been found to affect teaching practices. For example, Sorensen (2014) categorized 380 online classes into three groups, with the first group having a small class size (10 or fewer students), the second a medium size (11 to 19 students), and the third, a large size (20 to 30 students). The results showed that the teachers of large classes applied their expertise and content knowledge less effectively and less consistently than the teachers in either of the other two groups. Badders (2012) recommended that instructional designers design large online courses with more opportunities for students to reflect, analyze, synthesize, and communicate, to enhance the overall effectiveness of their learning. It appears that no one study has looked at both teaching style and teacher experience when seeking to determine an optimal K-12 online class size.

3.3.2 Through Learning Performance

The second approach to determining ideal class size relates to student learning performance. For example, Qiu et al. (2012) found that the size of graduate level online courses was an important factor affecting students' learning behaviors; specifically, those in classes with large class size were more likely to experience information overload and less likely to engage in note-reading. The same study suggested that the problem of information overload could be resolved by dividing students into small discussion groups. Qiu et al. concluded that a class size of 13 to 15 would be optimal for ensuring high quality note-taking and note-reading. A more recent study by Lin et al. (2016) was the first to directly examine the relationship between class size and learning outcomes in a K-12 online-learning context. Using hierarchical linear modeling, Lin et al. found that increasing class size significantly and positively predicted students' final grades until it reached 45 students, but that after this turning point, further increases in class size resulted in lower final grades.

3.3.3 Through the Quantity of Interactions

The third approach to estimating ideal class size is via quantification of students' opportunities to interact with their teachers and peers. Orellana (2006) examined university teachers' perceived ideal class sizes in combination with different levels of teacher-student interaction, and found that the average optimal class size named by the teachers was 18.9 – lower than their actual average class size – and that high levels of teacher-student interaction were correlated with a small class sizes. Based on previous studies involving online class size, Arzt (2011) concluded that the ideal size for online undergraduate classes would be 15 to 22 and for online graduate classes, 12. Arzt further argued that active interaction between teacher and students, among students, and between students and course content could only be guaranteed if class sizes were kept at or below these thresholds Taft et al. (2011) recommended three different optimum class sizes for different interactional needs: less than 30 if there is little teacher-student interaction and the main purpose of the class is simply one-way knowledge transmission; 16 to 30, if there is a moderate level of teacher-student and student-student interaction; and less than 15, when the class requires a dense network of interactions.

The above-mentioned studies that used numbers of interactions to determine optimal online class sizes were all conducted in higher-education settings. Nevertheless, it is reasonable to consider the same factors when seeking to determine optimal sizes for K-12 online classes, as high quality teacher-student interaction has been found critical to students' success in K-12 online learning (DiPietro, 2010; Lin, Zheng, & Zhang, 2017). Oliver, Osborne, and Brady (2009) found that K-12 online learners expected their teachers to provide faster and more detailed responses to their questions, and more individualized attention generally, than face-to-face learners did. However, a large class size may create obstacles to students' communication with their teachers (Badders, 2012). Because large class sizes increase teacher workloads, particularly when it comes to grading assignments and writing feedback (Sorensen, 2015; Tomei, 2006), it is not necessarily possible to meet students' expectations that feedback in such classes be fast, detailed, and individualized. Burruss et al. (2009)

confirmed that teacher-student interaction occurs more often in smaller classes, due to larger classes' limited opportunities for communication.

Communication between peers, or student-student interaction (Moore, 1989), appears to be beneficial both educationally and motivationally at the K-12 level (Beldarrain, 2008; Borup, Graham, & Davies, 2013; Oliver et al., 2009). Since student-student interaction in online learning generally takes place through online discussions, the literature suggests that large class sizes may hamper it, as individual students may struggle to make their voices heard (Buckingham, 2003). However, prior studies of K-12 online learning have yet to propose any optimal class size based on student-student interactions' quantity or quality.

3.3.4 Through Subjects

Prior research findings imply that subject matter plays an important role in the optimal sizes of online classes. According to Cavanaugh, Gillan, Kromrey, Hess, and Blomeyer (2004), online K-12 students found math and science difficult to learn online, as these subjects required high levels of technical understanding. In addition, students enrolled in online K-12 world language courses underperformed compared to those enrolled in other subjects (Cavanaugh, 1999). Similarly, Oliver, Kellogg and Patel (2012) found that world language students attending a virtual school consistently perceived that they were learning less than face-to-face world language students of the same age did. Lin et al. (2016) found that the relationship between class size and learning outcomes varied greatly across subjects. Specifically, in language subjects (i.e., English and foreign languages), class size did not predict final grades significantly; but in science, the higher the class size, the higher the students' final grades were, until the class size reached 35, at which point their grades declined as class size increased. The same pattern was observed with math and social science classes, which had turning points of 38 and 42 students, respectively.

4. Implications

It should be clear from the foregoing discussion that there is no one size fits all solution to the ideal class size question, and that it is vitally important to consider contextual factors when seeking to answer it. As noted above, almost all of the current studies regarding class size in online learning were conducted in higher-education settings, the only exception being Lin et al. (2016). Although online learning shares some common features across post-secondary and K-12 settings, it is important that researchers consider the special characteristics of the K-12 online learning population. For instance, many students only enroll in one or two courses from an online learning institution, while continuing to attend their brick-and-mortar schools each day (Lin et al., 2017). In addition, K-12 online-learning providers are extremely varied, and include public schools, charter schools, private schools and for-profit schools (Miron & Gulosino, 2016; Watson et al., 2013, 2015). In addition, online student performance has been found to vary significantly across these types of institutions (Freidhoff, 2017). It is also important to consider the unique personal characteristics of young K-12 online learners, whose motivation and self-regulation have been found to be low, as compared with online adult learners (Weiner, 2003). Given these unique contextual factors, we recommend not only that ideal class size findings cease to be generalized from post-secondary settings to K-12 ones, but also that future research on the issue of class size be situated in each distinct type of K-12 online-learning setting. This will deepen our understanding of how contextual factors shape optimal online class size.

4.1 Implications for Research

We recommend the following directions for future research. First, as briefly noted, it is essential that further attempts to arrive at ideal online class sizes be tailored to each distinct type of learning setting, which in turn will require considerable new efforts in data collection regarding K-12 online class sizes and student performance/satisfaction across all academic subject areas and across the various types of online learning providers. In other words, without a large new pool of K-12 data, it will continue to be difficult for researchers to arrive at a clear understanding of the status quo, without which, recommendations for changes in class size will be broadly meaningless. Second, as Lin et al. (2016) have suggested, researchers should focus more clearly on the relationship between class size and learning performance, as part of a broader agenda of maximizing how much and how well online K-12 students learn. Apart from final grades, future studies could consider how class size may affect students' psychological, affective, and behavioral performance. Third, special attention should be given to online teachers, especially in terms of the possible impact on the overall processes of instructional design and instruction related to class size. And lastly, given that real-world decisions about class size are almost always intertwined with factors other than maximizing student performance, we recommend that research on class size always consider factors such as subject matter, difficulty level, instructor experience, pedagogical approaches, and budgetary concerns.

In addition to pursuing the potential new research directions noted above, it would be desirable to ground research on online class size in solid theoretical frameworks. Taft et al. (2011) suggested that three educational frameworks be used for evaluating online classes and class sizes in higher education. These include Bloom's taxonomy (which ranks thinking from lower-order to higher-order, as knowledge, comprehension, application, analysis, synthesis, and evaluation); objectivist-constructivist teaching strategies (with objectivism referring to the passive receipt of knowledge, and constructivism to the active construction of it); and the community-of-inquiry model (which holds that the three essential components of online learning are teaching presence, social presence, and cognitive presence). In addition to these three frameworks, we believe that several additional ones could usefully be adopted, both for determining ideal class sizes, and for examining the relationship between class size and other learning variables in K-12 online learning settings. In particular, the adolescent community-of-engagement framework developed by Borup, West, Graham, and Davies (2014), which comprises engagement on the part of adolescent students, teachers, peers, and parents, could be particularly relevant, in addition to the sense of community framework devised by Rovai (2002), that focuses on spirit, trust, interaction, and learning.

Methodologically, we call for future class size research to utilize multiple methods, including but not limited to case studies, correlational studies, and longitudinal studies. Given that each learning context is unique, case studies may provide more insights about class size in an exploratory, yet detailed and descriptive manner. This may be through interviews with teachers and students, observations on how class size might affect students' learning, and/or discourse analysis of the communication between teachers and students. Researchers using case-study methods could also consider how unique and multiple contextual factors jointly affect class size effects, and arrive at clearer explanations of how students feel, think, or behave in online classes of various sizes.

Correlational studies, meanwhile, would enable us to understand the underlying relationships between class size and other crucial factors in online learning. Orellana (2006) effectively used correlations to examine the relationship between class size and specific teaching practices, while Lin et al. (2016) used hierarchical linear modeling in their analyses of the relationship between class sizes and students' learning outcomes. This technique enabled them to control for statistical errors relating to each individual in a nested structure (i.e., students nested in different classes).

Future longitudinal studies could examine the effect of class size on learning over time, through collecting data several times during a semester or year and identifying the trajectory of changes in both teachers' and students' behaviors and attitudes to learning. In addition, longitudinal studies might enable us to reconcile contradictory findings on the relationship between teachers' experience and class size from existing literature.

Lastly, this chapter only addressed class size in online learning, due to the difficulty of measuring the class size in blended learning context and the scarcity of published studies in that context. Future study could examine how class size may affect student learning in blended learning context, and how it may work in a similar or different way compared to online learning settings.

4.2 Implications for Policy and Practice

Given the lack of research pertaining to online class size in K-12 settings, it would be highly premature for this paper to suggest any concrete number as the ideal K-12 online class size. Rather, we propose a principle for administrators, policymakers, and others seeking to determine ideal online class size: the decision should be based on the four main contextual factors outlined above: i.e., teaching approach and teacher experience, learning performance, quantity of interaction, and subject matter.

5. Conclusion

Class sizes vary widely across and within institutions (Mupinga & Maughan, 2008). Our review of previous work on online class size implies that there is no "one size fits all" method for deciding upon the optimal class size for online K-12 learning, let alone any one particular class size figure that should be universally accepted and adopted. Instead, future educational researchers, online teachers, policymakers, and school administrators should give careful consideration to the perspectives, factors, and methods these prior studies adopted when thinking about class size. In terms of future academic research, in particular, the results of our review indicate that the study of optimal online class size must be embedded in specific online learning contexts. Future research should examine how class size interacts and correlates with other factors crucial to student achievement and other learning outcome variables.

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PART IV

K-12 Online & Blended Learning in Content Domains

21

Introduction

Kristine E. Pytash & W. Ian O'Byrne

Introduction

There continues to be a growing contingent of K-12 classrooms that are virtual spaces engaging in the use of open learning and open educational resources. The challenge for educators is that the transitory nature of online information creates a mixed blessing. The Internet can be an empowering tool that allows individuals to create, share, connect, and learn with other like-minded individuals around the globe. Conversely, the use of open educational resources in the classroom may provide challenges for educators who want to integrate this valuable resource into their classroom. The chapters of this section update and address the challenges and opportunities that exist as we consider the pedagogies involved in teaching and learning in online and blended spaces.

To help guide the contents of the upcoming section, we've included a list of the implications we've drawn as section editors across these chapters. As is detailed by good teaching and learning, we as readers to begin with the end in mind. Consider the implications across these chapters, and then review this introductory section for the chapter after you have completed your review. The implications help frame the research needed in the area, structure of contents and courses, and considerations about what is meant by success in these environments.

Implication #1: More research is needed

As themes in this handbook suggest, the trends toward online and blended learning continue to be prevalent. The number of students enrolled in online virtual schools or participating in a hybrid learning environment continues to grow at rapid paces. Despite this trend, there is a significant lack of research in the area of online learning with regards to teaching and learning in specific disciplines. This results in a lack of understanding of these spaces, and missed opportunities to leverage the affordances of these environments.

While the authors in this section acknowledge that their particular disciplinary fields have significant research investigating technology integration, there is a lack of research specifically into teaching and learning in specific disciplinary contexts in online or virtual schools. In our chapter focused on literacy instruction, we acknowledge that technology has significantly influenced our notions of what it means to be literate. Multimodal literacies has extended our notion of literacy to consider how audio, image, video, and gestures etc. are used for communication purposes. And yet, there is little research that explores what this means for students enrolled in K-12 online or virtual schools. Future research might investigate if virtual schools reinforce traditional notions of literacy as print literacy or if they are more innovative in their conception of literacy education. In addition, there are particular areas that need to be emphasized in particular fields. For example, Kosko and colleagues note that there is little research exploring how learning math online varies across grade levels, while Zheng notes that in the arena of world languages, there are no studies investigating students' learning and teachers' instructional practices. In addition to more research, Heafner & Handler remind readers that there is also a need to examine how instruction and learning takes place in a diversity of contexts and with a variety of research methodologies.

Implication #2 Disciplinary knowledge, skills, and assessments should influence how courses are structured.

Discipline specific classes not only assume students will acquire specific knowledge, but they also invite students to think, read, and write in ways that are required by the discipline. It is important to consider how the discipline shapes the instructional approaches used in online learning environments. For example, in their chapter Daum and Buschner note that physical educators must consider how courses are designed to allow students opportunities for teaching specific motor skills, sport skills, and fitness. In addition, educators must consider ways to track physical activity or how to assess particular movements through online tools.

Understanding the types of instructional approaches that both honor the discipline and are effective in online settings are crucial in all content areas. For example, Kosko and colleagues stress that additional work is needed to explore how virtual manipulatives are used in teaching and for learning in online math classes. This implication is similar to Crippen and colleagues finding that the most compelling teaching and learning involves " technology use as a construction and representation tool as opposed to simply for information retrieval and communication." Future educational and career situations will require that individuals can use technology in domain specific instances and modify as needed. This is critical as educators consider which instructional approaches to implement in order to design integrated online learning environments integrating numerous tools for teaching and learning.

Implication #3: Broader considerations about what is considered "effective instruction" or "student learning success"

Traditionally, student learning is measured by content acquisition; however, many of the authors in this section include broader ways that educational success can be defined. Put simply, much of current instruction is focused on taking what we've done with teaching, learning, and assessment and building it online or in blended spaces. There is no relatively no consideration of the ways in which educators can leverage the time, place, path, and pace to support or challenge learners.

The current ecosystem contains a mix of educators playing and exploring with these new learning environments and even fewer researchers testing new models. For example, numerous chapters included information about student engagement. In addition, Zheng noted that research on language acquisition has focused on student satisfaction and students' attitudes, and that researchers could also include identity construction and socialization. Similarly, Heafner and Handler point to students' deep learning when they are involved in learning that results in the creation of a project that encourages students to civically participate in our democracy or take active stance in a civic role. O'Byrne and Pytash examine the growing field of MOOCs and higher learning in K12 instruction, while considering the finances and seat time, as opposed to what is best pedagogically.

Conclusion

The goal of this section is to help provide an understanding of the current landscape as we consider teaching, learning, and assessment in K12 online, and blended learning environments. As detailed in the previous version of the *Handbook*, there continue to be a plethora of opportunities for authors to help make sense of different parts of this topography. While great progress has been made in this second edition, it is a challenge to document what has changed, while not losing sight of where we've been. This is in addition to the continual change that happens as new Internet and communication technologies become more ubiquitous in society. There are still areas where research and exploration is needed. As section editors, we are also very cognizant of the vast areas in which we have not been able to send an expert to conduct these forays into the space and map learning for others. For educators and researchers searching for insight into areas not discussed in this text, please use the other chapters as guidance. But, please consider the merit of lessons learned in your own spaces. We believe you'll need to translate these lessons learned into your own fields. Document your learning over time openly online…and we'll look forward to including your work in the next edition of this handbook.

22

Growing in Number

Research on Mathematical Teaching and Learning in the Online Setting

Karl W. Kosko, Lauren Sobolewski, & Md Amiruzzaman

Abstract

In this chapter, we describe how research focusing on online and blended mathematics learning (OBML) has generally focused on OBML as a treatment for learning rather than a context for it. Within this focus, research has generally suggested a mix of positive, negative, and no significant differences in mathematical learning outcomes for OBML and traditional face-to-face learning environments. Further, the majority of OBML research, and practice, resides in secondary mathematics. We discuss reasons for the current focus on OBML research, recommendations for building upon this literature base, and implications for practice.

Keywords: Mathematics Education; Mathematical Learning; Mathematics Achievement; Mathematics Pedagogy; Online Learning; Blended Learning; Algebra; Virtual Manipulatives.

Introduction

Variations in online and blended learning (hereafter OBML) in K–12 mathematics are becoming more and more prevalent. As of the 2002–2003 school year, 36% of all school districts had students enrolled in some variation of online learning and 15% of all of those students were enrolled in an online mathematics course (Setzer & Lewis, 2005). However, a more recent report by Watson et al. (2013) found that most U.S. states have some version of online or blended K–12 schooling. Providing detailed statistics of this trend for the state of Ohio from 2010 to 2013, Ahn and McEachin (2017) report statistics indicating that the percentage of K–12 students enrolled in an online school increased every year from 1.41% in 2010 to 2.22% in 2013. Mathematics online course offerings are predominately focused on middle and secondary topics, with a heavy emphasis on Algebra readiness (Archambault & Crippen, 2009), but online mathematics coursework is available as early as pre-K and throughout the school years (Archambault & Crippen, 2009; Ahn & McEachin, 2017; Setzer & Lewis, 2005; Watson et al., 2011). There are many reasons for the proliferation of both online and blended mathematics learning across K–12. In many cases, OBML provides scaffolds for students identified either as gifted in mathematics or having a mathematics learning disability (Fung, Yuen, & Yuen, 2014; Seianni & Coy, 2014). In other cases, OBML is used by teachers as a supplemental means of supporting students' mathematical learning (Borba et al., 2016; Brasiel, Jeong, Ames, Lawanto, & Yan, 2016; Clements & Sarama, 2016; Foster, Anthony, Clements, Sarama, & Williams, 2016). However, one of the primary reasons for the large growth in online coursework is the availability, or unavailability, of face-to-face mathematics coursework, such as certain AP courses or Algebra I in some middle schools (Heissel, 2012; Sloan & Olive, 2005). Blended learning in mathematics has been influenced by this proliferation, as well as the technologies that online contexts have created and distributed.

As noted by Sloan and Olive (2005), many rural schools lack access to qualified mathematics teachers, or have the resources to offer a diversity of coursework to their students. Heissel (2012) states that this trend has led to a large virtual presence of middle school students taking online Algebra I courses in North Carolina, and others provide confirmatory evidence for this claim (Archambault & Crippen, 2009; Setzer & Lewis, 2005). Yet, Heissel (2012) also found that a large percentage of students in urban settings are enrolled in online mathematics courses, mainly as an accommodation to keep these students on track for graduation. Cavanaugh (2009) reported that online classes added credit recovery and closed achievement gaps. Essentially, Heissel (2012) found two demographics prevalent in online mathematics learning: rural students with successful backgrounds in mathematics taking Algebra I coursework in the middle grades and urban students with less-than-successful backgrounds in mathematics. Those students with the successful backgrounds tend to have higher mathematics achievement than their grade-level peers in face-to-face classrooms, while the latter group tends to have lower mathematics achievement (Heissel, 2012; Oliver, Kellogg, & Patel, 2010). Although the case of the North Carolina virtual schools is but one example of how online mathematics learning is manifested, it suggests that online and blended mathematics learning in K-12 works for some students and not for others. Various literatures on online and blended mathematics learning comes to the same general conclusion, but often with different descriptions of promising practices in mathematical learning.

This chapter provides an updated, general overview of research on online and blended learning for K-12 mathematics. Much of this literature is limited both in scope and in magnitude. Further, such research often seems contradictory as various studies find positive, negative, or no relationships between online and blended mathematical learning with achievement outcomes. Although seemingly contradictory, in our review of the literature, we discuss potential reasons for differences in research findings, current and emerging trends in research for online and blended learning in mathematics, and conclude with a discussion of recommendations for future research.

Online and Blended Mathematics Learning

Mathematics Education and Technology Before the Internet

Beginning around 1980, the National Council of Teachers of Mathematics (NCTM) began encouraging the incorporation of computer and calculator technology in mathematics teaching (Johnson, Anderson, Hansen, & Klassen, 1980). As the popularity and fascination with computers and calculators increased both in research and in schools (Milner, 1980; Shumway, 1990; Hunter, 1993), NCTM (1989) released recommendations for technology in mathematics instruction in their seminal *Curriculum and Evaluation Standards for School Mathematics*. While NCTM (1989) generally advocated access to and use of computer and calculator technology in mathematics instruction, they suggested that "access to this technology is no guarantee that any student will become mathematically literate. Calculators and computers for users of mathematics, like word processors for writers, are tools that simplify, but do not accomplish, the work at hand," but also that "contrary to the fears of many, the availability of calculators and computers has expanded students' capability of performing calculations" (p. 8). In their later vision of mathematics standards, NCTM (2000) articulated a technology principle to guide the professional identities of mathematics teachers suggesting, among other things, that "electronic technologies – calculators and computers – are essential tools for teaching, learning, and doing mathematics" (p. 24), and that such technologies provide tools for the doing of mathematics. This vision of technology use in mathematics teaching and learning included the use of virtual manipulatives, dynamic geometry software, and access to resources available on the world wide web. Despite the advocacy of technology use, specific discussion of how the internet can be used within mathematics, by mathematics educators, has been relatively limited. NCTM's (Masalski & Elliott, 2005) sixty-seventh yearbook, *Technology-Supported Mathematics Learning Environments*, was devoted to how various technologies could be used to support mathematics learning. This included recommendations and examples of how to use calculators, virtual manipulatives, dynamic geometry software, spreadsheets, and the internet. In the various chapters that discussed it, it is clear that many mathematics educators viewed the internet as a means of sharing or using specific resources, including virtual manipulative experiences (Galindo, 2005; Hart, Keller, Martin, Midgett, & Gorski, 2005; McCoy, 2005). Only in the closing chapter does Heid (2005), in her discussion of future directions for technology in mathematics education, discuss the uses of OBML:

> "That universities are headed toward delivering complete undergraduate programs on the Web is inevitable…Is instruction online 'as good' as it is face-to-face? Will students be able to afford the necessary software and hardware to pursue online mathematics courses? Will online courses adequately address the problems of teaching mathematics in home-school settings or in very small school districts? Will Web-based courses lead to reliance on online quizzes and low-level testing?"

Though research on all aforementioned technology-related aspects continues in the field of mathematics education, the topic of online mathematics learning has received relatively little attention, but is gaining popularity in various conference presentations (Joubert, 2013). The focus on mathematics education research regarding OBML, as it has been with most technologies, focuses on how mathematics exists and is created in such environments, as well as how teachers and learners engage in the content itself.

Differences Across the Grades

There is currently little research examining how online and blended mathematics learning differs across grade levels. However, the focus of research at these varying levels is somewhat telling. There is limited, but increasing research that examines OBML in early childhood and elementary grades. This research typically focuses on how mathematics applications, applets, and games can be used either in class or at home (Garcia & Pacheco, 2013; Kiger, Herro, & Prunty, 2012; Kosko & Ferdig, 2016; Stoyle & Morris, 2017). In the past few years, there is emergent research examining how mathematical scaffolds via computer assisted instruction (CAI) can be incorporated through technology (e.g., Foster et al., 2016; Fyfe & Rittle-Johnson, 2016; Watts, Moyer-Packenham, Tucker, & Bullock, 2016), as well as whether there are differences in mathematics achievement for those engaging in OBML versus traditional settings (Brasiel et al., 2016; Faber, Luyten, & Visscher, 2015; Hung, Huang, & Hwang, 2014).

OBML research in middle grades includes a myriad of comparisons, including examination of social interaction within OBML (Edwards & Rule, 2013; Hossain & Wiest, 2013; Li, 2002), gender differences (Li, 2002; Nguyen, Hsich, & Allen, 2006), motivation factors (Edwards & Rule, 2013; Higgins, Crawford, & Silvestri, 2016), and CAI (Haelermans & Ghysels, 2017). While mathematics achievement is often examined (Nguyen, 2006; Ross & Bruce, 2009; Wang, 2013), it is not necessarily the dominant focus of research.

Research on secondary OBML is dominated by examinations of mathematics achievement as an indicator of the effectiveness of OBML as a policy initiative (Ahn & McEachin, 2017; Anthony, 2015; Bruce & Ross, 2009; Heissel, 2012; Heppen et al., 2011; Hughes, McLeod, Brown, Maeda, & Choi, 2007; Kim, Park, & Cozart, 2014; O'Dwyer, Carey, & Kleiman, 2007; Paadre, 2011; Shirvani, 2010; Stone, 2013). Most of these studies examine the effectiveness of online Algebra I courses, a consequence of the growing demand based on the Algebra for All movement (Cavanaugh, Gillan, Bosnick, Hess, & Scott, 2005; Link & Heckman, 2013), and the lack of supply of mathematics teachers or resources for rural schools to offer specialized mathematics courses at various grade levels (Heppen et al., 2011; Sloan & Olive, 2005). In other words, OBML appears to fill a need in a supply-and-demand scenario where students and parents seek specific mathematics courses, particularly Algebra I, but their schools are unable to offer the course due to various resource deficits. Additionally, the reported online mathematics course offerings are predominantly upper-middle school and high school mathematics courses (Archambault & Crippen, 2009; Heppen, Clements, & Walters, 2015). Evidence does suggest that when face-to-face Algebra I courses are not available for middle school students, those taking an online Algebra I tend to see higher gains in algebraic knowledge and go on to take more advanced mathematics courses in high school (Heppen et al., 2015), but such courses are not necessarily more effective than their face-to-face equivalent Algebra I courses (Heissel, 2016; Heppen et al., 2017). Examining Algebra I in a blended online setting, Karam et al. (2017) found that teachers in the blended setting tended to teach students in a more traditional, and less inquiry-based manner than teachers in the face-to-face setting. Thus, one potential reason for differences in students' mathematics achievement in OBML Algebra I settings may be in how teachers scaffold students' experiences.

Factors Affecting Mathematics Learning and Achievement

Current literature presents mixed findings regarding the effect of OBML in K-12. Some researchers report that face-to-face courses have a more positive effect on mathematics achievement than OBML courses (Ahn & McEachin, 2017; Anthony, 2015; Heissel, 2016; Heppen et al., 2017; Hughes et al., 2007; Nguyen et al., 2006; Shirvani, 2010). Others suggest that OBML has a more positive effect than face-to-face courses (Brasiel et al., 2016; Faber et al., 2015; Foster et al., 2016; Heissel, 2012; Oliver et al., 2010). Some research results indicate that differences between OBML and face-to-face courses' math achievement outcomes are negligible (Heissel, 2012; Heppen et al., 2011; Nguyen et al., 2006; O'Dwyer et al., 2007; Paadre, 2011; Shirvani, 2010; Stone, 2013). The primary reason for such seemingly varying results is due to the variance in research design from study to study, and sometimes within the same study. As noted by Karam et al. (2017), many studies do not examine how instruction and interaction in OBML contexts is structured, and this can explain a large portion of variance in such designs.

O'Dwyer et al. (2007) provide a useful example for characterizing variance in study design, both within and between studies, in their examination of Louisiana's Algebra I OBML course. In describing their sample and study conditions, O'Dwyer et al. (2007) state "the online teachers were selected on the basis of their outstanding teaching credentials and were identified by the Louisiana Department of Education to be at the level of *mentor teachers*" (p. 294), while teachers in face-to-face classrooms were not selected on a similar basis for the study. Further, the online course integrated Java applets, video, graphing calculators, and tablets. Although students enrolled in the face-to-face classrooms reported frequent use of graphing calculators, access to the other materials was less prevalent. Even with the differences in comparison groups, O'Dwyer et al. (2007) found that both groups had statistically similar mathematics achievement gains. However, the main limitation with studies such as O'Dwyer et al.'s (2007), and the majority are of this nature, is not in the sample differences but in how instruction is assessed. Specifically, online and blended learning are often considered as the treatment in such studies, rather than the context of student learning. As such, pedagogical decisions incorporated, including course design, in face-to-face and OBML courses are often either superficially included or neglected altogether. One example exception are studies is Karam et al.'s (2017) examination of teachers' survey-responses regarding how mathematics was taught in their classroom (either blended or traditional face-to-face). Karam et al. found that students with more exposure to inquiry-based approaches tended to have higher mathematics scores regardless of condition, but that the teachers in the blended setting were less likely to use such approaches. Studies of this nature may account for the variation in significant differences between OBML and face-to-face courses (Heissel, 2012; Heppen et al., 2011; Nguyen et al., 2006; O'Dwyer et al., 2007; Paadre, 2011; Shirvani, 2010; Stone, 2013). Indeed, researchers have increased efforts in investigating pedagogical features and student learning differences in OBML, and the remainder of this section is devoted to describing them.

There are three features of OBML that have been found to influence mathematics achievement: student self-regulation in their own instruction (Edwards & Rule, 2013; Heissel, 2012; Kim et al., 2014; Kim et al., 2015; Ross & Bruce, 2009; Shirvani, 2010), available mathematical scaffolds and feedback (Bruce & Ross, 2009; Fyfe & Rittle-Johnson, 2016; Haelermans & Ghysels, 2017; Heissel, 2012; Luzon & Leton, 2015; Nguyen et al., 2006; Oliver et al., 2010; Wang, 2013), and social interaction with others (Hossain & Wiest, 2013; Hrastinski, Edman, Andersson, Kawnine, & Soames, 2014; Li, 2002). These factors, each relate to various aspects of motivation theory, which Kim and colleagues (Kim et al., 2014; Kim et al., 2015) have recently begun to investigate regarding OBML.

Student Control and Self-Pacing

Student control (autonomy) and self-pacing has been found to be a positive feature for many students taking OBML courses (Edwards & Rule, 2013; Bruce, 2009; Corey & Bower, 2005; Shirvani, 2010). Specifically, by allowing students to have more ownership and decision making in their learning, the argument is that students become more self-regulated in their engagement with the content. It should be noted that similar arguments for the positive effect of student autonomy on mathematics achievement and dispositions have been made for face-to-face contexts (Kosko, 2015; Kosko & Wilkins, 2012). However, proponents of both online and blended learning contexts indicate that the structure of OBML allows for more promotion of student control and self-pacing.

Although providing a certain degree of autonomy to students is generally beneficial, allowing students to have too much control has been found, in face-to-face contexts, to have a negative effect (Alderman, 2008; Levinson, 1999; Sfard, 2007), and there appears to be evidence of this within the OBML context as well. Heissel (2012) found that younger students (sixth and seventh grade) did not self-pace well in comparison to their older, eighth grade, peers. Yet, this may be more a consequence of not having enough support, which Heissel (2012) also found to be a critical factor in the success of online Algebra I success. Similar to the findings of Heissel (2012), Kopcha and Sullivan (2008) found that students with lower mathematical ability tended to score lower when given the opportunity to choose their own pace as they often do not receive essential instruction. This is primarily due to skipping examples and soliciting additional instruction, even if it such students recognize they need it. Studying high and low performing high school students enrolled in an online mathematics course, Kim et al. (2015) observed that lower performers' self-efficacy decreased throughout the semester while high performers' remained mostly unchanged. Further, high performers in mathematics tend to have higher computer self-efficacy than lower performers, which is positively associated with the use of tools and scaffolds embedded in online learning platforms (Higgins et al., 2016). Thus, lower performing students entering OBML contexts tend to have lower self-efficacy regarding mathematics and computer use, and this may affect how they interact in online and blended mathematics environments.

Feedback and Scaffolding

Scaffolding and support can come in a variety of formats for OBML. Studying the blended learning of a computer-based learning sequence, Bruce and Ross (2009) found that when the classroom teachers' lessons were more aligned with the specific activities done online, it correlated with higher mathematical gains. Various studies have also found that when adaptive and immediate feedback in OBML environments is available, students have higher perceived and measured mathematical competence than when such feedback is not available (Fyfe & Rittle-Johnson, 2016; Nguyen et al., 2006; Wang, 2013). Nguyen et al. (2006) compared seventh graders' perceived mathematical competence under two conditions: completion of homework problems from the text via paper-and-pencil and completion of the same homework problems via an online-based version that included instant feedback. Although no statistical differences were found between both groups regarding measured mathematics achievement, male students reported higher perceived mathematical competence. However, various studies have shown that immediate and personalized feedback from automated systems is beneficial to students' mathematical learning (Freeman & Crawford, 2008; Ku, Harter, Liu, Thompson, & Cheng, 2007; Wang, 2013), particularly for students with lower prior mathematics ability. Fyfe and Rittle-Johnson (2016) found that while all forms of computer-based feedback was more effective than no feedback, immediate feedback was more effective than summative feedback on its own. However, Kopcha and Sullivan (2008) found that several students with lower prior mathematics ability in their study did not use the feedback and examples system, and thus did not perform as well as students who did use it.

While OBML provides the potential for more immediate and automated feedback, individual feedback from teachers is also helpful. Specifically, when such feedback is seldom provided, mathematical gains suffer (Oliver et al., 2010). Such feedback is highly contingent on personal relationships constructed between the student and teacher (Hrastinski et al., 2014). Yet, another source of feedback in OBML comes from the various representations of mathematics. Specifically, OBML courses have the potential for including virtual manipulatives, and students' interaction with these virtual manipulatives provides immediate feedback as they engage dynamically with the content (Cavanaugh et al., 2005; Clements & Sarama, 2016; Foster et al., 2016). Various studies have reported on the use and benefits of virtual manipulatives in mathematics education (e.g., Reimer & Moyer, 2005; Sarma, Clements, & Henry, 1998; Watts et al., 2016; Zengin, Furkan, & Kutluca, 2012), however there is relatively little research on how to incorporate them in K-12 OBML. To specify, there is research on the use of virtual manipulatives in face-to-face contexts, and how to use such tools, but there is a need for such research in online contexts (for both online and blended learning). Papadopoulos and Dagdilelis (2006) examined how students used three different dynamic computer-based geometry software programs and found that differences in how geometric diagrams were constructed through the program interface, how such diagrams were labeled and measured, and how various properties of the diagrams were conveyed interacted with the way students came to understand relevant mathematics content. Thus, use of virtual manipulatives in OBML is not a simple decision of to include or not to include, but should take into account how mathematics is constructed through a particular program or applet. Research at the college level indicates similar issues for consideration. Comparing various e-learning programs, Smith and Ferguson (2004) found that many such programs are limited to whether and how they incorporate mathematical notation and diagrams. This adds a layer of complexity for individuals to write and draw mathematically. The mathematical representations (diagrams, symbols, writing) embedded in OBML effectively act as one means of feedback for students (Cavanaugh et al., 2005), which interacts with their understanding of mathematical content (Papadopoulos & Dagdilelis, 2006). Yet, these forms of feedback are also present in face-to-face classrooms. Therefore, it is important to consider how the context of OBML alters how such representations are incorporated into mathematics teaching and learning.

An additional aspect of feedback stems from the structure of such feedback. An emergent area of research on OBML finds that when instruction is structured with students' learning trajectories specifically in mind, the OBML environment is more effective in promoting mathematical learning (Clements & Sarama, 2016; Foster et al., 2016; Haelermans & Ghysels, 2017). Haelermans and Ghysels (2017) found that seventh grade students who had more individualized scaffolding in an OBML context saw higher mathematics achievement gains than when they were allowed to access any and all features within the OBML environment. Similarly, Foster et al. (2016) found that a CAI of a blended mathematics program targeting specific points in children's hypothetical learning trajectories was effective in promoting mathematics learning. Findings of such studies indicate that structuring students' engagement based on theory of how students learn mathematics is essential. A simple, but powerful study by Luzon and Leton (2015) helps convey this point. Luzon and Leton (2015) provided two groups of high school students with the same information for learning about event probability. In both contexts, students were presented information on the topic similar to viewing a PowerPoint slideshow. In one context, all information was presented on each screen all at once, while in the other context symbolic and textual information was presented sequentially on the screen. The simple change in structure had a positive and statistically significant effect on students' mathematics achievement and helps exemplify the importance of structure within OBML contexts.

Social Interaction

Little research has been conducted regarding social interaction in OBML. However, the little research that exists is informative. Hossain and Wiest (2013) studied the blended learning application of blogs with sixth grade students learning geometry. Hossain and Wiest suggest that use of such social interaction features for blended learning allows for more in depth discussion of relevant topics that may not occur during face-to-face classroom sessions. Similarly, Stoyle and Morris (2017) used blogs with fifth grade students learning about fractions and found that the online context may have allowed for more interaction between students leading to appropriate peer critique of mathematical reasoning. Li (2002) found supporting evidence of such interaction in studying sixth grade students' interactions in an online mathematics forum. However, Li also found that there were differences in how male and female students interacted in online discussions. Specifically, male students tended to posit explanations more frequently, while female students solicited additional detail more frequently. It is clear from the two studies described that there is potential for incorporating social interaction opportunities for OBML. Yet, such incorporation should be mindful of the mathematical representations that are included, and how they are included (Hossain & Wiest, 2013), as well as how individual students interact (Li, 2002).

A Context for Discussing OBML

Much of the current research on OBML is centered on the question of whether OBML is effective or not, which essentially amounts to a value-based judgment of the *goodness* of OBML. Lacking in much of this research are evaluations of or recommendations for effective (i.e., good) OBMLs. Put another way, the grain size of focus has been too general, providing seemingly contradictory findings in the literature and little practical guidance for teachers and administrators. In a previous section, we suggested one central reason for the discordant findings regarding the effectiveness of OBML was due to the consideration of OBML as a treatment rather than a context for mathematical learning. However, this particular form of confusion (viewing a context as a treatment) is not particular to OBML. In fact, studies on the differences between public schools and magnet or private schools (Archbald & Kaplan, 2004; Braun, Jenkins, & Grigg, 2006a; Braun, Jenkins, & Grigg, 2006b; Lubienski & Lubienski, 2006) have found that, when considering all student and school level factors, there are no statistically significant differences in the mathematics achievement between these contexts. Therefore, it is not surprising to find many studies comparing OBML and face-to-face courses have found no statistically significant differences in mathematics achievement gains (Heissel, 2012; Heppen et al., 2011; Nguyen et al., 2006; O'Dwyer et al., 2007; Paadre, 2011; Shirvani, 2010; Stone, 2013). However, where charter and private schools generally serve as an alternative to available public schools, in certain contexts OBML courses and schools may serve as the only viable option for students to have access to certain mathematics (Heppen et al., 2015; Sloan & Olive, 2005), or as a needed supplement to already available schooling (Brasiel et al., 2016). Further, the specific nature of the OBML context presents certain affordances and limitations that are unique. Given these considerations, we consider it of fundamental importance for future research on OBML to consider it as a context, with various pedagogical treatments that associate with student mathematical learning, and potentially interact with this context.

Implications for Practice

In the context of mathematical learning, practical implications for online and blended instruction are currently limited to three primary recommendations. First, students learning in both online and blended settings need several opportunities for feedback from the computer systems, their assigned teacher, their fellow students, and the representation of mathematics. Recommendations from prior (NCTM, 2000) and current (CCSSI, 2010) mathematics policy documents recommend students engage in mathematical communication to analyze and evaluate the mathematical thinking and strategies of others. The Common Core State Standards for Mathematics describes proficient students as those who are able to justify their mathematical conclusions and engage in mathematical argumentation with others. Thus, opportunities for students to be able to communicate must be built into both online and blended settings.

Second, the manner in which mathematics is represented is critically important and should be a central consideration for any OBML implementation. Numerous studies have reported on the benefits of virtual manipulatives for students' understanding of mathematics (Reimer & Moyer, 2005; Sarma et al., 1998; Zengin et al., 2012). Coupled with the recommendation that multiple representations be used by students in learning mathematics (NCTM, 2000), OBML courses would benefit from further attention to how virtual manipulatives, and other mathematical representations, are used by students to develop deeper understandings of the content. However, because the specific nature of these representations influences what content is learned (Papadopoulos & Dagdilelis, 2006; Smith & Ferguson, 2004), attention must be paid to how these representations align with learning objectives.

Third, the manner in which mathematics is scaffolded should account for how students learn the topics of focus. An emerging body of literature suggests that attention to students' mathematics learning trajectories may be both highly effective and pragmatic (Clements & Sarama, 2016; Foster et al., 2016; Watts et al., 2016). Additionally, there is preliminary evidence that an over-reliance on open exploration in OBML contexts may be less effective than scaffolded experiences aligned with how students think about the mathematics at hand (Haelermans & Ghysels, 2017; Luzon & Leton, 2015).

Implications for Research

Future research on feedback systems in OBML can, and should, take many approaches. First, there is too limited amount of research examining how teachers in online mathematics settings best provide feedback to students. Such feedback could potentially be provided in online forums, individual chat, annotations to students' digital work, individual or group webcam conferencing, etc. Second, while automated feedback systems appear to be helpful to mathematical learning, further research needs to be conducted regarding features of such systems that are more helpful than others. For example, is it significantly more helpful for students to have dynamic demonstrations or text-only descriptions of a mathematical principle when they are completing online homework? Should such feedback be interactive to the point of requiring students to engage with it, or should such feedback be passively received? Integrated with both teacher and automated feedback is a need to examine how students with varying mathematical backgrounds respond to different forms of feedback. Specifically, different studies suggest students with weaker mathematical backgrounds interact with OBML differently (Heissel, 2012; Shirvani, 2010). Therefore, future study of feedback systems that are more supportive of such students is highly needed.

The few studies on mathematical representation in OBML are informative and point to important avenues of future research. Papadopoulos and Dagdilelis's (2006) comparison of how different dynamic geometry software conveys mathematical concepts differently suggests that such considerations should be taken into account with other virtual manipulatives and applets used in online and blended learning. For example, virtual manipulatives used to help develop an understanding of fractions can incorporate area models, linear models, or set models. Rau, Aleven, and Rummel (2009) found that when students used virtual manipulatives with all three models, they learned more than if they had used any single fraction model. However, a critical feature of the success of this approach to OBML was in soliciting descriptions from students on how the representations related (Rau et al., 2009; Rau, Aleven, Rummel, & Rohrbach, 2012). Such an approach mirrors much of the recommendations for face-to-face instruction with physical manipulatives and representations. Therefore, a useful question for any researcher to ask, when seeking to study mathematical representations in OBML, is how such representations and manipulatives are effectively used in face-to-face classrooms, and how such usage is applied to the OBML setting.

The last evident area currently in most need of future research is an investigation of social interaction in OBML contexts. Stoyle and Morris (2017) provide one example in describing how blogging can be used to support the development of elementary students' mathematical explanations. However, there is surprisingly little research in this area, given the Web 2.0 culture and the prevalence of literature focusing on mathematical discussions (e.g., Herbel-Eisenmann, Drake, & Cirillo, 2008; Kosko, Rougee, & Herbst, 2014; Walshaw & Anthony, 2008). As with mathematical representations, a useful question for interested researchers to ask is how effective practices for facilitating mathematical discussions can be applied to OBML settings.

Conclusion

The initial version of this chapter written in 2014 indicated that the research base on mathematical teaching and learning in the online and blended setting were few in number. The number is growing, with increased attention to OBML scaffolds aligned with mathematical thinking, and with an increased number of studies in elementary settings. The information provided by the current research base is useful in pointing to additional areas of needed research. Specifically, future research should continue its increased focus on mathematical pedagogy and students' mathematical learning in a manner similar to current research in face-to-face settings. There is still too heavy a focus on considering OBML as a treatment for educational outcomes rather than as a unique context for mathematical learning to occur. If online and blended learning is considered a treatment, then features of mathematical pedagogy and learning are automatically placed as secondary considerations, or are not considered at all. Considering OBML as a context where mathematical learning can occur is, therefore, a much more useful conception for researchers and practitioners to consider. There is a great need for future study with this conception in a multitude of areas. We have provided some recommendations, but acknowledge other critical areas may not be discussed here. Rather, we reiterate our central recommendation for all researchers and practitioners to consider OBML as a context for learning. We believe to do otherwise is to open the door for focusing on technological aspects without a meaningful attendance to the mathematics. Only when the mathematics is considered as central in how technology is incorporated in online and blended learning can the promise of such learning environments be fulfilled.

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23

Research on Literacy Instruction and Learning in Virtual, Blended, and Hybrid Environments

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Abstract

Drawing on current literacy research, the goals of this chapter are to examine and synthesize the relevant research and best practices associated with literacy learning and teaching in virtual, blended and hybrid environments in K-12 settings. While the research base for literacy education in virtual schools, blended, and hybrid learning environments is significantly limited, it is supported by research done in the field of literacy education investigating reading and writing in online spaces. This chapter provides specific recommendations and implications for writing instruction and reading instruction in online education spaces, and in addition, implications for future research are provided.

Keywords: Literacy education; Writing instruction; Reading instruction; Literacy pedagogy; Online learning; Blended learning

Introduction

The number of students enrolling in fully online virtual schools or participating in hybrid or blended learning environments is growing at a rapid pace as many states have opportunities for students to engage in some version of online learning (Watson et al., 2013). While research has examined the effectiveness of distance learning, instructional approaches, and the characteristics of successful students in online settings, missing from the research is an examination of the discipline-specific pedagogical practices necessary for literacy instruction (Barbour & Reeves, 2009; Cavanaugh, Gillian, Kromrey, Hess, & Blomeyer, 2004; DiPetro, Ferdig, Black, & Preston, 2008; Ferdig, Cavanaugh, Freidhoff, 2012). The concern is that more and more students are being educated in online or virtual school settings without research documenting successful teaching practices and students' learning experiences in these contexts. While the field can draw literacy teaching and learning that happens more generally in online spaces, this lack of research is certainly a gap in our knowledge about how students learn to read and write and engage with reading and writing in virtual school settings.

Since this chapter was first published in 2014, some changes have occurred in the fields of literacy instruction as it relates to virtual, blended, and hybrid learning environments. Yet, even with some advancements in technological tools and platforms, the understanding of the pedagogical opportunities is still as limited as it was when we first published this chapter. In this revised chapter, we will fold in some of the new research and opportunities that have presented themselves, as well as expand the focus of this chapter to include a broader consideration of literacy instruction as we integrate instruction for English learners. The field is also missing understanding of cross curricular learning instances where learning occurs in and out of traditional school environments and how virtual, blended, and hybrid environments play a role. These non-traditional, cross curricular learning environments include Massive Open Online Courses (MOOCs) and the lurking, or learning that occurs as a bystander in these situations.

To guide our understanding of the teaching and learning of literacy with technology, specifically in online settings, the goals of this chapter are to include the relevant research and best practices associated with synchronous and asynchronous computer mediated learning as defined by virtual, blended, and hybrid learning environments in K-12 settings. We examine these contexts to include the impact on international and global learners while providing a better understanding of non-traditional learning situations. In addition, the inclusion of international contexts is important as we consider the impacts of English Learners as they engage in online spaces where they may speak a different language. In this examination of virtual, blended, and hybrid environments, we recognize that learners exist in global, networked learning spaces. We provide specific recommendations and implications for writing instruction and reading instruction in virtual, hybrid, and blended environments. In addition, implications for future research are provided.

Research Synthesis

The goal for this literature synthesis was to develop a coherent picture of the research surrounding K-12 literacy education in online, blended, or hybrid settings. While there is substantial research about literacy education in traditional *brick and mortar* settings, there is the need for a close examination of research in online and blended settings. This literature synthesis continues this examination, and remains guided by the following question: *What are the pedagogical practices that foster K-12 students' literacy engagement, learning, and acquisition in virtual, blended, or hybrid school settings?* What has changed since our last examination of these contexts is our framing and contextualizing of what is meant by "school settings."

Similar to our 2014 chapter, a series of electronic searches using the Education Research Complete databases were completed. Search terms associated with literacy education and online education were used in combinations, such as *language arts, literacy, reading, reading instruction, writing, writing instruction, virtual schools, online learning, hybrid learning* and *blended learning*. Various search term combinations were used. Peer-reviewed literacy journals were reviewed, including *Reading Research Quarterly*, *The Journal of Adolescent and Adult Literacy, The Reading Teacher, English Journal,* and *Language Arts,* and a more general educational journal*, Distance Education.* While the research base for literacy education in virtual schools, and hybrid and blended learning environments is significantly limited, it is supported by research done in the field of literacy education investigating reading and writing in online spaces. Therefore, the focus of this literature synthesis was to identify patterns and themes in the literature on literacy instruction in K-12 virtual schools, hybrid, and blended learning environments.

As we begin this review, we must state that is a challenge reviewing this space as there is often little agreement on the part of schools, educators, or researchers on the terminology or meanings of these terms. This serves as a complicating factor as state laws, frameworks, and pedagogical materials will often use terms like online learning, virtual schools, and blended learning without defining each of these elements. This serves to create a lack of consistency in the field as similar terms often mean different things. To help move the field further, in this chapter we will strive to identify and define these terms and practices. Furthermore, we advise educators, researchers, policy makers, and administrators to use an agreed upon set of terminology, and calibrate use of these terms to meet definitions from the field.

We begin this examination by defining what is meant by *online learning*. Online learning is "teacher-led education that takes place over the Internet, with the teacher and student separated geographically, using a web-based educational delivery system that includes software to provide a structured learning environment. It may be synchronous (communication in which participants interact in real time, such as online video) or asynchronous (communication separated by time, such as email or online discussion forums). It may be accessed from multiple settings (in school and/or out of school buildings)." (Watson, Murin, Vashaw, Gemin, & Rapp, 2013, p. 8). This framing of online learning provides a certain amount of flexibility as we examine the texts, tools, and practices involved in integrating the Internet and digital communication technologies into instruction. For the purposes of this chapter, we will focus on the aspects of this definition of online learning that integrate virtual schools, blended learning, and the nature of synchronous and asynchronous learning.

While there are numerous definitions of *virtual schools*, for this synthesis virtual schools were defined as "an educational organization that offers K-12 courses through Internet or Web-based methods" (Clark, 2001, p. 8). Also included in this literature synthesis were learning environments considered *hybrid* or *blended* learning environments. Hybrid, or blended learning, indicates a pedagogical approach that includes a combination of face-to-face (F2F) instruction with computer-mediated instruction (Ferdig et al., 2012). The terms blended learning, hybrid learning, and mixed-mode learning are often used interchangeably in current research. In the United States the term *blended learning* is primarily used (Martyn, 2003). Blended learning is often defined as "a formal education program in which a student learns at least in part through online learning, with some element of student control over time, place, path, and/or pace; at least in part in a supervised brick-and-mortar location away from home; and the modalities along each student's learning path within a course or subject are connected to provide an integrated learning experience" (Horn & Staker, 2014, p. 53). In this mix of instruction, learners and instructors work collaboratively to improve the quality of learning and instruction (Bonk & Graham, 2006). The Internet and other educational technologies are used to provide realistic, practical opportunities to make learning independent, useful, and sustainable (Graham, 2006; Heinze & Proctor, 2006). Research shows there is no one perfect method to balance out F2F and online instruction in a way that is not negative to each other, or perfect in every situation (Garrison & Kanuka, 2004).

At the beginning of this continuum we will consider and promote the usage of as close to a 50/50 mix of online and offline learning environments. Offline learning environments are often indicated as being "brick and mortar" institutions where primarily "face-to-face" (F2F) instruction occurs. At the far end of the continuum we will consider fully online, virtual K-12 classrooms and schools. A growing number of blended schools are launching within this continuum to support learners across districts and placements. Blended schools are "stand-alone schools with a school code (as opposed to programs within a school) that deliver much of their curriculum in a blended format and students are required to show up at a physical site for more than just state assessments" (Watson, Murin, Vashaw, Gemin, & Rapp, 2013, p. 9). This spectrum of complexity is important to consider as data shows that if current trends continue, 50% of all high school classes will be offered solely online by 2019 (Allen & Seaman, 2011), which is problematic considering that few teacher preparation programs address online or blended learning environments (Means, Toyama, Murphy, Bakia, & Jones, 2009; Kennedy & Archambault, 2012). Several additional parameters were set for this literature synthesis. Criteria for articles included a focus on K-12 students, literacy learning and acquisition, and English language arts classrooms. Specifically not included were studies looking to remediate or assist in special education or foreign language. In addition, the geographic regions included the United States, and did not extend to other regions of the world.

Asynchronous and synchronous learning events have different discursive elements that may be exploited for different pedagogical purposes (Sotillo, 2000). Synchronous refers to *real-time* communication that mimics elements of a conversation or discussion (Mason, 1994; Riva, 2002). Using computer mediated communication (CMC) tools, synchronous learning is only possible using text, video, or audio chats. Asynchronous refers to communication of learning activities that occur outside of real-time (Warschauer, 1997; Curtis & Lawson, 2001). CMC tools that encourage asynchronous learning include videos, bulletin boards, readings, and writing or blogging activities. Advantages to asynchronous learning events include opportunities to build in elements of metacognitive delay, to allow learners to *press pause* on learning, or perhaps delay an immediate response. Challenges of asynchronous learning include the problems that exist as this form of collaboration lacks a sense of urgency or immediacy. Learners and educators may be frustrated as they wait for hours, days, and perhaps weeks for feedback. And yet, Sotillo (2000) contends "in the hands of experienced teachers, both modes of computer mediated communication (CMC) can be used as novel tools to enhance the learning process by encouraging interaction among participants, collaborative text construction, and the formation of electronic communities of learners" (p. 82).

Virtual, Blended, and Hybrid Learning Environments

An examination of the role of virtual, and or blended learning environments needs to take into account the specific type of program as well as the role of the educator making pedagogical decisions in their classroom. The intersection of these elements play a large part in framing the learning objectives and overall effectiveness of these learning environments (Garrison, 2011). Online and blended learning environments may provide an opportunity for reaching a large, locally or globally dispersed group of students in a short period of time with consistent, semi-personal content delivery (Zhang, 2008). Online and blended learning have experienced growth in higher education as increased flexibility and lowering the cost of learning is balanced with a focus on pedagogy and valued time face-to-face with learners (Olapiriyakul & Scher, 2006; Graham, 2006). It appears that K12 institutions are trying to figure out the best way to strike this balance.

Watson, Murin, Vashaw, Gemin, & Rapp (2013) outline six different program types of online and blended learning environments being utilized in K12 settings. *Single-district programs* are largely developed and facilitated for students within a specific school district. They may be fully online or blended. They service learners in a supplemental or remedial capacity, depending on the needs of the learner and the district. A *blended school* is standalone school within a district where the curriculum is delivered in a blended form. Attendance is required at a physical site during the school year for state assessments as well as some other school based activities. *Multi-district fully online schools* are the main source of education for students in which they rarely (if ever) go to a physical school. These multi-district fully online schools often enroll students from across an entire state or across multiple states in the U.S. *State-supported supplemental options* includes virtual schools created by legislation, and operated by the state, or a state-level agency. These entities are usually funded by state appropriations as well as grant streams, and possibly charging course fees. *Consortium online programs* are often developed through the combination of students from multiple districts to form one consortium of courses, programs, or schools. Finally, *private or independent schools* are non-public schools that are primarily supported through grants, endowments, tuition, and other revenue streams. Private or independent schools may start with a physical campus, and then extend into online or blended learning in an attempt to build marketshare, serve learners, and reduce costs. This collection of models for online and virtual learning provides a complicated web of policies and provisions that are dictated by funding sources and administrative objectives, as well as locations of students and physical buildings.

Research has focused on the effectiveness of distance education (Cavanaugh et al., 2004; Ferdig et al., 2012), characteristics of effective online students (Barbour & Reeves, 2009), and pedagogical approaches employed by effective online teachers (DiPetro et al., 2008). While this research has implications for teaching in virtual school settings, or hybrid or blended learning environments, these studies have examined instruction in a *content free* manner, without investigating the practices specific to particular disciplines (DiPetro et al., 2008). For example, in a study of 16 virtual school teachers, DiPetro et al., (2008) found specific pedagogical strategies contributed to students' engagement and content learning. Interacting using communication tools, monitoring progress and providing feedback, and making content relevant and meaningful, were found to be effective in a virtual school setting.

Research has also highlighted three basic elements that need to be considered while facilitating a blended or hybrid learning course: the online and F2F learning activities; the role of students; and role of the instructor (Waston, 2007). Within this context, there are generally six goals of blended learning: pedagogical richness, access to knowledge, social interaction, personal agency, cost effectiveness, and ease of revision (Osguthorpe & Graham, 2003). To that end, teachers need to be trained in "how to motivate individual learners, enhance student interaction and understanding without visual cues, tailor instruction to particular learning styles, and develop or modify interactive lessons to meet student needs" (Watson, 2007, p. 13). At this point, there is a lack of resources identifying best practices crucial for addressing these elements in teacher training programs (Kennedy & Archambault, 2011).

Teachers need to be trained and given the pedagogical liberty to utilize traditional classroom methods, while engaging in enhanced training to develop skills targeted for online and blended learning environments (Kennedy & Archambault, 2011). There are several other skills needed by teachers as they prepare for an online or blended learning environment (Watson, 2007):

1. Enhanced communication skills: teachers can't rely on nonverbal or proximal cues with which to address misunderstandings. Teacher preparation programs will need to help teachers develop a clarity in their instructions not required by traditional classrooms (Darling-Hammond, 2012);
2. Time management (in asynchronous classes): students can be online at any time, so teachers can't predict when heavier work loads will occur (Ng, 2007);
3. Teacher planning (in synchronous classes): lessons need to have a multimedia component which requires more planning than a traditional classroom lesson (Palloff & Pratt, 2002);
4. Differentiation: if students have different learning styles or disabilities, teachers must be able to adapt online content for them. Reaching students with physical or learning disabilities will be much different than in a traditional classroom (Moore & Kearsley, 2011).

MOOCs and K12 education. At the far end of our framing of versions of online and blended learning are learning opportunities provided by open learning and MOOCs (Massive Open Online Courses). Open learning or open education "can be defined as a set of practices, resources, and scholarship that are openly accessible, free to use and access, and to re-purpose" (Graham, LaBonte, Roberts, O'Byrne, & Osterhout, 2014, p. 418). Educators who support the open learning/education movement often argue that knowledge should be free and that anyone should be able to access an education. This approach to education also encourages teachers and learners to engage in collaborations, create networks, and connect new forms of knowledge (O'Byrne, Roberts, LaBonte, & Graham, 2014).

As brick-and-mortar educational institutions renew their focus on blended learning environments, the emphasis on open, online learning as encompassed by a MOOC has become viewed as valuable. MOOCs and blended learning play an interesting, evolving role in the future of these learning environments as they may play a role in connecting local and global nodes of learners (Czerniewicz, Deacon, Small, & Walji, 2014; Pet, Silvestri, Loomis, O'Byrne, & Kist, 2017). In this, teacher may supplement course instruction by mentoring students as they complete the learning activities of a MOOC. Students may also choose to informally complete the work of a MOOC, or lurk in the curricular materials to supplement their own learning pathways (Ferdig, 2013). While MOOCs have quickly expanded their notoriety, popularity, and hype, there have also been serious questions about their pedagogical effectiveness and reach (Morrison, 2013). There are a number of new initiatives aimed at integrating the philosophies and structure of MOOCs into the virtual and blended learning in K12 education (Ferdig, 2013). At this point, most of this early research and development highlights the potential value of MOOCs in K12 learning environments.

This synthesis of research highlights some of the literature surrounding teaching in online, blended, and hybrid learning environments. Included in this research are the identified characteristics of effective virtual school teachers and the essential elements necessary when designing online instruction. While educators can draw conclusions from these studies, this does not provide an in-depth examination of pedagogical practices specific to literacy acquisition and learning in online learning environments. This is a significant gap in knowledge about teaching and learning in online settings. While little research has examined literacy instruction in virtual schools, there has been a tremendous amount of research examining pedagogical practices using technology to teach reading and writing in traditional K-12 settings.

Writing Research

Writing is a complex endeavor requiring both cognitive abilities (e.g. knowledge of content), conceptual knowledge of the writing process, and knowledge of strategies to assist writers during the process (Flower & Hayes, 1981). Social contexts, or learning environments, and the relevance of writing tasks, also influence writing outcomes (Hayes, 2000, 2006; Piazza & Siebert, 2008; Nystrand & Duffy, 2003; McClenny, 2010). Writing researchers have established that writing is not linear, rather a complex and recursive processes, in which the writer is constantly drafting, editing, and revising throughout the writing event.

There continues to be a lack research focused on how writing is taught in virtual schools; instead, much of the current research is exploring the affordances and constraints of using technology to teach writers. Using technology to teach writing is incredibly important, as researchers have found, "when students have daily access to Internet-connected laptops, they conduct more background research for their writing; they write, revise, and publish more; they get more feedback on their writing; they write in a wider variety of genres and formats; and they produce higher quality writing (Warschauer, Arada, & Zheng, 2010, p. 221). In addition, research has specifically highlighted that technology is used to facilitate the writing process in three broad ways: (a) technology provides students with a more thorough understanding of purpose and audience when writing, (b) technology becomes a means for receiving detailed feedback about writing, and (c) technology provides an impetus for reconceptualizing writing.

Purpose, context, and audience are intricately related, meaning students must know why they are writing and who the intended audience is that will read their work. Often writing in schools is seen as an isolated act with teacher as sole reader and evaluator of written work. Literacy researchers have found technologies, such as social media platforms, blogs, and digital portfolios, allow writers to write for a wider audience that can provide authentic feedback, leading to an increased awareness of purpose, context, and audience (Jaramillo, 2013; McGrail & Davis, 2011; McGrail & McGrail, 2013; Vasudevan & Reily, 2013; West, 2008; Witte, 2007). Although often associated with older students, research has found blogging to also be an effective practice for writing at the elementary level (McGrail & Davis, 2011; McGrail & McGrail, 2013). McGrail & Davis (2011) investigated the composition of blogs in a 5th grade classroom and found the blogs provided a connection to an audience of readers beyond the teacher. This led to an increase in not only better comprehending the concepts of audience, form, and purpose, but also engagement in the writing process. As this research suggests, digital environments can redefine the relationship between the student writer, teacher, and reader. This shift moves teachers from being the sole evaluator of student work, and also moves students to write with a reader-based stance, keeping in mind readers' perspectives while writing.

Online platforms can influence not only how writing is produced and disseminated, but also how students receive feedback about their work. While researchers have explored social networking sites and Google Docs (Yim, Warschauer, Zheng, Lawrence, 2014) others have examined tools, such as Scholar and Eli Review, designed specifically to facilitate students' learning during the revision stage (Lammers, Scott-Curwood, Magnifico, 2013; McCarthey et al., 2013). McCarthey et al., (2013) examined Scholar, "a technology-enabled classroom writing tool," used to "support writing, peer review, annotation, and revision" (p. 153). McCarthey et al., found Scholar's online writing environment provided three major affordances: (1) increased access to peer responses, (2) motivated students to write for an audience, and (3) scaffolded and increased responses to other's writing. Online platforms designed specifically to engage students in revision can increase the amount of interaction by teachers and peers that surround a student's writing. This creates a shift from a traditional, teacher-led classroom, to a more collaborative writing community.

While there are many affordances of using technology, researchers have noted the constraints and challenges of using technology to teach writing. In a case study of a first grade classroom, Van Leeuwen & Gabriel (2007) found students had a preference for writing with computers and word processing programs; however, for some students, poor keyboarding skills slowed text production and for all students their handwritten pieces were longer in length than their computer composed pieces. Despite this, they also found students' conversations about writing, their collaboration while writing, and their support for peers' writing increased during times they used computers. These findings suggest the complexity of having elementary aged students use word processing computers during writing instruction. Theoretical perspectives and new research has emerged in which broadening notions of text and allowing elementary aged students to include visuals, audio, and video in their compositions, may provide new possibilities when teaching writing in an online context.

Language and literacy instruction is increasingly viewed as including multiple modes of information (Leu, Kinzer, Coiro, & Cammack, 2004; Proctor, Dalton, Grisham, 2007). In hybrid learning environments this involves writing using different modes of communication including language, image, audio, video, gesture, and other semiotic resources to make signs in explicit social contexts (Kress & Van Leeuwen, 2001). Stemming from a social semiotics theory (Halliday, 1978; Hodge & Kress, 1988), multimodality is the combination of modes, defined by Bezemer and Kress (2008) as a "socially and culturally shaped resource for making meaning" (p. 170), such as written words, speech, audio, visuals, and spatial representations (New London Group, 1996). Composing multimodal arguments and visual rhetoric is recognized as a sophisticated process that requires recontextualizing, reconceptualizing, and redesigning traditional print literacies (Bezemer & Kress, 2008; Newall, Beach, Smith & VanDerHeide, 2011). Multimodal compositions encourage students to "assess the potential rhetorical uptake of their uses of images, sounds, music, and editing based on their assumptions about audiences' semiotic and popular culture knowledge of the meanings of these images, sounds, music, and editing" (Newall et al., 2011, p. 296).

Additionally, the use of ICTs in writing of text empowers individuals to reconfigure or remix the mode or message into an entirely different mode or message (Kress, 2009). Students as producers of multimodal content, may choose to recreate, or remix an online text. In this process a student can recreate or re-write the text, change the mode (e.g., transform from text to image or video), or change the message entirely using a critical literacy lens. This in turn sets the stage for elements of critical multiliteracies in hybrid learning environments.

A multiliteracies perspective is based on critical literacy and new literacies to develop a pedagogical agenda of social change and empower students as "active designers of social futures" (Cope & Kalantzis, 2000). Multiliteracies includes elements of critical literacy by encouraging students to *read the word and read the world* (Friere & Macedo, 1987) while integrating the teaching of writing (Cope & Kalantzis, 2000) and ICTs. Multiliteracies pedagogy is influenced by elements of multimodal design, which build aspects of critical engagement between students and text to promote social justice in both learning process and product. This learning tool can assist students to think critically about online information while also focusing on the skills necessary in multimodal design (Cope & Kalantzis, 2000).

Literacy researchers have examined students' complex cognitive processes when creating compositions that include sound, image, graphics, and video, and findings suggest that creating multimodal compositions motivates student writers and scaffolds their writing skills (Chisholm & Trent, 2013; Dalton, 2013; Foley, Guzzetti, Angello, & Lesley, 2013; Hicks, 2013; Smith, 2013; Sylvester & Greenidge, 2009). In addition, digital writing and digital tools can also be used to support learners as they engage in vocabulary and verbal language development (Dalton & Grisham, 2011).

Reading Research

Research shows that reading comprehension is an active, constructive, meaning-making process in which the reader, the text, and the activity play a central role (RAND Reading Study Group, 2002). As students engage in online and blended learning environments, the majority of texts they'll encounter are primarily multimodal, informational texts. Multimodal is defined as a combination of two or more communication modes to make meaning. As an example, this could include a webpage with images, charts, and an embedded video on the page. In this context, reading of informational text often proves to be a bit more challenging for students (Duke & Pearson, 2002) as they read and learn about the natural or social world (Duke & Purcell-Gates, 2003; Weaver & Kintsch, 1991). Adding to this complexity, informational texts include abstract concepts, special vocabulary, and text structures that impact a reader's ability to locate, understand, and use the contained information (Cox, Shanahan, & Tinzmann, 1991; Weaver & Kintsch, 1991).

Research highlights that the combination of these elements proves problematic for teachers and students using online informational text in the classroom. First, students are often allowed to connect and collaborate, and they work with peers to search, synthesize, and comprehend online texts with peers (Wade & Moje, 2000; Coiro, 2003). Second, use of online informational text requires educators to permit students to use information and learning materials that may not have been vetted and may be unreliable (Metzger, 2007). There is a degree of risk and trust between the teacher and students to read and work collaboratively in hybrid learning environments.

There are other aspects that may affect comprehension of online informational text for some students. Young children are provided with far too few formal experiences with learning how to read informational texts in F2F elementary settings (Duke, 2000; Duke, Bennett-Armistead, & Roberts, 2003). Research shows that elementary students need to be provided with more instructional opportunities to engage with informational text (e.g., Chall, Jacobs, & Baldwin, 1990; Duke, 2000; Smolkin & Donovan, 2001; Gregg & Sekeres, 2006). To address this concern, there are research-based instructional strategies available to guide instruction (e.g., Biancarosa & Snow, 2004; Davis, Spraker, & Kushman, 2005). Despite this focus, many students are unable to comprehend the informational texts that have become so prevalent on the Internet (Duke, 2000; Leach, Scarborough, & Rescorla, 2003; Biancarosa & Snow, 2004; Duke, 2004). It is clear that students need to be provided with multiple opportunities to work with online informational text (Proctor, Dalton, & Grisham, 2007; Proctor, Dalton, Uccelli, Biancarosa, Mo, Snow, & Neugebauer, 2011).

As the Internet and hybrid learning environments become more prevalent in schools and society, it is important to build the knowledge, skills, and dispositions students will need as they read online in a global classroom. This is challenging as teaching and learning in the Internet era can be totally different from the way most teachers were educated. The Internet and other communication technologies (ICTs) require that we continue to define and redefine what literacy is and how individuals learn. Outside of an academic context, students regularly read, write, and collaborate with others online. In traditional and online learning and academic environments, educators sometimes view this as a distraction rather than an opportunity to educate children using social practices they are accustomed to using. Through the intentional use of online informational text in the hybrid classroom, instructors can help students recognize text structure and features and use them to effectively communicate to multiple audiences in school and in personal communications.

As researchers study and embed digital literacies in hybrid learning classrooms, it is important to consider that the nature of literacy is rapidly evolving as ICTs emerge (Coiro, Knobel, Lankshear & Leu, 2008). This consideration must include an expanded view of *text* to include visual, digital and other multimodal formats (Rose & Meyer, 2002; New London Group, 2000; Alvermann, 2002). Important in this expanded view of *text* as it relates to hybrid instruction is an opportunity to create a way to communicate with others while situated in the codes and conventions of society (Robinson & Robinson, 2003). In essence, the hybrid classroom needs to be able to consider the cultural, societal, and situated elements involved in literacy-based practices (Black, 2009).

Critical Readers of Online Information. Informational texts may include complex concepts, specialized vocabulary, and unfamiliar text structures that significantly impact a reader's ability to locate, synthesize, and act on the information contained therein (Cox, Shanahan, & Tinzman, 1991; Weaver & Kintsch, 1991). The intersection of these two areas proves problematic for teachers and students reading online text in blended learning environments. Critical literacy may provide new opportunities when incorporated into a blended learning classroom that effectively uses digital texts and tools for instructional purposes. As these texts and ICTs constantly change (Leu & Kinzer, 2000), learners must reflect these changes in our classrooms (Reinking, 1997; Cuban & Cuban, 2009; Zhao, Pugh, Sheldon, & Byers, 2002). Researchers have noted that teachers should work to authentically and effectively integrate online informational texts into the classroom (Torres & Mercado, 2006) as the use of the Internet as a text in the classroom allows the teacher and students to build reading comprehension skills while engaging in literacy practices.

Web literacy practices. The Web has become this generation's defining technology for literacy. This technology facilitates access to an unlimited amount of online information in a participatory learning space. Multiple theories and years of research have investigated the literacy practices in these online and hybrid spaces. As we identify opportunities to leverage these spaces for instructional purposes, it is necessary to identify opportunities to empower students using digital literacies (Henry, Castek, O'Byrne, & Zawilinski, 2012). The ability to read and write using digital tools has been shown in hybrid learning contexts to construct *spaces* for learning and sharing of interests (Lam, 2000).

Many frameworks, such as digital literacy, media literacy and information literacy have considered the skills required for the web. However, these frameworks have attempted to make sense of the web using previous metaphors, rather than understanding the explicit affordances of the web as a networked medium. Knowing how to read, write and participate in the digital world has become the 4th basic foundational skill next to the three Rs – reading, writing, and arithmetic–in a rapidly evolving, networked world. Having these skills on the web expands access and opportunity for more people to learn anytime, anywhere, at any pace. Combined with 21st century skills (i.e. critical thinking, collaboration, problem solving, creativity, communication), these digital-age skills help us live and work in today's world. The skills have been consolidated into Web Literacy Map, which was developed by Mozilla and a core group of the community to identify a set of core web literacy skills, and set the stage for engaging individuals as learners on the web.

The purpose is to prepare students for a digital and global economy while also reinforcing reading, writing, speaking, listening, and viewing of subject area content. There are three cornerstones in the web literacy model which support lifelong reflective learning which in turn empowers students through online inquiry, composition, and comprehension with the use of learning environments that utilize authentic, productive, and ethical use of applications required in today's global economy:

- **Read** – This is defined as how we explore the web or as "Online Reading Comprehension." In this, it identifies the skills, strategies, practices, and dispositions students need to locate, evaluate, and synthesize information during problem based inquiry tasks. Web literate individuals understand basic web mechanics such as the difference between names and addresses on the web, and how data is linked and moves through the infrastructure of the web. They can evaluate web content, and identify what is useful and trustworthy.
- **Write** – This is defined as how we build the web or "Online Content Construction." In this, it is a process by which students construct and redesign knowledge by actively encoding and decoding meaning through the use of ever shifting multimodal tools. Web literate individuals can transform a word into a hyperlink and add media to websites. As abilities are honed, one becomes more adept at remixing other users' content and understanding or writing code.
- **Participate** – This is defined as how we connect on the web or as "Online Collaborative Inquiry.' In this, it identifies a group of local or global learners who arrive at a common outcome via multiple pathways of knowledge. It includes interacting with others to making your own experience and the web richer to working

in the open. It also includes having a grasp of security basics, like protecting your online identity and avoiding online scams.

English Learners in digital spaces. As learners engage in online, blended learning environments, it is important to consider the role non-native English speakers play in this equation. Today's classrooms increasingly include students for whom English is a second language. As the English learner (EL) student population grows much faster than the overall student population (OELA, 2010) and as international learners increasingly join the Internet, educators need to identify ways to support multiple languages as they teach and learn online.

The use of digital texts and tools in instruction for ELs provides opportunities for students to practice English skills and discourse practices without requiring additional modification from peers or the instructor (Dukes, 2005). Digital texts and tools can be used to support second language learners as they engage in vocabulary and verbal language development (Green, 2005). The integration of these texts into an online or blended learning environment also provides opportunities for international learners and ELs to build skills in new and digital literacies (Proctor, Dalton, & Grisham, 2007), critical multiliteracies (Shetzer & Warschauer, 2000; Black, 2005; Genesee, 2006), all while improving students' motivation to learn (Butler-Pascoe, 1997).

It is important to note that digital spaces sometimes provide challenges and opportunities for providing ELs with the visual and aural stimulation necessary to render new concepts more accessible (Cummins, 2009, 2011). This draws on Vygotsky's (1978) sociocultural theory that indicates that learning is facilitated through interaction with the social environment (e.g., interpersonal learning) as opposed to intrapersonal learning. Strengths of the inclusion of online and blended instruction are that it provides the ability to scaffold students as they construct meaning in a digital environment (Healey & Klinghammer, 2002).

Readers and Writers of Online Information.

Given the changes and shifts that are occurring to literacy as a result of technology, it can be a challenge to thoughtfully and routinely embed digital texts and tools. As detailed throughout this chapter, this integration of ICTs should be viewed as a literacy, and as a result is a social imperative for all classrooms, not just F2F or fully online. ICTs provide challenges and opportunities for development of hybrid learning environments with the visual and aural stimulation necessary to render new concepts more accessible (De Freitas, 2006; Borgman, 2011). This draws on Vygotsky's (1978) sociocultural theory that indicates that learning is facilitated through interaction with the social environment (e.g., interpersonal learning) as opposed to intrapersonal learning. Strengths of the inclusion of ICTs in instruction include the ability to scaffold students as they construct meaning in a digital reading and writing environment (Healey & Klinghammer, 2002).

With these challenges, there is a rich opportunity and a need for innovative instructional research uses that explore the various permutations of virtual, blended, and hybrid learning environments. Challenges associated with the inclusion of ICTs into instruction mostly focus on the access and training associated with use of digital texts and tools. With the use of technology in any setting, especially the classroom, there is the likelihood that computers will crash, hardware fails, or software is non-existent (Cuban & Cuban, 2009; Bingimlas, 2009). The key component in the successful use of educational technologies in a classroom setting involves the proper training and support the individual teachers need to use the digital texts and tools (Higgins, Smith, Wall, & Miller, 2005). For the most part, all challenges may be averted through the strategic training and empowerment of educators and the logical distribution of educational technologies (Hefzallah, 2004; Brown, & Warschauer, 2006).

Implications for Practice

While it is important to note that "virtual schools have a complexity that distinguishes them" from other learning contexts (DiPetro et al., 2008), research from literacy instruction using technology can be a source for recommendations in virtual, hybrid, or blended settings.

Writing Instruction

The integration of technology for writing instruction is a goal for many literacy educators as technology is changing the way writing is produced and disseminated. The National Council of Teachers of English (2004) position statement asserts "the use of basic word processing to support drafting, revision, and editing to the use of hypertext and the infusion of visual components in writing, the definition of what writing instruction includes must evolve to embrace new requirements" (¶ 42). There are various ways that technological tools can help facilitate the writing process; however, based on literacy research this section details three main implications for writing pedagogies in virtual schools, and blended and hybrid learning environments.

One of the affordances of technology is students' writing can reach a wide audience of readers so that teachers are no longer the sole readers and evaluators of student writing. Similar to teachers in traditional schools, teachers in virtual, blended, or hybrid learning environments could enhance their writing instruction by using tools, such as blogs, wikis, and social media sites, that might provide students with opportunities to write for authentic audiences and to receive a wider range of feedback on their writing. In addition, using these tools might also foster social interactions between teachers and students, which DiPietro et al., (2008) found to be a positive characteristic of virtual school teachers.

Technology provides teachers with multiple ways to give students feedback on their writing. Teachers can consider using platforms that readily engage students in the act of revision during the writing process. Using either a program similar to Scholar, such as Eli Review, or class wikis or websites, teachers could use learning platforms as a way to engage students in the writing and revision process. As the research highlights, these tools become a way to not only support student writers, but also a way to foster collaborative writing.

Research has highlighted that for many elementary aged students, keyboarding can be a skill that creates challenges; however, evolving perspectives on what it means to be literate considers the ways students compose using multiple modes. This broadening notion of text provides new pedagogical practices when engaging students in the writing process. Technologies, such as iPads, Twitter, Blogger, YouTube, and iMovie are transforming how educators conceptualize writing and composition (Albers & Harste, 2007; Dalton, 2013; Hicks, 2013; Kist, 2005; Smith, 2013; Sylvester & Greenidge, 2009).

Reading Instruction

Students in virtual, blended, or hybrid learning environments have the opportunity of being exposed to informational texts from online sources on a consistent basis. Online reading comprehension (Leu et al., 2009) is framed as a process of problem-based inquiry that takes place as students use the Internet to search and sift for answers to problems. This cornerstone is viewed as reading of online information. While the complex concepts, specialized vocabulary, and unfamiliar text structures can create challenges for students, online collaborative inquiry is framed as collaboration and co-construction of a body of information by a group of local, or global connected learners. This cornerstone is viewed as collaboration by learners as they search, sift, and synthesize online informational text. Online content construction (O'Byrne, 2013) is framed as the skills, strategies, and dispositions necessary as students construct, redesign, or re-invent online texts by actively encoding and decoding meaning through the use of digital texts and tools. This cornerstone is viewed as including the process and product of writing using digital texts and tools.

As these skills are propelled by technological advances, teachers can begin to explore instructional strategies to engage students in this learning. For example, teachers can use digital tools to facilitate classroom discussions about the thinking process used when reading informational texts. Allowing students to collaborate in deconstructing informational texts can provide insight into the text structures and particular features, as well as the understanding of specialized disciplinary knowledge needed for comprehension.

Implications for Research

In the 2014 edition, we noted the lack of research focused on literacy instruction in virtual or online schools; unfortunately, three years later, in 2017, there is still a lack of research in this area. This field is greatly understudied and needs a research base to support instructional approaches for teaching reading and writing in online schools.

Future research should be conducted to examine the affordances and constraints of literacy instruction in virtual, hybrid, and blended school settings. While there is research about general pedagogical practices that are effective in virtual, hybrid, and blended settings, there is currently a lack of empirical research studies in the area of literacy teaching, learning, and acquisition. And, while there are numerous research studies focused on technology in the field of literacy, there is little information about specific pedagogical practices in virtual school settings. As researchers explore literacy instruction in virtual, blended, and hybrid settings, there are a number of avenues to be explored.

Technological tools provide ubiquitous learning. While there is much conversation about the ways students read and write in various contexts and spaces, often highlighted is the binary between those literacy practices considered school sanctioned practices and those considered unsanctioned literacy practices. As more students are learning formally and informally in online spaces, these practices are becoming blurred. Researchers should be examining how these practices overlap and inform each other, with a critical eye examining the privileging of text and form in school settings. Notions of literacy have broadened as researchers and educators explore how students learn to read and write using images, video, audio, and other multimodal formats. As definitions of texts and of what it means to be literate are continually defined and redefined, researchers should explore how this influences the ways we teach literacy, particularly in virtual, hybrid, or blended learning spaces.

While online opportunities provide specific affordances, there are still constraints to consider when working with students in online settings. Researchers can pay more attention to the particular challenges elementary aged students may face when learning to read and write in online spaces. With specific challenges, such as lack of keyboarding skills, young readers and writers potentially face numerous challenges while learning in virtual, hybrid, or blended learning settings. In addition, the types of texts students are expected to read are changing, particularly as there is a current emphasis on informational texts. As noted, informational texts can be particularly difficult to comprehend, especially for young learners. Therefore, more information is needed on instructional practices that support young students reading of informational texts. In addition, much of literacy and English language arts classrooms revolve around involving students in discussions about writing, literature, and informational texts. As students work together to write collaboratively or to work with peers to search and comprehend online texts, researchers should be examining the best ways to scaffold students' abilities to work in interactive and collaborative learning environments (Coiro, 2003; Kanuka & Anderson, 2007).

In addition, the affordances and constraints of learning in online environments requires strategic and empowering professional development specific for instruction in these settings. As more teachers are expected to teach in online contexts, what professional development opportunities are needed to facilitate teachers' learning about effective instructional approaches for online educational spaces? In addition, what discipline-specific pedagogical approaches are most effective practices in online, hybrid, or blended learning environments? Teacher educators should also explore preservice teachers' learning about how to teach in online, hybrid, and blended learning spaces.

Conclusion

Educational institutions from Pre-K through higher education are experimenting with the effect that different chronotopes have on teaching and learning. In this context, chronotope refers to configurations of time and space in which educators manipulate pedagogical opportunities across hybrid learning spaces. Yet, with these experimental forays into hybrid learning environments, there is very little known about the challenges and opportunities that exist while supporting student learning. This is even more disconcerting as we consider the paucity of research and identified best practices developed for K-12 educational settings.

While the research base for literacy education in virtual schools, and hybrid and blended learning environments is significantly limited, it is supported by research done in the field of literacy education investigating reading and writing in online spaces. The first step may be to simply view the use of ICTs and digital content as another form of text in the classroom. This analogy allows educators to consider opportunities such as the ones discussed in this chapter to support content learning with literacy-based activities. This still does not account for issues with interpersonal and intrapersonal, or dispositional attitudes that make up the *glue* that holds together learners in a classroom. Advances in educational technologies such as videoconferencing may bring this functionality to the classroom and support all learners, but it still will require further examination and research.

Educators interested in developing and facilitating blended learning experiences can refer to the guidance detailed in this chapter. There are also tremendous online learning experiences, or open educational resources available online supporting educators from Pre-K through higher education as they consider blended learning experiences that are effective and rigorous. One such example is the Blended Learning Toolkit open online class that is facilitated by Kelvin Thompson every year (the website for the course is http://blended.online.ucf.edu/blendkit-course/). The Blended Learning Toolkit, and other guidance on best practices in blended, or hybrid learning environments can also be reviewed in academic journals like Hybrid Pedagogy (www.hybridpedagogy.com) and online through using personal learning networks.

As detailed in this chapter, it should be understood that the research and identified best practices as they relate to hybrid instruction are very much fluid and not well informed. This fluidity and constant change will most likely continue to be a constant identifying characteristic as technologies, and the literacies associated with these digital texts and tools continue to change. As the only constant in educational technologies is change itself, it seems necessary that constant meta analysis and research are conducted to define current trends, test instructional methods, and reflect before repeating this iterative cycle. As the number of students enrolling in fully online virtual schools or participating in hybrid or blended learning environments grows exponentially, we need to continuously develop a coherent picture of the literacy-based practices used in the interstices between online and offline educational spaces.

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24

Research on Teaching K-12 Online Physical Education

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Abstract

Physical education is one of the many K-12 content areas undergoing change due to the prevalence of online learning which includes online physical education (OLPE). OLPE faces the same issues as other content areas taught online such as academic honesty, learner readiness, student retention, technology issues, etc. OLPE, however, also has unique difficulties such as the teaching and learning of motor skills (hopping, skipping, jumping, etc.), sport skills (throwing, catching, kicking, striking with bat, etc.), dance, and fitness. The purpose of this chapter is to examine what is known about current K-12 OLPE programs based upon how well these courses meet physical education content standards and guidelines. In addition, this chapter will examine and synthesize the limited research regarding OLPE, then outline suggestions for policy, practice and future research. OLPE is an exciting, even attractive, option as an alternative method of delivering physical education content at the secondary level.

Introduction

Since this chapter was first published in 2014 (Daum & Buschner, 2014), several significant studies combined with additional school-based implementation increased our understanding of K-12 online physical education (OLPE). A relevant peer-reviewed article and two dissertations have been completed from 2014 to 2018 and added to this chapter. Furthermore, there has also been a resurgence of technology related articles in practitioner-based journals. We believe with the increased prevalence of online education and OLPE this has generated efforts to ensure quality. In this update we discuss the new additions to this research area and have revamped our recommendations and implications based on our current understanding of K-12 OLPE.

In this chapter we will summarize the limited research completed on K-12 OLPE but also make appropriate connections to the research that has been completed with hybrid and online physical activity and wellness courses at the University level. It is important to note however, that research conducted on college wellness, lifetime fitness, and activity courses are not included in the literature review and beyond the scope of this chapter. To fully understand the research synthesis section of this chapter, we will provide a contextual understanding of the recent evolution of OLPE. We will also discuss the implications for policy, practice, and research. This chapter will purposely omit the research on generic use of technology in face-to-face K-12 physical education courses such as exergaming (wii fitness, dance dance revolution, etc.) as we wanted to differentiate between teaching physical education utilizing technology and teaching physical education content online. It should be noted that the line between teaching with technology and teaching OLPE is blurred as more research addresses how "traditional" technology may be used in the online setting (Kooiman and Sheehan, 2014). We will end the chapter with conclusions, based on the empirical evidence, of how, or if, OLPE might contribute to a student's overall education.

OLPE is unique in online and hybrid education because the subject matter, if taught well, should elicit a movement response from the learner. Because of this, some of the goals of physical education become extremely difficult to meet online even with readily available technology. On the surface, the term "online physical education" seems counterintuitive and possibly even an oxymoron. Physical education is seen as an essential part of educating the whole child by addressing psychomotor (motor skills), cognitive (thinking and processing skills), and affective (self-esteem and cooperation) domains of learning. But in terms of OLPE, one might ask: How can a subject matter that is primarily about practicing, developing, and learning motor skills (hopping, skipping, jumping, etc.), sport skills (throwing, catching, kicking, striking with bat, etc.), dance, and fitness be taught online? That question and more will be will examined in this chapter.

Awareness of OLPE

Initial widespread awareness of K-12 OLPE came with the release of the 2006 *Shape of the Nation* (SON) report (NASPE, 2006) which was co-authored by the American Heart Association (AHA) and the National Association for Sport and Physical Education (NASPE). This report provided a state-by-state outline of policies and practices regarding K-12 physical education. In the 2006 report, it was found that 12 states allowed physical education credits to be earned through OLPE courses. In subsequent reports the number of states that allowed physical education credits to be earned online rose to 22 in 2010 (NASPE, 2010), 30 states in 2012 (NASPE, 2012), and 31 states in 2016 (SHAPE, 2016). Surprisingly, only seven of the 12 (58%) states in 2006, 10 of the 22 (46%) states in 2010 and 17 of the 30 (57%) states in 2012, required those courses to be taught by state certified physical education teachers. Additionally, the 2016 SON report found that 25 states allow only state certified teachers of physical education to teach OLPE in their respective states (SHAPE, 2016). It is important to note that to date there were no data published regarding the prevalence of OLPE at the district or local level, the number of teachers involved in OLPE, the number of students taking OLPE courses, nor detailed information about the qualification of those teaching this subject matter. More important, these early SON reports failed to mention curricular focus, pedagogical strategies, or evidence of student learning.

Prior to these SON reports, the only proof that K-12 OLPE existed were news articles that both praised and criticized this emerging technology for learning (Balona, 2003; Brooks, 2003; Cerabino, 2004; Gussow, 2002; Whritenour, Voss & Vogt, 2006) and an editorial in the *Journal of Physical Education, Recreation and Dance* (Buschner, 2006). In this editorial Buschner (2006) examined the potential advantages and disadvantages of OLPE. The advantages were: 1) students are motivated by technology, 2) benefits students who live in remote areas, 3) fits students' needs by using a personalized system of instruction (PSI), 4) it is convenient for students, parents, and administrators, and 5) it could be used as an elective once required coursework was complete. The disadvantages Bushner (2006) included were: 1) OLPE threatens face-to-face programs and teaching positions, 2) the counterintuitive message to students taking physical education online, 3) difficulty meeting state and national content standards for learning, 4) first generation OLPE courses do not satisfy the criteria for comprehensive physical education, and 5) data were unavailable to validate OLPE as a viable medium for learning.

In response to the apparent growth and development of K-12 OLPE programs across the country, NASPE put together a taskforce which developed the *Initial Guidelines for Online Physical Education* (2007). Both authors of this chapter were part of the taskforce and are part of the revision of these guidelines which will begin Fall 2017. Due to a lack of research related to OLPE, it was recommended that K-12 OLPE proceed with a hybrid or blended model as the "reasonable instructional alternative for this subject matter until further research is available" (NASPE, 2007, p. 3) and has continued to be the recommendation from current OLPE research (Trent, 2016). It was the position of NASPE and physical education leaders that technology can be a valuable tool in enhancing teaching and learning in physical education, however, the technology needs to be carefully selected and used in a pedagogically sound manner (NASPE, 2009).

Subsequent editorials and viewpoints concerning best practices in K-12 OLPE were published in the physical education literature. Articles by Ransdell, Rice, Snelson and Decola (2008) and Mohnsen (2012a; 2012b) discussed solutions to some of the challenges outlined in Buschner's (2006) article such as using proctors to conduct fitness tests, journaling, videotaping of performance in physical activities, and virtual field trips. Regardless of what had been written about OLPE, most authors came to the same conclusion, more research is needed to validate K-12 OLPE and any new learning technology must maximize student learning (Buschner, 2006; Buschner, 2014; Mosier, 2012; Ransdell, et al., 2008; Rhea, 2011).

The Role of PE in OLPE

Similar to other school subjects, physical education leaders have published and promoted student learning standards for the past twenty years (NASPE, 1995; NASPE 2004; SHAPE 2014). The National Association for Physical Education and Sport was recently renamed The Society of Health and Physical Educators (SHAPE) America. It retains the same mission to enhance the teaching and learning of school-based physical education. While it is up to each state to determine their own content standards, many teachers, school districts, and states use or modify the national learning standards to fit their needs. Teaching and learning benchmarks are important for evaluating face-to-face, hybrid, or online physical education courses.

After decades of debate, the agreed upon aim of school physical education "is to develop physically literate individuals who have the knowledge, skills and confidence to enjoy a lifetime of healthful physical activity (SHAPE, 2014, p. 11)." SHAPE (2014) defines the physically literate individual as someone who has learned the skills necessary to participate in a variety of physical activities, knows the implications and benefits of being physically active, participates regularly in physical activity, is physically fit, and values physical activity and its contribution to a healthy lifestyle. There are five national standards (SHAPE, 2014) relating to what the physically literate individual should be able to do. The physically literate individual:

1. demonstrates competency in a variety of motor skills and movement patterns.
2. applies knowledge of concepts, principles, strategies and tactics related to movement and performance.
3. demonstrates the knowledge and skills to achieve and maintain a health-enhancing level of physical activity and fitness.
4. exhibits responsible personal and social behavior that respects self and others.
5. recognizes the value of physical activity for health, enjoyment, challenge, self-expression and/or social interaction.

The above national standards are accepted in the profession as the gold standard for K-12 student learning and the basis for planning and teaching in physical education. This introduction, to include a recent history, context, and the challenges regarding OLPE, is essential to understanding the empirical evidence that will follow.

Research Synthesis

As stated in the introduction, the literature regarding K-12 online physical education (OLPE) is very limited. The published research includes five peer-reviewed research articles and five doctoral dissertations (see table 1). We will organize this portion of the chapter by what we know about the organization of OLPE courses and requirements of those who take K-12 OLPE, the characteristics of the learners and teachers involved in K-12 OLPE and teacher educators' perceptions of K-12 OLPE.

Physical Activity Levels and Course Organization

One of the major concerns of critics of K-12 OLPE is that students are not being physically active and engaged in motor learning (Buschner, 2006; Buschner, 2014; Mosier, 2012; NASPE, 2007; Ransdell, et al., 2008; Rhea, 2011). In addition, SHAPE America considers the development of motor skill competence as the highest priority of physical education because of its impact upon student engagement, intrinsic motivation, perceived competency, participation in physical activity, and sufficient levels of health-related fitness (SHAPE, 2014). Physical activity is inherently important to physical education and is what makes the subject matter different than any other in the K-12 curriculum. There was only one published study (Daum & Buschner, 2012) and two doctoral dissertations (Futrell, 2009; Trent, 2016) that addressed the physical activity levels and other requirements of students enrolled in K-12 OLPE.

Physical Activity Levels. There is only one study to date that has compared OLPE secondary students' fitness outcomes versus those in face-to-face physical education (Futrell, 2009). Data were collected on 24 online physical education students and 36 traditional face-to-face physical education high school students. Pretest and posttest physical fitness data were collected on all participants. A valid and reliable measurement tool (Fitnessgram) used criterion-based sub-tests designed to assess cardiovascular fitness, muscular strength, muscular endurance, flexibility, and body composition. Findings indicated that online secondary students increased their flexibility (sit & reach) and muscular strength (trunk lift, curl-ups, and push-ups) but not cardiovascular fitness (mile run). This is contrary to a similar study with a college online, hybrid, and face-to-face weight training course that did not demonstrate improvement in upper body strength (McNamara, Swalm, Stearne, & Covassin, 2008). Because of the population size and differences, and alternative methods to assess strength it would not be prudent to conclude that online learning is superior or inferior to face-to-face learning in regards to fitness.

Course Organization. Daum and Buschner (2012) surveyed thirty-two secondary OLPE teachers. The purpose of this study was to attain a general understanding of what was happening in secondary OLPE courses across the country and to help clarify what OLPE looked like. The majority of participants' (*n*=24) indicated that their course was based on a "Fitness for Life" curriculum (Corbin & Le Masurier, 2014), while other participants allowed their students to go to local gyms or other facilities to complete the physical activity component of their course. The most common form of assessment in OLPE courses were physical activity logs for the psychomotor domain and the use of tests or quizzes for the cognitive domain (Daum & Buschner, 2012; Mosier & Lynn, 2012).

It was found that the primary focus of the OLPE curriculum was cognitive, which indicated that a minimal level of the course focused on physical activity (Daum & Buschner, 2012). This was further confirmed when only nine of the 32 respondents said their courses met the NASPE (2004) recommendation of 225 minutes of learning per week. A historically accepted professional axiom for teaching face-to-face physical education is to keep the majority of the class physically active, the majority of the allocated time. Six of the participants reported their course had no physical activity requirements. Twenty-one of the participants, however, required their students to be physically active on three or more days per week. Regardless, these numbers fall short of the 60 minutes of moderate to vigorous physical activity on all or most days per week recommended by the Center for Disease Control (CDC). As will be discussed later in this chapter a major challenge for OLPE teachers is the verification of learning in the physical activity domain.

In a follow-up study, Trent (2016) investigated a high school OLPE course in Georgia and how it aligned with the NASPE (2007) initial guidelines for OLPE. Data were collected through document analysis, interviews, and questionnaires of 110 OLPE students and 10 OLPE instructors. Trent (2016) found there was strong alignment with eight of the ten guidelines (student pre-requirements, teacher pre-requirements, curriculum and instruction, assessment, class size, equipment and technology, program evaluation, and services for students with disabilities) and moderate alignment with the other two (time allocation and community resources). She notes that while on the surface the OLPE course superficially met the guidelines, but major questions about documented learning remain due to concerns with accountability, time spent in physical activity, rigor, and meaningfulness of assignments. Interestingly, a theme that emerged was that OLPE students did not think assignments are as meaningful or challenging because of the lack of differentiation with the course material and instructional practices (i.e. watch video then complete assignment). As noted in both the Daum and Buschner (2012) and Trent (2016) studies a major challenge for OLPE teachers is the accurate verification learning.

Learner and Teacher Characteristics

It is important to know why students take online courses in addition to knowing if the online courses meet the needs of the students. In addition, it is also important that we know about the training and qualifications of teachers who teach OLPE and if online courses are meeting student needs. Four studies (Daum & Buschner, 2012, Mosier & Lynn 2012; Kane, 2004; Karp & Woods, 2003) and three dissertations (Futrell, 2009; Jackson, 2015; Williams, 2013) examined the characteristics of students and/or teachers involved with hybrid or fully online K-12 physical education courses.

Teacher characteristics. Daum and Buschner's (2012) research also investigated the teachers' perceptions of secondary OLPE. While the results were mixed with some of the participants stating "in this day and time it [OLPE] is necessary (p. 94)" other participants were not supportive of this notion. One participant, who did not like OLPE, did not feel the program met student learning standards nor had enough physical activity. Half of the participants (*n*=16), however, were indifferent and saw both the pros and cons of offering OLPE. While it was described in the *Shape of the Nation* reports (NASPE, 2006; 2010; 2012) that some states did not require their online teachers to have teaching licenses, three seminal studies delimited their populations to those holding a physical education teaching license and experience teaching face-to-face physical education courses (Daum & Buschner, 2012; Mosier & Lynn, 2012; Williams 2013).

Williams' (2013) dissertation was a case study of four female OLPE teachers that examined their experiences and perceptions of teaching online. The purpose of the study was to describe the daily practices of OLPE teachers, the educational theories that guide the teachers, how they enhance learning, and the teachers perceptions of what students got out of their OLPE course. The participants were from central Florida, northwest United States, southwest United States, and Alberta, Canada. Each of the participants had a minimum of two years of teaching high school OLPE and had two years of "successful" teacher evaluations. Data were collected by interview, virtual classroom observations and field notes, e-mails between researcher and participants and the researcher's reflective journal. The results of Williams' study indicated one of the reasons the teachers chose to teach online was because of the flexibility. Specifically, having young children and being able to work part time as a non-traditional physical education teacher were mentioned.

Florida Virtual School (FLVS) is the largest virtual school system in the United States. Mosier and Lynn (2012) analyzed data on 19,000 secondary students taking an online personal fitness course. Student data were collected by an external non-profit group and FLVS then analyzed by Mosier and Lynn. In addition, the online course shell was analyzed and four FLVS employees were interviewed. The courses are self-paced which allowed students to complete the course as fast or as slow as they wanted, however, the longer it took a student to complete the course, the lower the final grade was likely to be. The teachers of OLPE at FLVS were required to be available 8:00 a.m. to 8:00 p.m., seven days a week and respond to e-mails within 24 hours. One-on-one communication, typically e-mail and/or phone calls were not only the most common form of communication between OLPE teacher and OLPE student, but the most effective (Daum & Buschner, 2012; Mosier & Lynn, 2012; Williams, 2013). Mosier and Lynn (2012), for example, found that it is a requirement of the FLVS online teachers to call their students at the beginning of the course, and at least once a month during the course.

It is important to note that participants in each of the aforementioned studies, who teach OLPE, are often philosophically divided in regards to their support of this online subject (Daum & Buschner, 2012). Those who supported this mode discussed being able to get to know students on a one-on-one basis (Daum & Buschner, 2012; Williams, 2013), while the detractors had major concerns about the accuracy and accountability for student learning, primarily regarding keeping track of physical activity levels (Daum & Buschner, 2012; Williams, 2013). Buschner (2014) observed that teaching secondary OLPE was similar to walking a tightrope when considering the multitude of challenges to produce student learning.

Learner characteristics. Karp and Woods (2003) conducted the first study on high school student's perspectives of learning nutrition information online while enrolled in a face-to-face physical education class. While this study was not conducted with a fully online course, it was the first that explored teacher and student perceptions of using the online medium to teach cognitive content in physical education. This study included 19 high school students enrolled in a semester-long hybrid wellness course. The results indicated that the students felt the online portions met their learning styles, allowed them to focus their learning, and allowed them to work at their own pace. However, both the teacher and students felt disconnected with their peers and each other. Williams (2013) found similar benefits regarding schedule flexibility, physical activity choice, working out in an environment that is comfortable for the learner, and improved attitude and advocacy behaviors for health and wellness. Other research, however, has shown that OLPE students are slightly less or as satisfied with their course experiences as the face-to-face students (Futrell, 2009).

The first research completed on a fully online OLPE course was a case study involving 38 students and their teacher (Kane, 2004). This study examined the experiences of the teacher and students. The course evaluated in Kane's (2004) study, unlike modern online courses, was e-mail based. The results demonstrated that students in the study had a difficult time keeping track of their learning. Similar to other findings (Karp & Woods, 2003), the students missed the face-to-face interaction with the teacher but they enjoyed the flexibility of the course. The teacher in Kane's (2004) study felt the course was very time consuming, it lacked credible assessments and lacked structure. It is easy to wonder how many of the issues the teacher and students faced in this study were due to the technology of the time, however, this study did provide an initial view into what OLPE looked like.

While course flexibility is a defining characteristic of online education, physical educators at all levels have a suspicion that students take OLPE for other reasons. A more recent study (Jackson, 2015) confirmed some of the fears and assumptions that physical educators at all levels had about OLPE. Jackson (2015) investigated why K-12 students opted to fulfill their physical education credits online, what the characteristics of those students were and how OLPE learning experiences were remembered. Using a case study design she interviewed five students, five parents (one for each student), three school administrators, and two face-to-face physical education teachers. Similar to teacher concerns cited above, Jackson found that there was a need for greater accountability because it was easy for students to fabricate results on physical activity logs. When a fitness log is completely on the "honor system" teachers lack confidence in the accuracy and students feel it is easy to fake results (even if they did not). Perhaps not surprisingly, another finding was that students took the course because of scheduling reasons. They wanted to free their schedules for more advanced placement courses and other courses they wanted to take such as music and band. The student participants noted that physical education was not as valued as the other courses and was an expendable part of their schedule, and possibly education. This finding is of course a major concern of physical educators around the world as the requirements of this subject matter continues to decline as obesity, physical inactivity, and unhealthy habits rise.

Teacher Educators Perceptions

K-12 OLPE could be described as the "elephant in the room" as the physical education profession appears unwilling to examine its merits (Kooiman, 2014). As outlined in the introduction, online education is well established in the United States education system which is requiring teacher educators to catch up with school districts using this delivery model. There has been only one dissertation (Daum, 2012) and the subsequent published journal article (Daum & Woods, 2015) that has investigated physical education teacher educators perceptions of K-12 OLPE and how, or if it can, meet the learning standards for physical education.

Daum (2012) investigated physical education teacher educators (PETE) perceptions towards K-12 OLPE by conducting semi-structured, open-ended telephone interviews with 25 tenure-track faculty members who were currently teaching methods courses to undergraduate physical education majors. The study employed a stratified random sampling in selecting the participants by using the Carnegie classification (Carnegie, 2011) of the institutions where PETE faculty were employed. The results of Daum's (2012) study indicated that the majority of the PETE professoriate had minimal knowledge of K-12 OLPE. Most of the respondents knew OLPE existed but viewed its availability primarily for students from rural areas or those who were homeschooled. Regardless of this lack of knowledge, twenty of the twenty-five participants felt that, for better or worse, K-12 OLPE was likely part of physical education's future. Conversely, five participants believed it was a negative trend and detrimental to the profession.

Participants were almost unanimous in their view that elementary OLPE was developmentally appropriate because "foundational skills at the elementary school require more face-to-face contact, and those kids aren't as self-directed [as older kids] (Jennifer, p. 51)." Regarding middle school, the participants were split; some felt it was not appropriate because of the wide range of skills and abilities in middle school learners, while others felt there are some middle school students who would be able to handle the responsibility. Likewise, participants were nearly unanimous in being supportive of high school OLPE. For example, one of the participants said as long as high school students had "quality [physical education] programs [in elementary and middle school], they should be ready for independent learning [OLPE] (Theresa, p. 53)."

While the participants were lacking knowledge of model K-12 OLPE programs, they were experts in physical education and spoke to how, or if, K-12 OLPE could or could not meet the SHAPE 2014 content standards for physical education. The discussion of physical education standards focused on two areas, motor skill competency (SHAPE Standard 1) and cognition (SHAPE Standards 2 and 3). Motor skill competency is a major concern of physical educators, and was a major concern of the PETE faculty in Daum's (2012) study. In the online environment, activity logs could be used to track physical activity as suggested by Ransdell, et al. (2008), however, the participants questioned the ability to teach motor skills and be able to provide timely feedback. One of the participants stated "You can go back and do video analysis and look over the skill, but there is something to being in the moment and giving someone feedback when they are actually producing a movement (Brian, p. 48)."

The majority of participants felt that online education and K-12 OLPE could thrive if the focus was content area knowledge. They considered this a natural fit; however, there were a few participants' who questioned the ability of online teachers to assess student application of tactical knowledge (SHAPE Standard 2) in sport and game play. The remaining standards were fairly equally split between those who felt you could, or couldn't assess them through the online medium. One participant felt that the degree to which the standards could be met was only limited by the creative thinking of the teacher, while on the other hand some participants felt the lack of social interaction and feedback for motor skills were an insurmountable barrier. Regardless of their differing beliefs, most PETE faculty believed that future teachers needed to receive training on how to use online technology.

Table 1. **Summary of Research Completed Related to K-12 OLPE**

Authors	Purpose	Participants	Design/Measures
Daum & Buschner (2012)	Surveyed secondary OLPE teachers to investigate course requirements, assessment techniques, curriculum focus, and teacher perceptions.	32 OLPE teachers	Mixed-Methods – questionnaire with open-ended questions
Daum (2012) and Daum &Woods 2015)	Examined physical education teacher educators' perceptions and attitudes towards K-12 OLPE.	25 Physical education professors	Qualitative – Semi-structured open-ended interviews
Futrell (2009)	Examined course satisfaction and fitness with secondary face-to-face physical education and OLPE students.	26 OLPE students and 36 FTF students	Quantitative - FITNESSGRAM
Jackson (2015)	Explore why K-12 students and/or parents opt to fulfill PE online and their OLPE experiences	Five OLPE students, five parents, three administrators, and two FTF teachers	Qualitative - Semi-structured open-ended interviews
Karp and Woods (2003)	Examined perceptions of students who are enrolled in a face-to-face secondary physical education class in regards to using online modules to teach health concepts.	19 Hybrid students and 23 FTF students	Mixed-methods - Technology survey, knowledge test, goal-setting assignment, fitness paper, nutrition analysis, injury case and interviews
Kane (2004)	Investigated teacher and student perceptions of a personal fitness distance learning course.	One OLPE teacher and 38 OLPE students	Qualitative – interviews, focus groups, student survey, observation notes, and other document analysis
Mosier & Lynn (2012)	Investigated the Florida Virtual School OLPE courses in regard to student completion rates and characteristics of the OLPE courses.	Two OLPE teachers, two administrators	Mixed-Methods – interviews, document analysis, evaluations, and an external case study
Trent (2016)	Examined how an OLPE course aligned with national OLPE guidelines	110 OLPE students and 10 OLPE teachers	Mixed-Methods – questionnaire, document analysis, student activity data, and semi-structured interviews
Williams (2013)	Completed a case study on four secondary OLPE teachers examining their experiences and perceptions about teaching online.	Four OLPE teachers	Qualitative – interviews, observations and field notes, and reflective journal

Implications for Policy and Practice

Policies that will drive OLPE in our nation's schools will come from six primary groups: school administrators; physical education teachers; teacher education programs; professional organizations (ex. SHAPE America); parents; and students. All educational innovations are fraught with economic, political, ethical, social, and pedagogical challenges. A viable OLPE delivery model will necessitate communication and consensus among the aforementioned groups. The reasons states and/or school districts may implement an OLPE program will vary based upon local values and needs. This variation will make reaching a consensus about best practices difficult.

We concur with the *Initial Guidelines for Online Physical Education* (NASPE, 2007) and look forward to the revision of this important document for physical education teachers. This forward thinking position paper recommended hybrid physical education courses until additional research verifies OLPE. Students and teachers would likely benefit from a hybrid model of physical education (Futrell, 2009; Karp & Woods 2003, Trent, 2016) however, recent research findings indicate that OLPE can be worthy as a fully online option (Mosier & Lynn, 2012; Williams, 2013). The obvious benefit of the hybrid model would be that the face-to-face time would address some of the criticism of OLPE regarding minimal student socialization and motor skill learning. On the other hand, an issue with the hybrid model is that it may not be feasible for all students, especially if the student is across the state, country or world. The concept of the hybrid model also goes against the reason that some students take online courses, for schedule flexibility and to be able to learn when they want to.

Another perplexing problem for physical education professionals is the close connection between a student's screen time and lack of physical activity. One-third of US youth have been found to be overweight or obese (CDC, 2013). The highly regarded Kaiser Foundation Study (2010) found that youth, ages 8-18, average 7.5 hours a day media (often multitasking). Screens include TV, video games, music, movies, reading, social media, the panoply of websites and apps, and online learning in a variety of educational related areas. Turkle (2011) claims that youth are "growing up tethered to media". It is our view that all educators must examine the role of screen life, for children and youth, in the 21st Century. Not surprisingly, the American Academy of Pediatrics recommends no more than two hours of entertainment screen time per day for the appropriate development of children and adolescents (AAP, 2013). This influential group argues that media can supplant important childhood activities such as exercising or playing with friends. Youth who spend more time with media earn lower grades and possess lower levels of personal contentment (Kaiser, 2010). It is imperative that educators and parents understand the impact of screen time on our youth. It may be that school physical education would be the school subject that should minimize screen time so that real time motor skill activity, socialization, and physical activity becomes an important habit and a respite from the digital world. In short, youth need to move more and sit less.

Our suggestions for OLPE policy and practice, based on limited evidence, include many of the guidelines and recommendations by NASPE (2007; 2012), the National Education Association (NEA, 2002), and the International Association for K-12 Online Learning (iNACOL, 2011).

Implications for Policy and Administrators

- Policy should set minimum expectations for OLPE courses to include physical activity. For example, to receive credit for secondary physical education, OLPE students must verify they were physically active at least 225 minutes a week (50 minutes per day), preferably physical activity that was moderate to vigorous in intensity.
- Policy should set minimum education standards for OLPE to ensure student achievement in regards to motor, cognitive, and social learning. Policy should delineate what needs to be included in an OLPE course to meet educational standards to satisfy graduation credits.
- Policy should define the type or amount of online learning that is acceptable for each grade level (elementary, middle and high school); it is our recommendation that OLPE not be available for elementary aged children, limited at the middle school level, and an option at the high school level.
- School policy should include OLPE as an option and not as a replacement for the face-to-face version of learning for this subject area. Not all students have the aptitude, interest, or characteristics to be successful in the online environment.
- Policy should create a teaching licensure track or certificate for online learning.
- Policy should ensure that online learning will be modified to meet the needs of all students, including those with disabilities.
- Administrators need to ensure that quality OLPE is delivered by certified/licensed physical education teachers and ensure that those teachers have received adequate preparation to teach online.
- Administrators need to assist their online teachers by offering in-service training or access to training that covers educational technology, online pedagogy, online curriculum design, and best practices.
- Administrators need to ensure courses are updated frequently and that appropriate technologies are being used.

Implications for Teacher Preparation

- Teacher educators need to ensure they understand the types of K-12 curricula implemented (including OLPE) in their service area and modify their training program as needed. Certain areas of the country have a greater influence from online education than others.
- Teacher educators must seek “buy in” from teacher education and non-teacher education faculty (exercise physiology, biomechanics, motor learning, sport psychology, etc.) and develop a meaningful inclusion of technology across coursework that reinforces teaching strategies throughout the undergraduate program (Wyant, Jones & Bulger, 2015).
- Teacher educators need to include online pedagogies, or at minimum, a generalized educational technology course into their curriculum to prepare future teachers for the possibility of teaching online.
- Teacher educators should develop partnerships with online schools to generate internship experiences for teacher candidates, especially where OLPE is prevalent.
- Teacher educators need to take advantage of in-service opportunities to learn about online pedagogies so they have a better understanding of online education, its possibilities and its pitfalls.

Implications for Students, Parents, and Teachers

- Students should be screened to determine their readiness before taking courses online education and OLPE. In

addition to some sort of online academic skills readiness test, screening could include passing a face-to-face physical education course, fitness test, and/or a motor skills test.
- Parents need to assist the online teacher by monitoring their child's learning. They can start by verifying daily physical activity participation and work carefully with the online physical educator to maximize learning.
- Teachers need to meet frequently (virtually or otherwise) with the parent(s) and student about course structure and the assessment of learning.
- Teachers need to ensure that there are assessments for motor, cognitive, and social learning to meet the SHAPE (2014) and/or state learning standards. These assessments should include technology that their students have access to and contribute to quality learning.
- Teachers need to utilize relevant and current technologies to enhance motivation and accountability for courses. Using exergaming for example, can be utilized to increase cognitive engagement (Kooiman & Sheehan, 2014).
- Teachers need to ensure the developmentally appropriateness of their course and ensure that students enrolled in their courses are ready for online learning.
- Teachers should design short term and semester length courses around key formative and summative assessments. Profound learning can occur if students are provided with extended contact to course materials. In addition teachers need to ensure their courses meet and/or exceed quality online standards created by NEA the (2002), NASPE (2007), and/or iNACOL (2011).

Some may view online learning as a panacea for education's (and physical education's) ills. It could also be seen as a threat to the brick and mortar school, teachers jobs and as a cost saving and convenience issue. Some educators believe that face-to-face teaching and learning should not be sacrificed without sufficient evidence to prove the worth of online education. Nevertheless, physical education teachers and their professors must spend the time and effort to evaluate the merits of OLPE. Unfortunately, research lags behind educational practice, "good practices" will not occur without close examination of the OLPE teaching and learning process. We believe, optimistically, that parents and students will support quality physical education, regardless of delivery mode, as long as it is meaningful in the lives of students. Lastly, we do not see federal legislation driving OLPE in the immediate future, or other online subjects for that matter. It is likely that online learning will remain a state and local issue based on recent prevalence studies (Watson, Murin, Vashaw, Gemin, & Rapp, 2012).

Implications for Research

The research regarding K-12 OLPE is sparse, and somewhat disconnected, now generating numerous questions for study. Five of the studies included teachers of secondary OLPE (Daum & Buschner, 2012; Kane, 2004; Mosier & Lynn, 2012; Trent, 2016; Williams, 2013), five included data collected from fully online students (Futrell, 2009; Jackson, 2015; Kane, 2004; Mosier & Lynn 2012; Trent, 2016), one included physical education teacher educators (Daum & Woods, 2014), and one included a health hybrid model (Karp & Woods, 2003).

A reason for the lack of research could be due to the controversial nature of this subject matter. Educational change is met with skepticism and resistance, and perhaps this is compounded by the fact OLPE seems like an oxymoron. Another reason for the lack of research could be that the United States is in the midst of a major health crisis in which physical education is seen as part of the solution. Because of this, valuable research resources have been put into studying solutions to childhood obesity or justifying physical education's status in the schools. It is apparent that more research is needed on the students who take these courses, the teachers who teach these courses, and the courses themselves.

Research is needed to determine the physical activity levels of students who take OLPE compared to students enrolled in face-to-face programs. It should also be asked what types of physical activity these students are completing. Also of interest would be what technology skills these students have or have access to. Perhaps the most important question related to students that can be explored with a greater number of participants, is why students are taking physical education online? Is it just due to convenience and scheduling problems (Jackson, 2015) or are there other reasons (i.e. bullying in the face-to-face classroom, freedom of choice, a pathway for students with lower academic success, etc.)? In addition, what are the characteristics of students who are taking OLPE (race, ethnicity, socio-economic status, high skilled, low skilled, at-risk, gender, students with disabilities, etc.). The answers to those questions have the potential to impact how teachers of physical education and professors in physical education view this delivery model. Similarly, what types of physical education content are taught in OLPE programs, and what types of content should be taught? An important question by Mosier (2010) ponders how OLPE programs impact parent involvement in student learning to include the successful completion of an OLPE course.

Research also needs to investigate the teachers who teach K-12 OLPE. This area needs research for teacher educators to know what pedagogical skills and tools are required for the online job. In addition, the daily practices and schedule of an OLPE teacher should be investigated; this could include physical activity levels, full time vs. part time employment, career satisfaction, socialization, class sizes/student load, planning time, technological acumen, coping mechanisms, and more. Research questions should also be asked in regards to teachers' dispositions and perceptions regarding content (what should be taught) and content delivery (hybrid or fully online) of OLPE.

Curriculum in K-12 OLPE courses needs to be researched. A question many physical educators and teacher educators want to know is if OLPE can or does meet state and/or the SHAPE (2014) physical education standards? Research should be conducted to develop a valid and reliable fitness test students can self-administer in addition to other valid and reliable assessments for the online student. There is a need for authentic ways to assess the psychomotor, cognitive, and affective domains. Studies should also address curricular design (self-paced vs. structured) and even the types of curriculum or curricular models that would be best suited for OLPE. Another consideration is that research needs to be conducted on developmentally appropriate ways to modify courses to fit the needs of students with disabilities.

It is difficult to discuss K-12 schooling without addressing teacher education. To help teacher educators prepare the next generation of physical education teachers, they need to know essential 21st Century technological skills and tools required for teachers on the front line of education. Further, researchers should investigate the preparedness of the professoriate, including one's technology skills to teach online pedagogies and strategies. It is highly unlikely there will be major changes within teacher education unless the accreditation bodies include standards related to online pedagogies. Even then, the resistance to change might overpower the desire to change. Teacher educators must realize that many school districts now expect teacher competency with online delivery models. Some school districts will not offer interviews to teachers who are technologically deficient. Teacher educators are part of the problem and solution for the improvement of school physical education using all forms of technology.

Our suggestions for future research are offered to stimulate thought and action. Tomorrow's OLPE research must address the most important questions that will help lead physical education teachers to employ best practices and ultimately student learning. We believe limited research efforts should compare face-to-face physical education to OLPE. It is not a matter of validating OLPE; it is a matter of ensuring that OLPE teachers and curricula meet indicators of quality established by the profession.

Conclusions

The question should not be if K-12 OLPE should exist, the question should be how to ensure K-12 OLPE meets the needs of the stake-holders, meets educational learning standards, and promotes lifelong physical activity. Physical education is physical by nature, and OLPE seems counterintuitive. While it can be argued that OLPE can address fitness (Futrell, 2009; McNamara et al., 2008) and it does show promise in being able to meet or exceed the physical education content standards (Daum & Buschner 2012; Futrell, 2009; Mosier & Lynn, 2012), it has apparent weaknesses in being able to enhance motor skill development. Current programmatic weaknesses have the potential to be remedied, in due time, by thoughtful research. As evidenced by the few doctoral dissertation and limited peer-reviewed journal articles, this "emerging" field of research is in its infancy and has yet to produce a cohesive line of research.

With the technology readily available, the development of basic motor skills (hopping, skipping, jumping, etc.) and sport skills (throwing, catching, kicking, striking with bat, etc.) is almost impossible in a purely online course. While it is plausible to video record a student's motor skill (ex. dribbling a ball), the question of immediate teacher feedback is lacking with OLPE. By the time the feedback is received the child could have incorrectly practiced the skill, thus hindering, as opposed to enhancing, long-term development of the child (Silverman, 1985). It is imperative that feedback be delivered immediately for learners to progress during motor skill instruction (Goodway, Crowe, & Ward, 2003). A possible solution would be to have students view a video of a motor skill being performed correctly (ex. tennis forehand), then compare against a self-made video of the same skill. Online communication between student and teacher might yield improved performance, but these tools and strategies must be studied. Thinking from a developmental perspective we know the accuracy of a student's ability to self-assess is linear with age (Feltz & Brown, 1984; Harter, 1998; Horn & Weiss, 1991). This perspective tells us that most children and youth lack the ability to self-assess thus, furthering the argument against OLPE in younger grades. Another possibility, is for a teacher to watch a child perform motor skills live via the web, however, the legal implications (ex. child safety) and logistical implications (scheduling, equipment, etc.) currently seem insurmountable. Nevertheless, creative ways to help students learn using OLPE may be part of a future research program. Funds will need to be allocated, by interested groups, so that these and other important questions can be addressed.

It is our belief based on the limited data outlined above, that OLPE should only be available for secondary students after they have demonstrated they have the motor and social skills to be a successful online student. Because the primary goal of physical education is to develop motor skills (SHAPE, 2014), and the issues related to assessment of motor skills online, OLPE is not prudent at this juncture for elementary aged children. Until research can address the feasibility of teaching motor skills online, including best practices, OLPE should be primarily a fitness focused curriculum. Teachers of OLPE should incorporate physical activity monitoring devices such as pedometers, heart rate monitors and other movement trackers as better ways to ensure that physical activity is taking place rather than activity logs. Administrators, parents, and teachers who value educating the whole child and student learning cannot afford OLPE to become a physical activity wasteland. OLPE courses need to contribute to the goals of SHAPE America (2014), and influence the next generation of movers to become physically active and healthy for a lifetime. This chapter offered an OLPE snapshot, based on the research evidence and best practices, of what we currently know and where we need to go.

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Online, Hybrid, Blended, and Technology-mediated Learning in Social Studies

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Abstract

This chapter summarizes and synthesizes findings from research focused on social studies instruction in online and blended learning environments. These forms of cloud-based applications offer a vision of technologically supported learning that goes beyond the descriptions of technology integration previously found in social studies literature. Because of the paucity of studies in the field labeled as such, this review expands discussion to forms of technologies utilized in classroom practice, which enables a continuation of previous analyses and literature reviews focused on technology integration and serves as a central resource for the most updated work in this domain with the introduction of some elements of cloud-based instruction. Limiting our examination to studies published in peer-reviewed journals in the last three years (2014–present) allows for a synthesis of the most recent and relevant trends in research and apportions more precise suggestions and interpretations for future directions in both research and practice.

Introduction

As technological innovation continually presents new opportunities and environments for teaching and learning, the field of social studies, dedicated to the education of democratic citizenship and civic-mindedness (NCSS, 2016), would seem particularly relevant for preparing students for participation in these dynamic contexts (NCSS, 2013a). Indeed, amidst educative and pedagogical trends of personalized learning that underscore meaningful engagement in the curriculum (Woyshner, 2016), studies of the surrounding world–its people, their history, its land, its governance–seem to offer the promise of a unique niche fit for online learning, particularly through the use of digital tools, technological resources, and virtual settings.

At first glance, social studies does seem to have a commanding presence in the contexts of online and blended learning, at least in the secondary sector, often leading enrollment numbers of online courses, being considered a core subject of study (Clements, Stafford, Pazzaglia, & Jacobs, 2015; Evergreen Education Group (EEG), 2017; Holian, Alberg, Strahl, Burgette, & Cramer, 2014). Closer examination, however, raises uncertainty of and doubts about the progress of effective or innovative practices in teaching and learning in the field. The primary reason for social studies course online availability was to offer opportunities for course recovery credit or to accelerate credit accumulation to meet high school graduation requirements (Clements et al., 2015; Holian et al., 2014). Furthermore, over a third of schools offering online classes expressed concern over the quality of the course (Clements et al., 2015). Scholarly and empirical research pertaining to this particular style of learning and associated instruction is significantly limited; hence, the omission of a chapter for this field in the previous edition of this handbook offers credence and is indicative of the lagging presence of social studies in technological capacities. Moreover, few states are publishing reports pertaining to these online learning opportunities, greatly restricting knowledge of an educational trend on the rise. As of 2013, six states (Alabama, Arkansas, Florida, North Carolina, Wisconsin, and Virginia) had requirements for students to take at least one online course before graduating from high school, with three more (Massachusetts, New Mexico, and West Virginia) passing recommendations to encourage such alternative learning experiences (Watson, Murin, Vashaw, Gemin, & Rapp, 2013), yet few specifics are known to affect the field of social studies education. In 2017, 24 states report having state virtual schools (EEG, 2017); yet, information regarding the quality or effectiveness of these schools is limited. For example, details about schools such as enrollment figures are often difficult to obtain (Glass & Wellner, 2011).

Further evidence can be found in our own review of research conducted for this chapter. To identify potential articles for meta-analysis, we conducted Boolean searches using journal databases in education and technology. Boolean searches combining "social studies" and "online", "blended", or "hybrid" yield very few results. We lengthened our list of keywords to include "virtual", "digital", and "technology" only to find hardly any articles. Additional efforts were made to search specific journals including all social studies journals and many technology journals. Subsequent searches of journals revealed a limited number of articles. Not until we conducted a fourth iteration of searches which included the manual combing through abstracts of articles did we identify relevant articles. Combined our efforts suggest the limited scope of research in social studies related to online instruction and online K-12 learning.

For nearly two decades social studies researchers/educators (Berson & Balyta, 2004; Brush & Saye, 2009; Heafner, 2002; 2013; Mason, Berson, Diem, Hicks, Lee, & Dralle, 2000; Swan & Hofer, 2008; VanFossen, 2001) have cited the capacity and potential of technology to drive pedagogical shifts, making calls to arouse the "sleeping giant" (Martorella, 1997) of the field. While advancements and innovations in technological tools and resources offer promising change in pedagogical practices, in reality the field of social studies has yet to embrace such student-centered, constructivist shifts advocated by leading organizations and researchers (DeWitt, 2007; Doolittle & Hicks, 2012; NCSS, 2013a; Wilson & Wright, 2010; Zhao, 2007). Previous literature reviews have provided similar conclusions (Culp, Honey, & Mandinach, 2003; Hicks, Lee, Berson, Bolick, & Diem, 2014; Friedman & Hicks, 2006; Lee & Friedman, 2009; Manfra & Hammond, 2008-2009), and the absence of a previous handbook chapter dedicated to social studies are indicators of unrealized value of online and blended learning in this field. Even the most recent research highlighted in this chapter continues to cite challenges and obstacles in pursuit of transforming teaching and learning of social studies and its related disciplines. Overemphasis of access to sources as a cutting-edge application of technology (Friedman, 2006; Hicks, Doolittle, & Lee; 2004; Marri, 2005; Vanfossen, 2001), camouflages the epistemological gaps needed to realize merits of online and blended learning for the discipline. In sum, the online and digital revolution, while pervasive and ubiquitous in personal and social realms (Pew Research Center, 2011), has yet to be realized on the scale desired in social studies.

The purpose of this chapter is to summarize and synthesize findings from research focused on social studies instruction in online and blended learning environments. These forms of cloud-based applications offer a vision of technologically supported learning that goes beyond the descriptions of technology integration previously found in social studies literature. Because of the paucity of studies in the field labeled as such, this review expands discussion to forms of technologies utilized in classroom practice, which enables a continuation of previous analyses and literature reviews focused on technology integration (Culp, Honey, & Mandinach, 2003; Doolittle & Hicks, 2012; Swan & Hofer, 2008; VanFossen, 2001) and serves as a central resource for the most updated work in this domain with the introduction of some elements of cloud-based instruction. Limiting our examination to studies published in peer-reviewed journals in the last three years (2014-present) allows for a synthesis of the most recent and relevant trends in research and apportions more precise suggestions and interpretations for future directions in both research and practice. Thus, following the research synthesis that highlights the nuances of online and blending learning in the context of social studies education, the chapter then offers our insight for implications for the field, aiming to recognize holes and gaps in the literature as well as ideas, practices and opportunities to advance epistemological understanding.

In order clarify the terms we will use in the following sections, we offer definitions of key concepts below. Their meanings will become elucidated as they are operationalized within the context of the research studies discussed in this review.

Definitions

online learning: delivers instruction primarily through the Internet or web-based platforms; synonymous with virtual learning

hybrid learning (in and out of class time): delivers instruction through a combination of the Internet/web-based platforms (outside of classroom) and face-to-face meetings (example: flipped classroom)

blended learning (within classroom time): during face-to-face classroom time, utilizes online (open environment) resources for at least part of instruction (example:

technology mediated learning: takes place in a confined space (fixed environment), either offline or web-based; the outcomes, products, and thinking all occurs within a specified program (example: game-based learning, simulation such as iCivics)

Research Synthesis

Our review of literature required several iterations of searches to locate relevant articles. In the first cycle of iterations, we searched the ERIC database for peer-reviewed publications using combinations of the Boolean search terms "online", "hybrid", "blended", "virtual", and "technology" with "social studies", eliminating those not focused on K-12 learning. Additionally, a review of abstracts indicated great variance in the application of these search terms in learning contexts, with many articles broadly focused on technology integration rather than online and blended learning environments, and many with outdated methods or topics. Thus, our second cycle of iterations took an alternate approach, as we independently searched technology and social studies journals for literature meeting our criteria published in the last three years, and then cross-referenced those collected in the first cycle. Finally, after an initial read of these articles, we refined our list of qualifying literature to exclude those from practitioner journals (*Social Studies and the Young Learner*, *Social Education*) with the intention of focusing on those with more robust research methods. Because of the small corpus of articles garnered from these searches and processes, we ultimately included several descriptive articles from *The Social Studies* if they offered contribution to using digital tools and technology resources in ways that supported the student-centered, inquiry-based shift in social studies instruction we were seeking.

Due to the paucity of literature yet wide variance in pedagogical methods, we decided to organize the review with these learning environments as our themes so that subthemes and patterns could be discussed as they were most applicable to the group. For our selected journal articles that met our apriori criteria (e.g. research in social studies published within the last three year with reference to any of our keywords), we read and re-read each article, highlighting key ideas, coding research methods and outcomes, and looking for emerging patterns related to any of our key words (Creswell, 2011). We coded the data first independently, and later together, comparing and contrasting codes to improve our confidence in our findings. We inductively analyzed these data using a three-level iterative coding strategy: open, focused, and axial (Charmaz, 2006), to identify the ways in which technology was used, evidence of the effectiveness of technology, and the effects on instructional practice, student learning, and social studies curriculum. We sought to unpack discipline specific uses of technology described within each article. During weekly meetings we identified commonalities and differences across articles and created lists of reoccurring concepts. We created a grid to assist in identifying overarching patterns (Miles & Huberman, 1994). Pattern coding was our method for summarizing data segments and grid summaries into themes (Miles et al., 2014). Through this partnered and thematic analysis, we established both dependability and credibility of our literature review findings.

Notably, our review is void of empirical studies of online learning (according to our definition offered in the introduction), as a review of abstracts including "online" and "social studies" only yielded two reports (referenced in the introduction) and otherwise articles referencing the use of online or web-based and Internet resources during instruction (classified as blended learning). Thus, this synthesis proceeds with a section examining hybrid learning in the field of social studies, primarily reported as the flipped classroom model, in which students were responsible for accessing materials outside of class time to learn content prior to face-to-face instruction. Next, we present themes in the literature related to blended learning environments, those in which students worked, learned, and utilized in an open, online space during face-to-face class time. Finally, because nearly half of our articles did not meet the previous criteria yet seemed to be published for the innovative practices and uses of technology in the classroom and in social studies instruction, we include a third section dedicated to technology mediated learning and analyze trends among those articles.

Hybrid Learning in Social Studies

Three articles (Mazur, Brown, & Jacobsen, 2015; Scheuerell & Jaeger, 2015; Snyder, Paska, & Besozzi, 2014) were initially coded and subsequently themed as hybrid learning because they reported on the use of the flipped classroom model in which students were responsible for learning outside of class. Also referred to as an "inverted" course or classroom (Mazur et al., 2015; Snyder et al., 2014), students in these studies were required to access course content on their own time prior to their face-to-face meeting. In two out of three classrooms (Mazur et al., 2015; Snyder et al., 2014), teachers used self-created screencasts, or video-based lectures, to deliver course material, and in the third (Scheuerell & Jaeger, 2015), teachers used Edmodo to post online materials to be read prior to class meeting. All three settings included social studies classrooms at the ninth grade level and above in which students had readily available access to necessary technology. See Figure 1 for a descriptive summary of these articles.

Author(s)/Year	Participants/Setting	Purpose & Methods
Mazur, Brown, & Jacobsen (2015)	5 secondary (9th grade) social studies classrooms	The purpose of this **action research study** was to systematically reflect on how the flipped classroom model can support teaching, learning, and assessment through inquiry-designed projects. Data includes one teacher researcher's reflections synthesized using Friesen's (2009) Teaching Effectiveness Framework.
Snyder, Paska, & Besozzi (2014)	9th grade Global History and Geography courses	The purpose of this **action research study** was to examine the effectiveness of using a flipped classroom approach to simultaneously deliver content knowledge in preparation of state exams while teaching critical thinking and citizenship skills through inquiry- and student-centered learning activities. Over three years the teacher collected student responses to a 17-item Likert scale survey to assess their perceptions and preferences for this pedagogical approach.
Scheuerell & Jaeger (2015)	secondary (Juniors) American History class	The purpose of this **descriptive** article was to discuss how web-based resources were used to deepen learning about the African American experience in American history. The authors share the unique affordances a 1:1 laptop initiative had towards developing students' historical and critical thinking skills.

Figure 1. Social Studies Hybrid Learning Research.

Hybrid Learning for Student Engagement with Social Studies Content

In utilizing a hybrid learning model, participating teachers from these articles sought to frame social studies instruction through an inquiry-based, student-centered approach, inviting their students to take an active role in their learning. Designed as curricular units focused on broad themes, such as immigration (Mazur et al., 2015) or ancient civilizations (Snyder et al., 2014), or alternatively posed as questions such as *Should the federal government or the people themselves be given credit for the successes of the Civil Rights movement?* (Scheuerell & Jaeger, 2015) or *How effectively does the Canadian Charter protect individual rights?* (Mazur et al., 2015), content material was presented through both direct instruction via lectures or readings accessible [online] outside of class and indirect instruction through collaborative, inquiry-based activities during class such as an archaeology simulation (Snyder et al., 2014). The use of screencasts were particularly useful in shifting control of the learning to the student, allowing the individual to view and listen to presentations [that integrated texts, images, and sound] at their own pace, pausing to take notes with accompanying handouts prepared by teachers (Snyder et al., 2014).

Furthermore, with content presented to students prior to class, teachers aimed to devote class time to activities in which students had "deeper engagement with content" (Mazur et al, 2015), were "thinking more deeply" (Scheuerell & Jaeger, 2015), or offered "in depth examination of the topic" (Snyder et al., 2014, p. 312). Promoting critical thinking skills rather than a dissemination of information (Mazur et al., 2015), students often analyzed primary sources (Scheuerell & Jaeger, 2015) and tasks encouraged collaboration and interaction with peers to aid the construction of knowledge (Mazur et al., 2015). For example, following an assigned screencast or readings for homework, in class students experienced an archaeology simulation to examine artifacts of the time period (Snyder et al., 2014), researched and composed a Weebly website on a pivotal event of the Civil Rights movement (Scheuerell & Jaeger, 2015), or created an augmented reality aura on the topic of immigration (Mazur et al., 2015). Another aim of the inquiry-based unit described by Scheuerell and Jaeger (2015) was to have students examine history through multiple perspectives, giving concerted consideration/attention to that of marginalized groups. Primary and secondary sources accessible via Internet enabled a critical examination of a more diverse set of events and individuals involved in the Civil Rights movement, encouraging students to learn more deeply about the African American experience, a perspective often omitted from traditional instructional sources such as textbooks.

In the hybrid model, the role of the teacher shifted as well, intent on serving more as a guide to support student learning during the interactive class activities (Mazur et al., 2015; Snyder et al., 2014). Having already presented and introduced content information through the online assignments, the teacher was free to facilitate more complex tasks that were cognitively and organizationally demanding (Snyder et al., 2014). Crucial to supporting deeper learning, the teacher circulated to ask critical questions to probe student understanding and stimulate conversations (Mazur et al., 2015). The teacher's constant use of assessment in various formats (entrance and exit tickets, written responses, performance tasks) and for various purposes (assessment for-learning and assessment of-learning) enabled constant feedback and increased personalization of learning (Mazur et al., 2015). For teachers caught in the midst of pressures to use direct instruction in preparation of/to deliver content for standardized tests and encouragement to use indirect instruction to foster inquiry-based learning/critical thinking skills of new social studies frameworks, the use of screencasts in this flipped classroom approach could help them achieve such a balance (Snyder et al., 2014).

Challenges & Limitations

These articles provide fodder for the innovative uses of technology and online learning for social studies instruction. While they embody the constructivist principles tethered to aforementioned social studies and technology research (Berson & Balyta, 2004; Brush & Saye, 2009; Doolittle & Hicks, 2012; Heafner, 2013), they only begin to scratch the surface of the potential of hybrid learning environments. Beyond the paucity of studies in this domain, the brevity of these articles (Scheuerell et al., 2015; Snyder et al., 2014) leaves many questions and details to be explored and discussed. The variance in research design and particularly data collection further limits advancements in the field due to lack of empirical studies and methodological rigor.

These studies do offer surveys, reflections, and descriptive data explicative of technological applications in social studies (see Figure 1). For example, reporting findings from three years of student surveys, Snyder and colleagues (2014) offer insight into the perspectives and experiences of learners in this type of environment; interestingly, while an overwhelming majority (95%) recognized the support screencasts provided in their learning, only slightly more than half (58%) actually preferred these pedagogical activities of watching screencasts for homework and activity-based learning in class (p. 313). We suggest that additional studies into the preferences and resistance of students in these types of learning environments are needed to more effective gauge mediated outcomes of hybrid learning in social studies.

As part of an action research design team, Mazur and colleagues (2015) analyze the reflections of one educator out of the group, sharing the numerous affordances (scaffolding, assessment, collaboration, and critical thinking) from one teacher's perspective, yet notes many areas for improvement amidst the complexities in the design and implementation of such approaches. Finally, though void of empirical data, Scheuerell and Jaeger (2015) offer recommendations for teachers utilizing this student-centered approach to teaching history, particularly mindful uses and furthering their purpose to promote historical thinking critical of the inclusion and/or exclusion of marginalized groups. These suggestions mirror pedagogical dialogue in the field in general (Chikkatur, 2013; Epstein, 2009; Heafner & Fitchett, 2017; Ladson-Billings, 2003; Merryfield, Lo, Po, & Kasai, 2007) and support the democratization of knowledge technology affords (NCSS, 2013b).

Blended Learning

Three articles (Beeson, Journell, & Ayers, 2014; Curry & Cherner, 2016; O'Brien, Lawrence, & Green, 2014) were coded and themed as blended learning because they described the utilization of online resources during face-to-face instruction and students were not required to view or study content material prior to class meeting. Two articles (Beeson et al., 2014; Curry & Cherner, 2016) were designed as multiple case studies to respectively analyze the pedagogical decisions of two different social studies teachers, both at the secondary level, who utilized a variety of online resources throughout their units of study in civics and American history courses. The third article, a shorter, non-empirical study (O'Brien et al., 2014) describes how synchronous online discussions during class time and the Ning.com platform supported the learning of approximately 300 middle school students in four schools across two states as they delved into a unit on the justification of war. See Figure 2 for a descriptive summary of these articles.

Author(s)/Year	Participants/Setting	Purpose & Methods
Beeson, Journell, & Ayers (2014)	2 secondary teachers (Civics)	The purpose of this **multiple case study** was "to compare the classroom instruction of two high school civics teachers in an attempt to illustrate the importance of technological pedagogical content knowledge (TPCK) in transforming social studies instruction via digital technologies" (p. 117). Data collection included more than 30 observations, 2 interviews, and artifacts from each lesson.
Curry & Cherner (2016)	2 secondary teachers (9th Civics, 11th American History)	The purpose of this **case study** research project was "to highlight the practices and philosophies of effective—but different—social studies teachers who balance the demands of teaching in the modern era while honoring their own philosophies of teaching social studies" (p. 123). Data collection included interviews with teachers and 3 90 minute observations of instruction.
O'Brien, Lawrence, & Green (2014)	four middle schools/300 students	The purpose of this **descriptive** study was to present the use of synchronous, online discussions amidst a social studies unit investigating why nations go to war. The authors describe other instructional materials and student thinking associated with this unit of inquiry.

Figure 2. Blended Learning Research.

Blended Learning to Increase Choice, Creativity and Communication in Social Studies

The diversity of the blended learning format is demonstrated even within this small body of literature. In fact, the studies of Beeson and colleagues (2016) and Curry and Cherner (2016) have similar research designs and purposes as each compares two teachers' integration of technology and their varying degrees of effectiveness in offering transformative social studies learning opportunities. Similar to those reviewed in the hybrid learning environments, most participating teachers in these studies report a desire to use digital technologies during class time to aid inquiry, problem-based learning with activities that promote depth of knowledge and critical thinking skills over memorization of facts. Tasks or projects included online research with the examination of primary and secondary sources (Curry & Cherner, 2016) and the creation of authentic products, such as political advertisements, requiring the application of learned course content (Beeson et al., 2014). Any number of online websites or resources could be used as tools for exploration of social studies concepts, either independently or collaboratively, and potentially help deepen student understandings with associated and aligned assignments prompting critical and higher level thinking (Beeson et al., 2014). Notably, with so many resources available online, a plethora of options for integrating them with instruction, and sufficient devices available for students in these one-to-one environments, teachers had to make important pedagogical evaluations of those that would enhance teaching and learning; set in a theoretical framework of technological pedagogical content knowledge (TPACK) (Mishra & Koehler, 2006), researchers emphasize the role of professional development and training in supporting the decisions that can offer dynamic, authentic social studies instruction (Beeson et al., 2014; Curry & Cherner, 2016).

A key feature of blended learning environments included the opportunity for collaboration afforded by online capabilities, but again, teachers' pedagogical decisions determined the instructional effect and impact on learning. With the comparisons and analyses of teachers' instruction offered by these articles, noticeable differences in the uses of Web 2.0 tools such as Google Drive yielded varying results in the levels of thinking required by students. For instance, while one teacher encouraged students to use Google Drive to maximize contribution of all members on a final group project (Curry & Cherner, 2016), another simply used Drive to share teacher-created digital documents with students, keeping learning at a knowledge-level (Beeson et al., 2014). Similarly, an online, silent seminar via Google Docs (Curry & Cherner, 2016) and TodaysMeet (Beeson et al., 2014) permitted all students in the classroom to participate in a discussion with more think time than a traditional setting, yet the conversation had to be scaffolded by the teacher in order to truly promote deeper thinking. Research projects offered another opportunity for collaboration, even beyond those in the classroom: while exploring civic issues and policies, students could locate and consult with others knowledgeable about their topic, including local policymakers (Curry & Cherner, 2016). Finally, though only listed in a chart of perceived uses of technological resources (Curry & Cherner, 2016), Twitter was also mentioned as online tool with potential for connecting students to people and ideas beyond their own classroom.

O'Brien and colleagues (2014) describe the use of the Ning.com platform to foster collaboration among students and classes across the country; features such as discussion boards, groups, blogs, and personal profiles supported in-class activities including debates, role-play, and simulations which compelled students to apply learned content knowledge about history and policy to make decisions when placed in the role of national leaders. Intentional pedagogical decisions by teachers proved vital for facilitating debates at a high-level of thinking, as lessons prior to synchronous online discussions prepped students instructionally for the debates and guided them on how to productively challenge and question comments of others (O'Brien et al., 2014). Though lacking empirical data, these middle school teachers reported "a sophistication of thinking, a respect for each other, and excitement about their online adventure" (O'Brien et al., 2014, p. 106).

The blended learning environment of combined online capabilities and face-to-face teacher support fostered differentiation of instruction in a number of ways. While students worked independently or collaboratively on tasks or assignments at their own pace, teachers could offer the scaffolds or real-time feedback that individuals or groups needed to deepen their learning; one-on-one discussions provided instant feedback and assessment and monitoring of student progress, as well as encouraged accountability and citizenship in contributing to the classroom learning environment (Curry & Cherner, 2016). Often technological and online resources themselves were used for scaffolding the learning of important concepts, as the interactive nature of websites and resources such as maps of the Electoral College aided a subsequent task exploring candidates' possible paths to presidency (Beeson et al., 2014). Many assignments and projects were driven by student choice in their selection of topic, and the open environment of online resources allowed for increased relevance and meaning in learning social studies disciplines of history and civics. For example, engaging in Project Citizen, students selected a civic issue important to them, researched the policy, and proposed solutions in a presentation (Curry & Cherner, 2016); in another civics class, an online quiz helped students develop their personal political beliefs in understanding philosophical tenets while avoiding traditional binary "left" or "right" distinctions (Beeson et al., 2014). Furthermore, having options of products to create (e.g. graphic organizers, video vocabulary, photo story, and mosaics) allowed students to demonstrate content knowledge in a variety of ways while supporting their development of digital literacy (Curry & Cherner, 2016). Once again, researchers urge caution and deliberation in pedagogical decisions to use technological resources, as there is the potential for replication and replacement of traditional seatwork and worksheets (Curry & Cherner, 2016) or a "mismatch of technology and content" (Beeson et al., 2014, p. 122) that will be discussed later in the chapter.

Interestingly, one teacher observed by Curry and Cherner (2016) designed a paperless unit assigned entirely online through the Schoology platform, with narrated PowerPoints, digital packets of assignment descriptions and products, and accessible links to all resources and materials, similar to the flipped classroom model. However, because of previous difficulties experienced with that hybrid format, citing complications of student completion of work outside of class time and home access issues, the teacher instead preferred a blended learning model in which students used school-provided laptops to work independently during class meeting time. While students utilized online guides and learning resources, the teacher provided real-time feedback on submitted assignments or answered student questions. Also citing previous challenges of keeping the class at the same place, the teacher chose to adapt the format of instruction to maintain elements of student choice and personalization of assessments, offering multiple options for informal and formal assessment, yet also monitoring the "release" a test or quiz to a student when the teacher felt he/she had mastered the material. Notably, this teacher "raised the most concerns…" of the value of such a format, reflecting that "sometimes kids like to have a piece of paper they can manipulate" (p. 130), and researchers observed a lack of social interaction in the classroom. This case provides valuable insight into the pedagogical and contextual complexities facing teachers as well as the diversity and overlapping nature of these formats.

Challenges & Limitations

The impact of a hybrid or blended approach on students' learning of social studies is still unclear and inconclusive evidence exists to support beneficial claims. The challenges associated with such pedagogy described in existing research questions inhibits the likelihood of its proliferation. Most of these studies take place in schools with a one-to-one technology initiative, yet funding for particular platforms (e.g. Edmodo, Schoology) or tools/programs (e.g. ScreenFlow, PowerPoint) necessary for this format of learning might require additional financial support of grants or otherwise further limit school and teacher participation. Some teachers voiced struggles with technology functioning consistently and properly or consuming valuable minutes of class time and content instruction waiting for devices to start up, log in, or access school wifi (Curry & Cherner, 2016). Ironically, these barriers fall within recognized first-order barriers to meaningful technology integration (Ertmer & Ottenbreit-Leftwich, 2013) and continue to plague the field (DeWitt, 2007; Heafner, 2013; Whitworth & Berson, 2002).

In some settings, a lack of home access to technological devices or Internet served as a deterrent for flipped classroom or compelled teachers to plan accordingly to mitigate such barriers to instruction (Curry & Cherner, 2016; Mazur et al., 2015). From NAEP studies, student background variables explain as much as a third of the variance among student scores (Fitchett, Heafner & Lambert, 2017a; Heafner & Fitchett, 2015). Adjusting from a flipped classroom to an in-class blended learning environment may temporarily address access barriers, but it does not assure content knowledge gains that out of class access to cloud-based learning does (Delen & Bulut, 2011). These results bring to light the importance of recognizing out of class computer access of students when making instructional decisions as well as the need for consideration of how to address this socio-economic, technological opportunity gap not only within schools, but also in the communities schools serve.

Beyond challenges associated with the technology itself, teachers also stress that considerable amounts of time are required for planning the curriculum (Snyder et al., 2014), and authors recommend having professional learning communities to collaborate/share the work with colleagues (Mazur et al., 2015). Despite populations of digital natives in the classroom, resources and platforms are continually changing, proving difficult for teachers and students alike to maintain familiarity and stay abreast of technological changes as well as the ability to utilize these effectively (Curry & Cherner, 2016). Findings from these studies suggest that many teachers lack the training or familiarity with online and technological resources–and the way to use them–that can potentially transform social studies instruction into dynamic, critical learning opportunities (Beeson et al., 2014; Scheuerell & Jaeger, 2015). Additionally, pressures of state testing requirements compel teachers to adapt instruction to align assessments and activities to support students' academic success and performances (Snyder et al., 2014; Fitchett, Heafner & VanFossen, 2014).

Technology-Mediated Learning

While there is limited literature on social studies instruction utilizing online, hybrid, and blended learning formats/models, a greater number of published studies in the last three years focused more broadly on the technology integration or digital resources being used in the field. Though we eliminated practitioner-based articles focusing on a particular element of technology to avoid descriptive how-to's in preference of data-based research, this group of articles indicates and supports a paradigm shift in the pedagogy and standards of social studies and the ways in which technological tools can advance these endeavors. Though these techniques or practices lack the open environments of online spaces to be characterized as blended learning, their use has potential for interaction, collaboration, and subsequent extended learning opportunities which may lead and eventually cross into the blended terrain. Researchers describe the aims of social studies instruction to extend students' learning beyond that of memorization of content, fostering critical thinking and analysis of complex issues and problems (Beeson et al, 2014; Chee et al., 2015; Chikkatur, 2013; Curry & Cherner, 2016; Epstein, 2009; Green et al., 2015; King et al., 2014; NCSS, 2016). With a student-centered approach, learning is posed through inquiry, inviting students to research, investigate, analyze, and create/communicate new knowledge through digital products and platforms (NCSS, 2013a). In various ways, intentional technology-mediated learning allows for such exploration and creation, often providing an authentic context for learning that is intellectually stimulating and deeply engaging. It moves learning beyond the "signature pedagogy" of social studies classrooms that centers learning on teacher directed-instruction (Beck & Eno, 2012) and embraces the new educational paradigm (Miller & Ribble, 2010) needed to transform social studies through technology.

The nature of this set of articles invites more diversity of contexts for research settings, from conference projects to after school and summer enrichment programs, as educators experiment with the use of various digital media products. Though still few in number, articles notably demonstrate the infiltration of technology across all ages and grade bands, including elementary classrooms. Just over half were empirical, with the other articles providing narratives and descriptions of technology use in the classroom or how to implement certain technological tools and resources without data collection or specific research questions. These articles are grouped into three categories and identified with the following subthemes: digital games, digital geographic tools, and digital media products. See Figure 3 for a descriptive summary of these articles.

Author(s)/Year	Participants/Setting	Purpose & Methods
Digital Games		
Chee, Mehrotra, & Ong (2015)	Nine government secondary school teachers (15 year olds in Singapore)	The purpose of this **collective case study** is to examine dilemmas facing teachers implementing game-based learning in the social studies classroom. Post-lesson dialogues and interviews with teachers shed light on the practical and greater contextual impediments experienced while using the *Stagecraft X* curriculum.
Jong & Shang (2015)	40 students (Grade 11 Geography class)	The purpose of this **qualitative case study** was to probe for phenomena that emerged while students used Farmtasia in a Virtual Interactive Student-Oriented Learning Environment (VISOLE). Researchers observed student behaviors that impeded learning and the teacher's facilitating role in mitigating these phenomena.
Blevins, LeCompte, & Wells (2014)	250 students/10 classrooms (grades 4, 5, 6, 8, 12)	The purpose of this **mixed methods study** was to explore the impact of the educational video game *iCivics* on students' civic learning and engagement. Data includes pre/post tests of students' civic knowledge in addition to student journals, teacher surveys, and teacher interviews throughout the duration of the program's use.
Maguth, List, & Wunderle (2015)	7th grade world history class	The purpose of this **descriptive article** was to consider how the use of the video game *Age of Empires II* could be used to engage students in historical inquiry. The authors describe the integration of the game into the curriculum, including challenges and affordances associated with the video game's use.
McBride (2014)		The purpose of this descriptive article was to provide best practices in general computer/video game use in the classroom. The author focuses on assessment processes prior, during, and after gameplay to support teaching and learning.

Author(s)/Year	Participants/Setting	Purpose & Methods
Digital Geographic Tools		
Radinsky, Hospelhorn, Melendez, Riel, & Washington (2014)	6 classrooms of 7th & 8th grades; 1 undergraduate class	The purpose of this **design-research study** was to reflect on the first iteration of an inquiry unit intended to teach information literacy and historical thinking through the use of online, public-use geographic information systems (GIS) data maps. Authors analyze students' presentations in meeting the three learning objectives designed for the curriculum.
Hammond, Bozdin, & Stanlick (2014)	third grade social studies class	The purpose of this **descriptive article** was to present a technology-enhanced approach to teaching concepts of latitude and longitude, a scaffolded geocache using Global Positions Systems (GPS). The authors explain how to utilize the technology and provide recommendations for integrating such learning into a variety of disciplines and themes.

Digital Games, Video Games and Gaming in Social Studies

With youth across the world increasingly engaged in digital games of various forms (computers, consoles, and etc.), educators are seeking to translate such interest to the learning of curricular concepts. In Hong Kong, students in a secondary geography course used *Farmtasia* to assume the life of a farmer managing three interactive farming systems, combining knowledge of geography and economics to experience the consequences/outcomes of their decisions (Jong & Shang, 2015). In Singapore, the principles of governance came alive for secondary students playing the role of a town governor in a virtual medieval world in *Stagecraft X*, having to attend to the basic needs of its citizens, including water, food, housing, and health care (Chee, Mehrotra, & Ong, 2015). In the United States, students across elementary, middle, and high school used the various games/modules in the web-based program *iCivics* for simulations of processes and concepts of the discipline, such as running for president or becoming a citizen (Blevins, LeCompte, & Wells, 2014). Presented as missions or problems for students to solve, these video games invite learners to experience the complexities of social studies concepts using 21st century skills, taking an active role in making strategic decisions with valuable learning opportunities stemming from their consequences (Blevins et al., 2014; Maguth, List, & Wunderle, 2015; McBride, 2014). These empirical and descriptive studies contribute particular insights into the underexplored field and genre of social studies video games.

While McBride (2014) offers valuable descriptions and recommendations of utilizing video games in the social studies classroom, including the intentional and strategic alignment to standards, considerations for management, and assessment strategies, an important focal point and debate arises: is the purpose of these games for entertainment increasing engagement in social studies or learning specific curricular concepts and ideas? Prior research in the field has linked the affective and motivational benefits of technology to student content knowledge gains in social studies (Friedman & Heafner, 2007; Heafner, 2004; Heafner & Friedman, 2008). The body of literature associated with technology mediate learning argues that both are attainable. In fact, Blevins and colleagues (2014) used a variety of data collection techniques to report the impact of the *iCivics* program on student engagement and learning, finding statistically significant increases in students' knowledge of civics, along with notable improvements in students' attitudes and dispositions towards the subject.

Although void of empirical data, Maguth and colleagues' (2015) descriptive study details the dual benefits of seventh grade students playing *Age of Empires II*, stating the affordances of the game: "Outside of enjoying the opportunity to 'game' in

Author(s)/Year	Participants/Setting	Purpose & Methods
Digital Media Products		
King, Gardner-McCune, Vargas, & Jimenez (2014)	30 rising seniors during summer academic enrichment program	The purpose of this **case study** was to describe and analyze the Workshop for Actively Thinking Computationally and Historically (WATCH) program and its culminating project of students' development of a **mobile app** to promote historical learning of the African American experience. Data included video and audio recordings of class sessions, field notes, student survey, and student artifacts over the duration of the inquiry unit.
Maloy (2016)		The purpose of this **descriptive article** was to present "an approach for teachers and students can use to develop web research and digital literacy skills by building Dramatic Event, Historical Biography, and Influential Literature pages in a teacher- or class-made **wiki**."
Green, Walters, Walters, & Wang (2015)	Secondary students participating in conference (27 out of 100 projects submitted, including 1,000 word essay, documentary, and visual)	The purpose of this **mixed-methods study** was to examine the relationship between print-based research (1,000 word essay) and digital media (**digital documentary**) in engaging students in inquiry of a global sustainability issue. Projects were assessed using Moon's (1999) five-stage map of learning and students completed a post-conference survey to share their perceptions of the learning experience.
Schul (2014)		The purpose of this **descriptive** article was to provide teachers knowledge of the benefits, skills, and examples of integrating desktop **documentary** making into their classroom history instruction.
Montgomery (2014)	third grade class	The purpose of this **collaborative interpretive qualitative** study was to explore how digital media creation (**podcasts**) and dissemination could "support education for critical democracy, especially among historically marginalized youth". Data includes field notes, documents, student and teacher interviews, photographs, podcasts, and listener comments.

Figure 3. Technology Mediated Learning Research in Social Studies.

class, students felt as if the video game provided them with a concrete venue in which to think about, tinker with, apply, and evaluate content discussed in class. We felt as if this game served as a virtual playground whereby students could look for and experiment with topics, issues, and philosophies discussed in social studies class" (p. 35). Taking a more nuanced approach to the effectiveness of video games on student learning, Jong and Shang (2015) analyze student performances while interacting with the technology: by outlining and exploring the gaming styles of students, teachers can intervene and scaffold instruction to mitigate problems and frustrations and maximize learning opportunities. Thus, another important theme and finding emerges: the instrumental role of the teacher while utilizing video games in the classroom.

Similar to other pedagogical tools, the teacher is instrumental in facilitating desirable outcomes (Doolittle & Hicks, 2012; Heafner, 2016), and games are most effective when integrated in a broader context for learning (Chee et al., 2015). Requiring students to journal or blog about their gaming experiences not only serves as an assessment and accountability tool, but prompting questions can also probe for deeper learning of particular concepts and ideas, such as perspective taking, cultural differences, and personal connections (Maguth et al., 2015). Blogs, discussion forums, or wikis are helpful digital tools to foster interaction among participating players (Maguth et al., 2015; McBride, 2014), and curricular guides accompanying games can help teachers springboard students' experiences to classroom discussion (Blevins et al., 2015). When framed and consistently assessed as a valuable learning tool, students and their parents increasingly recognize the benefits and are receptive to this innovative and alternative style of learning. Furthermore, the culture of schooling has to adapt and support gaming so that pedagogical aims are aligned to the pressures of standardized testing (Chee et al., 2015). Common challenges accompany the use of video games, namely the paucity of resources for teachers on the topic (Maguth et al., 2015) and the time for teachers to explore/familiarize themselves with the resource (Blevins et al., 2015; Chee et al., 2015).

Digital Geographic Tools

Geography is a natural context for integrating online and blended learning. While research is limited in these areas, there are discipline-specific, technology mediated applications that have embraced this synergetic relationship (Heafner, 2009) and leveraged social studies commitment to constructivist and inquiry-oriented learning (NCSS, 2013a). From website widgets (McGiboney & Roberts, 2015) to global positioning systems (Hammond, Bozdin, & Stanlick, 2014) to census data webmaps (Radinsky, Hospelhorn, Melendez, Riel, Washington, 2014), technology is bringing to life geographic concepts previously static and irrelevant to students' lives. Notable to this group of studies is its extension to use with younger students, with online and digital projects implemented with middle school all the way down to kindergarten. Seminal within these works is the effect of pedagogical approaches, such as dialectical and interdisciplinary instruction, in producing statistically significant content knowledge gains for elementary students (Fitchett, Heafner, & Lambert, 2017b). Refer back to Figure 3 for a descriptive summary of these articles.

At a very basic level, digital tools serve as highly engaging resources to meet learning goals of grade-level geography standards (Hammond et al., 2014; McGiboney & Roberts, 2015). Their interactive nature encourages inquiry and exploration, and such manipulative visualization tools uniquely enhance understanding of curricular concepts (Hammond et al., 2014; McGiboney & Roberts, 2015; Radinsky et al., 2014). Kindergartners developed meaning of maps and locations through the widgets that tracked the location and frequency of hits and visitors to their class websites; expanded collaboration and networking through family and friends allowed them to communicate with people from all seven continents of the world (McGiboney & Roberts, 2015). In third grade, scaffolded geocaching activities enabled young students to interact with concepts of latitude and longitude, using GPS devices to actively explore the meaning behind numbers and directions (Hammond et al., 2014). As suggested by these authors (Hammond et al., 2014), such geospatial skills and reasoning can serve as a platform for further connections and inquiries into a variety of disciplines and thematic units, including historical navigation, urbanization, and immigration.

Radinsky and colleagues' (2014) design-based research study did just that–their iterative cycles of instructional planning, implementation, and revisions created and refined a historical and social inquiry project into the population changes of students' local neighborhoods. Integrating pedagogical resources of classroom discussions and interviews with community members with personalized census data webmaps, students created presentations to showcase their many layers of critical thinking and analysis, from making observations and interpretations to drawing inferences and identifying limitations in the data. This approach promoted student-led historical inquiry, incorporated multiple sources and forms of data, the critical consumption of information, and authentic communication of findings. These learning experiences embody the goals envisioned by NCSS (2013b), the partnership for 21st Century learning (2012), and aims of geographic education in social studies (NCSS, 2013a).

Digital Media Products

Just as the popularity and proliferation of video games prompts application to educational contexts, many other forms of digital media provide avenues for students themselves to "do" history and present authentic products of their newly created knowledge (Lee & Friedman, 2009; Levstik & Barton, 2011). Used as part of a broader inquiry or investigation into global issues, curricular themes, or historical time periods and figures, digital products often encapsulate weeks or months of student learning, serving as a platform to showcase the depth of knowledge and higher level thinking that culminates from reading, analyzing, and synthesizing multiple sources and data. From wikis to mobile apps to documentaries to podcasts, this set of articles anecdotally and empirically investigate the impact of various digital tools on social studies learning. Studies report students from elementary to secondary levels experiencing added enthusiasm and motivation when presented these authentic learning opportunities in addition to becoming more deeply engaged in the content material as they feeling increased ownership in the topic and their product (Green et al., 2015; Montgomery, 2014). Refer back to Figure 3 for a descriptive summary of these articles.

Rather than passively receiving historical information, students charged with the creation of these digital products assume the role of historians themselves, actively developing and constructing their own ideas, beliefs, and depictions of events or topics. Creating a wiki, mobile app, documentary, or podcast requires students to search for information, analyze and synthesize sources, and corroborate findings to share with others in a new capacity. Such critical and conceptual learning is cognitively demanding for students and sometimes an overwhelming shift in the ways of thinking previously asked of students; thus, it requires considerable time and intentional guidance on the part of the teacher (King et al., 2014). This research suggests, however, that students doing such historical thinking demonstrate markedly higher levels and positive impact of these learning experiences.

In ranking and comparing the levels of thinking evident in students' traditional research papers with those in their digital documentaries, Green and colleagues (2015) found that the technology enhanced learning opportunity produced better results in developing "a reflective artifact" (p. 40) with empathy, transnational connections, and critical interpretation of global issues; furthermore, students themselves noted a greater impact of creating documentaries in post-conference surveys, stating that the project increased their understanding of the issue and compelled them to communicate their ideas more effectively through multimedia production (e.g. in choosing images, words, and sound). Post tests used by King and colleagues (2014) following the delivery of the WATCH (Workshop for Actively Thinking Computationally and Historically) program and secondary students' creation of a mobile app to portray the African American historical narrative, revealed statistically significant increases in students' engagement in history and shifts in students' beliefs of history away from a "dualistic, copier perspective of history as 'facts'" and more towards subjectivist or criterialist stances (p. 185). Finally, interviews with third graders who created and shared podcasts to communicate learning of historical topics such as child labor and Native American boarding schools provided evidence of increased civic engagement and beliefs that could "transform society through education" (Montgomery, 2014, p. 212), encapsulating the aims of democratic citizenship (NCSS, 2013a) and the democratization of content (NCSS, 2013b).

In a similar pattern to other research in this field, authors note challenges in juggling the demands of both technological and historical learning. Students must become adept with skills associating in the creation of their digital platform (e.g. "technical skills and intellectual dispositions of digital literacy," Maloy, 2014) while simultaneously engaging new ways of thinking about history (e.g. King et al., 2014; Schul, 2014). Undoubtedly such endeavors require considerable time that may not be afforded in social studies classrooms. Beyond the creation of digital media products, in order to maximize the affordances of these digital platforms, students should have time/avenue to continually engage with their audience and those with whom they are shared. As Montgomery's (2014) study demonstrates, the interaction through online commentary following the posting of their podcasts was what proved truly transformational for students, as they saw the impact and capabilities of their work reaching a broader audience. The podcasts encapsulated taking informed action, the fourth dimension of the College, Career and Civic Life Framework (NCSS, 2013a). "Students began to understand that democracy is not a static entity but rather an opportunity and responsibility to work together to speak out against justice and create the world" (Montgomery, 2014, p. 213). In accordance with the goals of social studies education, individuals began to understand how their thinking and knowledge could collaboratively contribute to positively resolve or at the least improve issues in society and their world.

Implications for Policy and Practice

Most glaringly this synthesis of research reveals the lagging traction of online, hybrid, and blended learning in the field of social studies, particularly in classrooms and in grades below the secondary level. Requiring exhaustive preparation, funding, and support, the few teachers utilizing such models recognize the unique contexts required for its implementation (Curry & Cherner, 2016). Despite calls for epistemological and pedagogical shifts in approaches to social studies learning (Beck & Eno, 2012; Hicks et al., 2014; Miller & Ribble, 2010; NCSS, 2016), teachers are frequently find themselves constrained by standardized curriculum and testing requirements and pressures (Fitchett, Heafner & Lambert, 2017a; Heafner & Fitchett, 2015). Without clear alignment of assessments with standards and practices purported for effective online, blended and technology mediated learning, social studies education will continue to remain thwarted in its efforts to provide students with the hands-on, inquiry-driven learning experiences that this research has shown yields higher levels of engagement and critical thinking. Because of the interdisciplinary literacies inherent in these pedagogies, standards of literacy, technology, and social studies need to be consistent for teachers to clearly understand the purpose and direction of their instruction.

Furthermore, educators in the field, as well as those preparing to enter it (e.g. preservice/teacher preparation programs), currently lack the training and professional development of TPACK needed to effectively evaluate technological, digital, and cloud-based resources to use them in ways that enhance, not replicate, traditional and signature pedagogies (Beck & Eno, 2012; Beeson et al., 2014; Curry & Cherner, 2016). As a result, technological devices that are becoming increasingly present in classrooms, from laptops (Beeson et al., 2014; Curry & Cherner, 2016) to tablets and apps (Waters, Kenna, & Bruce, 2016) to interactive white boards (Sheffield, 2015), are not often used in ways to support, much less transform, social studies learning. This point is well substantiated by the only nationally-representative studies of the association between technology and student learning in social studies (Fitchett, Heafner & Lambert, 2017a; Heafner & Fitchett, 2015) which document that technology mediated instruction and online learning are inversely associated with content knowledge of across grade bands at statistically significant levels even when controlling for student demographics and classroom contexts.

The few studies reviewed support previous calls that technology can be "the bridge that makes inquiry a realistic pedagogical approach" (Beck & Eno, 2012, p. 89). The time "bought back" by at-home learning of the flipped classroom model allows for student-centered, inquiry-based activities to more deeply engage students in higher level thinking under the guidance of the teacher during face-to-face class meetings (Mazur et al., 2015; Snyder et al., 2014). When strategically embedded in broader inquiry and social contexts, scaffolded by questioning and personalization, online resources, video games, and digital media products offer students rich and meaningful opportunities to study the world around them, to examine past and present issues, and to actively construct knowledge that can be authentically shared with peers, local community members, and global neighbors. However, this research reviewed for this chapter suggests that many learning opportunities stop short of realizing their full potential for engagement in civic action, as few reveal the impact of learning in its final stage, being shared or communicated with others by taking informed action.

This culminating step embodies the aims of inquiry as articulated in the College, Career and Civic Life Framework (NCSS, 2013a). As Montgomery's (2014) work with third graders creating podcasts demonstrates, powerful and transformative learning takes place in the interaction resulting from knowledge creation. While creating wikis and websites, presentations, auras, digital films and documentaries, and mobile apps invite students through deep processes of learning, students need multiple opportunities to authentically use, share and take action with these knowledge creation products in order to fully understand their role in democracy.

Implications for Research

The paucity of research, particularly empirical studies, in the social studies begs for further insight in order to advance the desired pedagogical shifts and use of technological resources to authentically transform learning and learning contexts. Research is needed to critically examine the secondary social studies courses currently being offered in online environments and merge findings with those of hybrid and blended learning formats. Furthermore, inconsistencies in the definitions, characteristics, and terms used to describe these alternative learning environments hinders cohesion across disciplinary fields which comprise the social studies. Perhaps most pressing, however, is the gap in empirical research across all forms of learning, as nearly half of recently published articles include anecdotal or descriptive uses of technology. Robust, data-based studies with intentional design to examine and measure the learning outcomes from various angles and perspectives are needed. Driving this work should be publications seeking to proliferate knowledge of these practices. Notably, most descriptive studies were published in *The Social Studies*; empirical studies in *Journal of Social Studies Research*; and only one was located in *Theory and Research in Social Education.* Of even greater concern is the need to show empirical evidence of the relationship between technology and student learning outcomes in social studies.

In sum, social studies, while making strides to embrace online, blended and hybrid teaching and learning in K-12 schools, as a field it is lagging behind. The glaring absence of articles related to online learning in K-12 education is sufficient evidence that there is much work to be done. We view this as an optimal prospect for significant change in the coming years and one in which social studies can leverage its curricular niche of civic and global understanding with the growing demands for online learning and social media engagement.

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A Synthesis of the Empirical Research on Blended Learning in K-12 Science Education, 2000-2014

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Abstract

Blended learning is a popular term for a mixture of online and face-to-face instruction that involves student-centered learning and a combination of teaching methods. However, the empirical basis for this educational approach is unclear, particularly in the context of K-12 science education. To address this issue, this study involved a systematic review of 90 papers that were published in science education research journals during the years 2000-2014 that met very specific inclusion criteria. The analysis focused on describing the demographic, methodological and topical trends in this corpus of research. Findings indicate that research on blended learning in the context of K-12 science education has focused at the activity level where students only have control over the path of learning in a rotation model. Student learning was assessed and it was common for activities to involve scaffolding and a visualization. Student beliefs and behaviors were explored as mediating or predicting variables, as was the form of argument as an outcome. Non-cognitive factors, the relationship among factors, learning effects for traditionally underrepresented students and institutional characteristics were identified as areas of need for future research.

Introduction

Blended learning is currently a popular term used to describe a mixture of online and face-to-face instruction that involves student-centered learning and a combination of teaching methods (Graham, 2006). As an approach to formal education, blended learning is often touted as a means for improving student access, performance and student-centered approaches to learning (Watson, 2008a). However, the concept is not universally defined and varies widely in its definition and application (Ross & Gage, 2006).

The movement towards blended learning as an educational approach is related to the growth of online learning as an alternative to traditional brick and mortar forms of schooling and the current popularity is attributed to its flexibility, potential for personalization, student-centered focus, and benefits relative to cost (Horn & Staker, 2011). However, due in large part to the lack of a standard definition for the construct, the empirical basis supporting such claims is unclear. For example, a recent meta-analysis conducted by the U.S Department of Education, determined a small effect size on student learning (+0.35) for "instruction combining online and face-to-face elements" (Means, Toyama, Murphy, Bakia, & Jones, 2009, p. xv). Yet, only five of the 99 studies (5%) were set in a K-12 context and *none* involved the domain of science. The ambiguity inherent to using such simple definitions not only limits our capacity to differentiate and understand the impact of the general approach of combining online and face-to-face elements in an educational approach, but also limits our understanding for nuanced or domain-specific forms of such practice. For science educators, beyond knowing if blending supports student learning, it is imperative to know the conditions under which specific elements of science instruction, such as laboratory work, collaborative argumentation or group model building are successful, including for which types of students and involving which forms of support.

To date, three comprehensive literature reviews have been published on the topic of blended learning, which offer findings that supplement those of the meta-analysis by Means et al. (2009) and address what the authors refer to as the first decade of research on blended learning, 2000-2011 (Drysdale, Graham, Spring, & Halverson, 2013; Halverson, Graham, Spring, &

Drysdale, 2012; Halverson, Graham, Spring, Drysdale, & Henrie, 2014). All three studies were based upon an educational technology perspective on teaching and learning, with domain general forms of analysis (i.e. not science specific), and weak methods for identifying studies that required authors to have described their studies with titles or abstracts that included variations of terms such as 'blend' or 'hybrid'. Subsequently, very few of the studies involved research in the K-12 context (<5%). While these reviews provide important insights about the general nature of blended learning research, their capacity to describe what is known about this approach for applications in a K-12 setting is quite limited, especially with regard to domain-specific approaches to learning, such as those for science.

The goal of the research reported in this chapter was to use a more detailed and nuanced definition of blended learning, involving an adaption of that provided by Staker & Horn (2012) to identify studies through a systematic review of journals that publish research related to science education. In doing so, we define the demographic, methodological and topical trends for studies that meet the criteria of blended learning in the context of K-12 science education without the requirement of authors self-reporting it as such. Our purposeful use of the 2000-2014 timeframe, as well as in our presentation of findings, was done so as to support complementary comparisons with the existing more general reviews by Halverson et al. (2012, 2014) and Drysdale et al. (2013). Accordingly, the following research questions framed our review:

Demographic Trends

1. What forms, grade levels and content domains define the research that involved blended learning in the context of K-12 science education?

Methodological Trends

1. What theoretical frameworks, research methodologies and questions define the research that involved blended learning in the context of K-12 science education?

Topical Trends

1. What forms of online content and instruction define the research that involved blended learning in the context of K-12 science education?

Due to the long cultural history and sheer number of students who attend brick and mortar schools, blended learning in K-12 education is most likely an adaptation or variation on face-to-face learning and much less often originating from purely online learning. Especially since online learning is a relative recent phenomenon with its roots in distance education (Watson & Murin, 2014). However, some indicators are suggesting that this situation may be changing. The paradigm from which blending originates has a significant influence on its form, which can include such attributes as the policies and regulations for operation as well as the perspectives, assumptions, rationale and forms of evaluation for teaching and learning (Rice, 2014).

The core rationale for combining online and face-to-face forms of learning as a means for improved outcomes tends to be based upon two main hypotheses that emanate from very different, but certainly complementary theoretical perspectives. The first suggests that learning will be improved through a greater focus on multimedia learning (i.e. images as well as audio and text) that is supported by social interactions among peers and with teachers. Multimedia learning theory, which recognizes the dual-channel processing advantage for images and text (Mayer, 2001), serves as the basic empirical support for the media element of this approach (e.g., Rosenbaum, Mikalsen, & Grahl-Nielson, 2014) and social constructivism (Vygotsky, 1978), which recognizes the role of language and collaboration as the means for building understanding is the foundation for the person-to-person interactive elements. Accordingly, the value of information and communication technology (i.e. the online aspect of a blend) for supporting such learning is the capacity for providing access to different forms of media (e.g., audio, video, image, etc.) along with multiple channels for collaborative communication such that students use them to make sense of science concepts socially, including interactions with more knowledgeable others.

The second hypothesis suggests that learning will be improved through a greater focus on activities that approximate the work of practicing scientists, especially those that involve collaborative work (which relates to the first hypothesis). This approach, which underpins the science and engineering practices of the Next Generation Science Standards (NGSS) (NRC, 2011), as well as that of scientific literacy in its precursor the National Science Education Standards (NRC, 1996), is grounded in the view that learning cannot be separated from the context of its origin (i.e. a situated perspective) (Wenger-Trayner & Wenger-Trayner, 2015). Thus, for the products of learning to be useful in the world, the process should occur in a sociocultural context that approximates how the knowledge products will be used. Such an approach prioritizes learning not as strictly the construction of cognitive artifacts, but as participation in such authentic practices (Lave & Wenger, 1991). While these hypotheses are presented separately, they are not independent from each other nor should they be considered as mutually exclusive.

In the following section, as a means for grounding the results of our study, we first describe what has been learned from three seminal and comprehensive literature reviews on the topic of blended learning that were undertaken from a domain-general perspective. Though these studies involve few examples from the K-12 science education context, the general findings are informative. We then illustrate findings from two domain-specific literature reviews on the topic of Internet-based science learning (Lee et al., 2011) and online inquiry-based science learning environments (Donnelly, Linn, & Ludvigsen, 2014) that inform and set the stage for an expansive exploration of blended learning applications in K-12 science.

Related Research

From their 2012 review of high impact scholarship on blended learning, Halverson and colleagues (2012) found sufficient evidence to describe applications in higher education and corporate training, but beyond a single paper that reported on administrators' projections for the potential growth of the phenomenon, the K-12 context was described as "…fairly uncharted territory." (p. 395). The majority of the articles, books and book chapters that were included in this study were noted as being more descriptive than empirical in nature. Further, although blended learning includes some form of online learning and as such, could be considered a relative of distance education, it has not been significantly reported in journals that focus on those areas. The authors conclude that the research on this topic lacks coherence and theoretical frameworks that could distinguish it as a unique and meaningful endeavor. The emphasis for research in this review was largely pedagogical in nature, based on the approach having potential to transform student learning. Cited as missing from this collection of research were studies that focused on access, cost-effectiveness, and overall theoretical coherence.

Halverson et al. (2014) used a thematic analysis to dig deeper into the ideas and issues underlying the most cited scholarship related to blended learning during the years 2000-2011. In the 85 pieces of scholarship that were included in this review, more than 50% were empirical and most involved a mixed (quantitative-qualitative) methodology. However, only 13% used the empirical results for theory building. Again, demonstrating a questionable empirical foundation. By coding research questions, nine major topics were identified (from most cited to least): instructional design, dispositions, exploration, learner outcomes, comparison, technology, interaction, demographics, and professional development. Some of these topics suggest a focus on instructors in a higher education context. The list implies that the general research over this timeframe emphasized the role of instructional design in the process as well as an exploration and occasional comparison of blended learning applications on instructor and student dispositions as well as student learning outcomes. The authors conclude by calling for studies that offer theoretical models that connect teaching and learning processes to outcomes.

In the most thorough review of blended learning to date, Drysdale et al. (2013) reported on a search and thematic analysis of 205 dissertation and theses that were completed between 2000 and 2011. In this collection, studies in a K-12 context only appeared after 2008. Eighty-three percent of these studies focused on course level blending of online and face-to-face elements, which is likely explained by the preponderance of these studies being completed in a higher education context with researchers evaluating their own courses as examples. Less than 10% of the research focused on program and institutional level blending. Three percent involved blending at the activity level. Use of inferential statistics was the most common form of analysis. By coding research questions, eight major topics were identified (from most cited to least): learner outcomes, dispositions, instructional design, interactions, comparison, demographics, technology and professional development. Though represented in relatively different amounts, the topics have a high correlation with those reported by Halverson et al. (2014) and suggest a similar conclusion, that research over this timeframe emphasized the role of instructional design and the use of inference to explore the comparison of blended learning applications on participant dispositions and student learning outcomes. The authors describe an overarching practical and pragmatic intent among these studies, which was to show that blended learning is at least as good as other alternatives. Perhaps most importantly, this review identified the general lack of theoretical frameworks on this topic and when theory was used, it took the form of those that are most commonly used for online or distance learning (e.g., Community of Inquiry, Transactional Distance, Transformational Learning Theory). All three of these domain-general reviews seemed to take the perspective that blended learning was a new form of online learning.

In a study more closely related to blending online and face-to-face elements in a K-12 science context, Lee et al. (2011) reported on a review of 65 research studies related to Internet-based science learning from 1995 to 2008. The focus of this review was learner characteristics and learning outcomes and the authors conclude that student performance in such environments is related to their prior knowledge of science concepts, their views related to the nature of science knowledge, as well as their spatial visualization and metacognitive ability. For students with low prior science knowledge, the visualization capacity of online learning is cited as being beneficial for addressing misconceptions through presentation or discussion. Results such as these provide an empirical and practice-oriented rationale for considering the addition of online learning applications to existing face-to-face applications. In particular, the results that focus on student characteristics provide some high-level suggestions for how the online component of a blended learning application could be designed for supporting all students. For example, the authors report that some studies indicate that the inclusion of group social supports for discussion forums have been effective for encouraging the participation of female students (e.g., Herman & Kirkup, 2008) or that the combined use of design projects and simulations were shown to be an effective strategy for improving the achievement of students from certain ethnic minorities (e.g., Cantrell, Pekcan, Itani, & Velasquez-Bryant, 2006). Student attitudes toward Internet-based science learning was found to be positive, but their motivation for learning in such environments varied. Gains in conceptual understanding were found for the use of a wide range of Internet-based strategies, including homework, formative assessment, simulations, virtual reality, as well as synchronous and asynchronous discussion. However, the authors cite the lack of studies looking at more science-specific outcomes, such as problem-solving or visual-spatial ability.

In an effort to identify the characteristics of online platforms that have been shown to be successful in supporting inquiry-based science learning for K-12 students, Donnelly et al. (2014) reviewed 106 papers that involved "Curriculum delivery systems that provide instruction for one or more science topics, take advantage of technology to represent complex ideas using visualizations and/or ask students to represent their ideas visually, scaffold inquiry, enable embedded assessments and support registration and logging of progress to monitor student outcomes." (p. 573) From this collection of papers, 30 unique learning environments were identified that had been studied in 12 different countries. The authors computed an average effect size of 0.87 for gains in conceptual understanding of science. Further, they developed an analytical framework of four design principles from existing studies on inquiry learning for features of such systems that produce learning and build inquiry skills. These design principles, along with the proportion of the 30 environments that were found to include each, were: a) exploring meaningful and authentic scientific contexts (30%), b) using powerful visualizations (43%), c) encouraging collaboration with others (41%) and d) developing autonomous, metacognitive learning (13%). If applied to blended learning designs, these principles would by nature afford new and important research investigations. Finally, the authors indicate that degree of guidance, impact of sustained implementations, role of the teacher and professional development are all themes that merit further research.

Though not necessarily defined formally as blended learning, the majority of the studies reviewed by Lee et al. (2011) and Donnelly et al. (2014) were conducted such that the online system at the focus of these studies was used within a traditional face-to-face classroom. Thus, they meet the basic definition of blended learning. We viewed this as compelling evidence that research on blended learning in the K-12 science context had been occurring for some time, but our reliance on self-identification has limited our capacity to draw inferences from such work. Thus, to address this issue, our review involved a method of identifying studies based upon the authors' published description of their work in highly reputable science education journals using a detailed and nuanced definition of blended learning.

Methodology

This study involved a systematic review of papers published between 2000 and 2014 in thirteen peer-reviewed research journals that focus explicitly on science education (Petticrew & Roberts, 2006). Many of these journals are indexed in the Web of Science with high impact factors and are recognized as the top research journals in the field of science education (Table 1).

Journal Title	**Volumes**	**Studies in Stage 1**	**Studies in Stage 2**
Journal of Science Education and Technology	9-23	55	30
International Journal of Science Education	22-36	44	22
Journal of Research in Science Teaching	37-51	37	18
Research in Science Education	30-44	18	9
Science Education	84-98	14	5
Journal of Computers in Mathematics and Science Teaching	19-33	11	3
Research in Science and Technological Education	18-32	3	2
International Journal of Science and Mathematics Education	1-12	5	1
Contemporary Issues in Technology and Teacher Education	1-14	0	0
Journal of Science Teacher Education	11-25	2	0
School Science and Mathematics	100-114	3	0
Science and Education	9-23	1	0
Studies in Science Education	35-50	1	0
TOTAL		194	90

Table 1. Peer-reviewed research journals, volumes and number of studies included in the analysis.

Two criteria were required to have been met for studies to be included in our analysis. In their reporting of the study, the authors' had to have made explicit 1) an empirical focus on *students* (not pre or in-service teachers) in the context of

K-12 science education and 2) their investigation had to have involved a learning environment that met Staker & Horn's (2012) definition of blended learning—"a formal education program in which a student learns at least in part through online delivery of content and instruction with some element of student control over time, place, path, and/or pace and at least in part at a supervised brick-and-mortar location away from home" (p. 3).

Our process for applying the inclusion criteria to identify manuscripts involved a two-stage screening process. For each stage, materials were read independently by two of the authors, then all three authors met to discuss the work in relation to our inclusion criteria and used a consensus discussion for a final decision. Stage one was an issue-by-issue reading of abstracts from each journal. Through this discussion about abstracts, we found that in order to successfully use Staker and Horn's (2012) definition, we further needed to define the constructs of science content knowledge and instruction and to maintain a working list of acceptable online forms of each. Accordingly, 'science content knowledge' was defined as—the "facts, concepts, principles, laws, theories, and models" (NRC, 1996, p. 23) that are recognized as valid by the scientific community. 'Instruction' was defined as—messaging that "offers explicit guidance on how to better help people learn and develop" (Reigeluth, 1999, pg. 5). We used the term instruction in a very broad sense as an indicator of "intentionally created processes, resources, environments, or programs for learning." (McKenney & Reeves, 2012, p. 61) Since the abstracts only provided an overview of each study, we were lenient in our application of the criteria under the assumption that we were gathering all studies that had the potential for inclusion. This stage of initial screening produced a pool of 194 potential papers.

During stage two, each of the 194 papers was read in its entirety with the intent of identifying specific narrative passages that met our inclusion criteria. To aid in this work, we developed a checklist and completed it for each manuscript. However, we quickly came to realize that the crux of this effort, the most critical indicator for whether a study fit the definition of blended learning, involved identifying whether both science content and a form of instruction were specified as being delivered online (Table 2). Since the entire initial pool of papers described studies that were done in some form of formal educational context, they included recognizable forms of science content knowledge and instruction being delivered face-to-face at a supervised brick-and-mortar location away from home. It was the necessary online forms of science content knowledge and instruction (sometimes one, sometimes both) that were missing from the narrative, perhaps even as part of the overall study, which resulted in their exclusion. Further, if the online forms of content and instruction were identified, then at least one element of student control (i.e. time, place, path, pace) was inherent. We found this method, though much more arduous and time intensive, to be a more nuanced and thorough way of identifying blended learning. In doing so, we are able to show that even though it has not been defined or recognized formally as such, research on blended learning in K-12 science education has been occurring for quite some time. Ultimately, our two-stage process produced a final sample of n=90 papers that were subjected to our analytic framework that was based in large part on the previous work by Halverson et al. (2012, 2014) and Drysdale et al. (2013).

	Face-to-Face	**Online**
Forms of Science Content	Narrative text Discussion Hands on activity	Narrative text Visualization Asynchronous discussion
Forms of Instruction	Lecture Video Small group work	Video Avatar Immersive environment

Table 2. Illustrative examples of the two teaching methods (face-to-face and online) and forms of science content and instruction that were required for a paper to be included in this study.

Analytic Framework

Our analysis involved coding each paper in relation to our research questions using the following analytic framework: year and journal of publication, abstract#, keywords, purpose statement(s)#, grade level(s), content area or domain, form(s) of technology, form(s) of online instruction, form(s) of online content, organization level, research questions#, theoretical framework#, purpose#, major areas of reviewed research supporting the work#, research methodologies, forms of data collected, nature of student control, model of blended learning, research outcomes#, and implications for future research#. These points of emphasis were used in order to make the epistemic elements of each study explicit and accessible for comparison. Some of these elements, including their coded categories, have been established and used in previous reviews. For example, the organizational level of the study (e.g., course, activity, program, institution) was adopted from Drysdale et al. (2013), the nature of student control (e.g., path, pace, place, time) as well as model of blended learning (e.g., rotation, flex, self-blend, etc.) were adopted from Staker & Horn (2012). Some elements were analyzed thematically (indicated by #) with an inductive form of qualitative analysis (Patton, 2002). Constant comparison was practiced in all forms of analysis. Cohen's Kappa for a sampling of our initial independent coding was determined to be 0.52, indicating a moderate degree of agreement (McHugh, 2012).

Research Synthesis

Overall, papers were identified throughout the time period 2000-2014, with a marked increase in 2007 and a rate of approximately ten papers per year over the four-year period of 2011-2014 (Figure 1). Consistent with the report of other reviews, the first papers on the use of the Internet for science education appear in 2000 and the time period 2007-2008 marks a surge in the interest for blending online and face-to-face forms of science education. For most of the studies, it was rare for the authors to refer to their work as technology rich curriculum or instruction, let alone blended learning. Studies were identified in eight of the thirteen research journals, but were largely reported in only three: The *Journal of Science Education and Technology* (34%), the *International Journal of Science Education* (23%) and the *Journal of Research in Science Teaching* (20%) (Table 1).

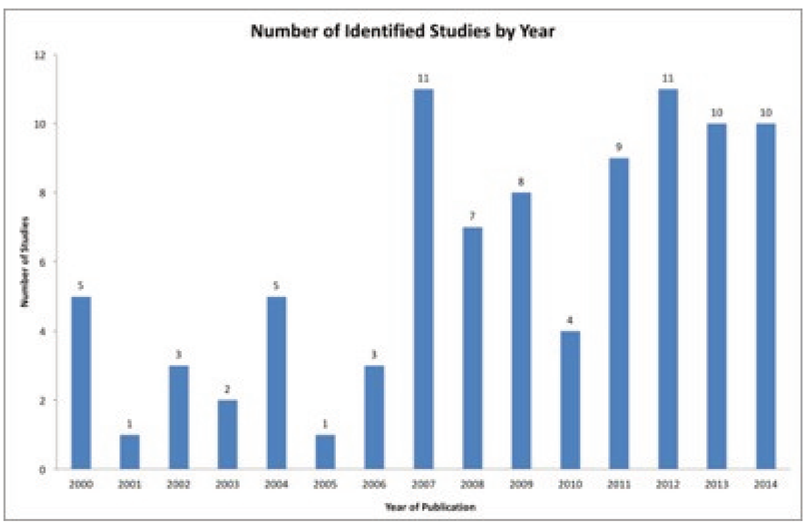

Figure 1: The number of published studies on blended learning in K-12 science by year.

In the following sections we present our results based upon the three themes from our research questions. Namely, the demographic, methodological and topical trends that define the research on blending online and face-to-face elements of instruction in the context of K-12 science education.

Demographic Trends

Eighty-four percent of the studies involved blended learning at the activity level—an individual lesson or smaller part of a course (e.g., Annetta, Mangrum, Holmes, Collazo, & Cheng, 2009), with an additional thirteen percent at the course level (e.g., Jang, 2006). Only one study investigated blended learning at the institutional level (Zucker & Hug, 2008). These results, which are vastly different from the more than 80% course level blending reported by Drysdale et al. (2013) for the higher education context, illustrate the primary intent of researchers working in the K-12 context, which was to assess an online intervention as part of an activity within a face-to-face classroom. This demonstrates a clear need for studies at the course, program and institutional levels.

The majority of studies were conducted in a secondary context (>80%) with a nearly even split between middle and high school. All but one of the studies in an elementary context was conducted in grade 5 (Barab, Sadler, Heiselt, Hickey, & Zuiker, 2007) and these studies were completed recently. The science domains studied in decreasing order included: chemistry (20%), physical science (16%), biology (7%), physics (6%), environmental science (3%), life science (2%), integrated science (1%), and biotechnology (1%) (Figure 2). However, 28% were coded as ‘other’ and 17% were ‘unspecified’. The trend for studies in the domain of ‘life sciences’ shows a slight increase since 2010. Ten studies (11%) involved advanced coursework (i.e. Advanced Placement, International Baccalaureate, etc.), indicating that blended learning interventions are being developed and tested with more heterogeneous populations of students.

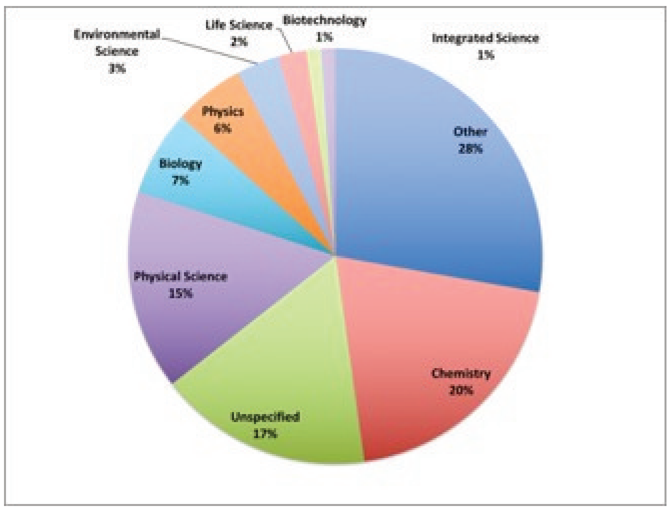

Figure 2: The science domains used for studies of blended learning in K-12 science.

Student autonomy and control are emphasized as a key element in the way that blended learning is defined and promoted (Watson, 2008b). However, the vast majority of studies in this review (70%) involved students only having control over the Path—Learning is no longer restricted to the pedagogy used by the teacher. Eleven studies (12%) involved students having control over all four dimensions of Path, Pace—Learning is no longer restricted to the pace of an entire classroom of students, Place—Learning is no longer restricted to the walls of the classroom, and Time—Learning is no longer restricted to the school day or the school year (e.g., Crippen & Brooks, 2005; Jang, 2006). Consistent with our finding that these studies largely involved an activity level blend, this trend is further indication that they emerged from the tradition of face-to-face classroom instruction with the research set in brick and mortar schools.

Staker & Horn (2012) define four primary models for blended learning: rotation, flex, self-blend and enriched virtual. In addition, the rotation model is recognized has having four variations: station, lab, individual and flipped classroom. For this group of studies, the rotation model—within a given course or subject students rotate on a fixed schedule or at the teacher’s discretion between learning modalities at least one of which is online learning—was used in nearly every study (97%). Perhaps most intriguing due to the degree to which we hear about the popularity of the model (Project Tomorrow, 2013), is the absence of any studies reporting on research related to flipped classroom—within a given course or subject students rotate on a fixed schedule between face-to-face teacher-guided work on campus during the standard school day and online delivery of content and instruction of the same subject from a remote location after school.

Methodological Trends

Knowledge integration, constructivism, conceptual change, models and modeling and argumentation were the most used theoretical frameworks with visualizations, use of the web, simulations, inquiry, design and use of representations as themes for supporting literature (Table 3). These studies were generally constructivist in nature and involved student-centered forms of learning, such as inquiry (Svihla & Linn, 2011), simulations (Neulight, Kafai, Kao, Foley, & Galas, 2007) and immersive environments (Ketelhut, 2007). The most recent of these studies were well aligned with current learning theory and in doing so address some of Halverson et al.'s (2014) concerns about the general lack of coherent theory. However, the theory did not specifically address the blend in these studies.

Twenty-seven of the studies (30%) were completed using a purely quantitative approach that involved assessing inferences between groups; seventeen studies (18%) were completed using a purely qualitative approach and one-half of the studies employed a mixed method (quantitative-qualitative) approach. A range of data sources were used, but surveys, participant artifacts and behavioral observations were the dominant forms. The perspective behind the approach to research demonstrates a great deal of influence on the results and subsequent implications.

Not all of the studies included research questions, but for those that did (74%), the dominant theme of investigation was whether students learned from a specific form of activity or method of instruction that most likely involved scaffolding and a form of visualization (e.g., Zion, 2008). In many cases, this included a comparison across conditions. Student beliefs and behaviors (i.e. activity) were often explored as mediating or predicting variables (e.g., Frailich, Kesner, & Hofstein, 2007), as was the form of argument as an outcome (e.g., Buck, Lee, & Flores, 2014). Non-cognitive factors (e.g., affective), the relationship among factors, learning effects for traditionally underrepresented students and institutional characteristics were only addressed in one or two studies and represent needed areas for future research.

Only 68 of the studies (75%) included an identifiable purpose which were quite broad and varied in their level of description. Several of the conditions (e.g., comparison, scaffolding, visualization), mediators (e.g., how to design, what did they learn), and outcomes (e.g., achievement, affect) identified in the research questions were also present in the purpose statements. The themes tended to capture larger constructs, mostly aligned with the design features and usability of the technology, affective and cognitive outcomes specific to the blend, and comparing forms of content and instruction.

Topical Trends

For these studies, science content knowledge that was delivered online, took the following forms: narrative text (31%), visualization (interactive visual model with control over more than time) (16%), discussion board (10%), still video (10%), simulated experiments (did not require set up, but allowed manipulation of virtual equipment) (9%), avatar (3%), instant messaging (3%), video game (3%), virtual experiments (required setup and allowed manipulation of virtual equipment) (2%), live video (<1%) and remote experiments (did not require set up, but allowed manipulation of virtual equipment that existed elsewhere; students did not have physical contact with the equipment) (<1%). In 33 of the studies, this content was provided in real time (synchronously) (Table 4).

Only one study in our analysis involved an online synchronous form of instruction (i.e. real time) (Lowe, Newcombe, & Stumpers, 2013), while the other 98% involved one or multiple asynchronous forms of instruction. These included: narrative text (71%), avatar (13%), video (8%) and audio (8%) (Figure 3). In 82% of the studies, these forms were delivered via an integrated learning environment (i.e. all components together within a system; see Varma & Linn, 2012); 11% were delivered via an immersive environment (i.e. the student is situated in a virtual world; see Annetta et al., 2009).

Some difficulty was encountered when differentiating empirical studies from non-empirical descriptive reports. This issue involved studies that made reference to, but never explicitly reported on any collection or analysis of data. Further, certain studies investigated student use of an online tool or resource that included appropriate forms of content and instruction, but the reporting did not explicitly describe face-to-face instruction (e.g., descriptive AP chemistry site; Crippen & Brooks, 2002 & 2005). Considering the nature, intent, and forms of data that were reported for these studies, we inferred that

Theory or Framework	Percent Occurrence
Knowledge Integration	22%
Constructivism	16%
Conceptual Change	14%
Models and Modelling	10%
Argumentation	10%
Self-Regulation	6%
Social Constructivism	6%
Situated Learning	5%
Socioscientific Issues and Inquiry	4%
Systems Theory	4%
Self-Efficacy	2%
Metacognition	1%
Sociocultural Theory	1%

Table 3. The theories and theoretical frameworks used.

the online resource could not have been used without face-to-face content and instruction and thus meet the criteria for blended learning and were classified according the attributes that were reported.

Since the majority of studies involved and specifically investigated particular technologies, the longevity of these tools is an issue. For example, the Web-based Inquiry Science Environment (WISE) was the core technology in 18 (20%) of

Form	Occurrence	Percentage of Total
narrative text	86	30.8%
visualization	46	16.5%
synchronous	33	11.8%
discussion board-asynchronous	29	10.4%
still video	28	10.0%
simulated experiments	25	9.0%
avatar	9	3.2%
instant messaging	8	2.9%
video game	8	2.9%
virtual experiments	5	1.8%
live video	1	0.4%
remote experiments	1	0.4%

Table 4. The forms of online content used.

the studies (e.g., Lee, Linn, Varma, & Liu, 2010; Ryoo & Linn, 2012). Though WISE was not always the focus of the intervention being studied, it represents a clear potential for bias in our analysis. On the contrary, WISE also represents a technology that is still freely available and is an active platform, used by a great many science teachers in a diversity of school contexts (http://wise.berkeley.edu). This situation is much different from that of many of the technologies that are no longer available, leaving unclear implications for practitioners.

Implications for Policy and Practice

We find clear and compelling evidence for blended learning as an activity-level strategy for secondary science, regardless of science domain. Research supporting course-level applications, including the use of flipped classrooms, as well as program or institution level applications was non-existent or emerging. Successful applications involve students having control over the path of instruction, where the pedagogy is not restricted to that used by their teacher in the face-to-face environment.

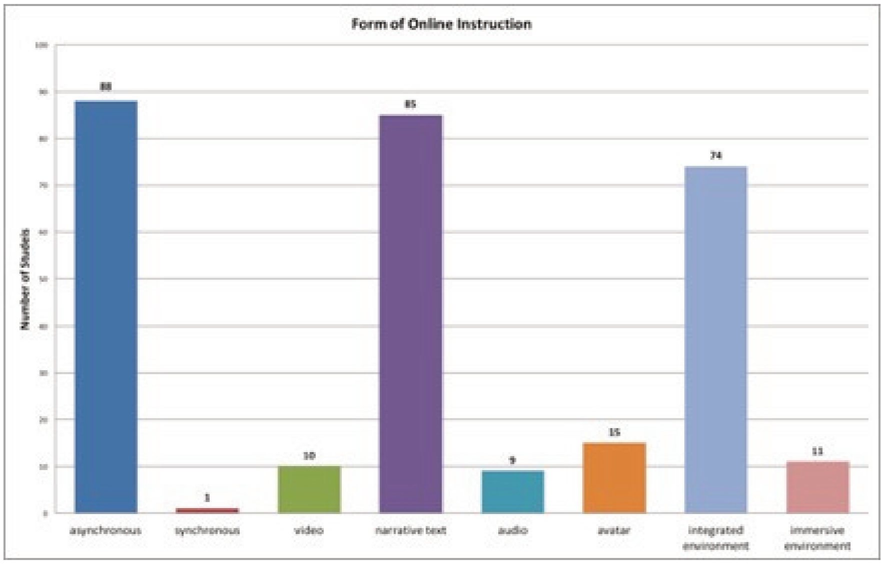

Figure 3: The forms of online instruction used in studies of blended learning in K-12 science.

Successful teachers accomplish this through rotation—where students rotate on a fixed schedule or at the teacher's discretion between online and face-to-face learning modalities. Applications of blended learning in K-12 science have been shown to support student-centered learning, including inquiry, simulations and immersive environments. In certain situations, learning outcomes for blended learning applications in K-12 science may slightly exceed other forms of instruction, but generally, these applications are at least as good as non-blended alternatives. The most compelling applications of blended learning for K-12 science involved technology use as a construction and representation tool as opposed to simply for information retrieval and communication.

Beyond general technologies for course management, blended learning in K-12 science requires domain-specific technologies that support visualization, simulation, argumentation and experimentation. In some cases, these technologies can be integrated with course management systems, but some are built to be independent, offering an immersive or domain-dependent set of integrated features that are tied to contemporary views of science teaching and learning (e.g., argument construction, data analysis, visualization tools). Many of these applications are available for free, but others are not. As with any technology, equitable access and lifespan are enduring issues with implications for practitioners.

K-12 science applications of blended learning must attend to leveraging and balancing the advantages and disadvantages for online content and instruction with those of face-to-face (Table 2). Consistent with the perspective that individual content area domains (e.g., language learning, mathematics, science) will invoke or require different forms of blended learning (see other chapters in this series), unique forms of blending are likely better suited for individual science processes based upon the nature of the process and learning requirements. For example, the visualization emphasis of a biology course is quite different from the more problem focused emphasis of a physics or chemistry course. Thus, the four primary models for blended learning: rotation, flex, self-blend and enriched virtual should be considered and employed flexibly based upon the unique teaching and learning needs for the content of a science course.

The Next Generation Science Standards present a unique opportunity for applications of blended learning. With its emphasis on 3-dimensional learning (Krajcik, Codere, Dahsah, Bayer, & Mun, 2014), a form of classroom practice that simultaneously attends to: 1) disciplinary core ideas, 2) science and engineering practices and 3) cross-cutting concepts, there is great potential for blending of modalities to advance the goals put forth in the standards. We view different forms of blending modalities as offering the potential to reach different students for different purposes, particularly when aligned to the science and engineering practices. For example, studies in this review indicated that the inclusion of group social supports for discussion forums have been effective for encouraging the participation of female students (e.g., Herman & Kirkup, 2008) which would relate to Practice 6—Constructing Explanations and Practice 7—Engaging in Argument from Evidence or that the combined use of design projects and simulations were an effective strategy for improving the achievement of students from certain ethnic minorities (e.g., Cantrell et al., 2006) suggesting Practice 2—Developing and Using Models and Practice 3—Planning and Carrying Out Investigations.

Any use of blended learning that involves work outside of the traditional school day (required or otherwise) should involve a consideration for and on-going assessment of the overall time requirement and ultimate efficiency from the student's perspective. Many applications of blended learning are based upon the simple notion of adding time-on-task by requiring work at home during the evenings and on weekends. For students and their families, this time is additive based upon the number of courses that they take and cumulatively, can easily amount to an unreasonable quantity. Aside from the quantity, if such time is not well-supported and judiciously spent, it is likely inefficient and potentially counter-productive. Basic cost-benefit analyses, determined in an ongoing fashion from the student perspective for all of their courses, is paramount for successful applications of blended learning.

Implications for Future Research

While a clear and universal definition of blended learning is important, it may not be the solution to all of the ambiguity surrounding this phenomenon. Of greater need, regardless of the study's intent, is a concerted effort by researchers and practitioners to more systematically categorize and articulate the forms of online and face-to-face content and instruction that are used in combination. Peer reviewers and journal editors also have a role to play here in helping to ensure that these attributes are appropriately addressed in published studies.

The published research studies between 2000-2014 that involved blended learning in a K-12 science context largely took the position that online learning was as an innovation and complementary component to face-to-face learning. However, the blending of these modalities as a concept or component of a larger system was not clearly described or investigated. Studies are needed that consider the combination of affordances that results from blending and subsequently describe the activities and experiences of all participants within these unique contexts. Such work would be important for addressing the conjecture that different forms of blending are better suited for individual content domains, learning objectives or forms of content (e.g., scientific processes).

The case for blended learning at the activity-level for K-12 science is compelling, but there is much needed research at the course, program and institutional levels. For studies that assess the basic effectiveness of such applications, researchers should more directly and systematically account for the role of context and student demographics in their studies. Doing so would further our understanding of the conditions required for all students, including those who are traditionally disadvantaged or underserved, to be successful. Such an approach would equally afford the opportunity for initiatives that would more directly address some of the historic inequalities in the educational system that have privileged certain students over others.

Under-resourced institutions or those serving largely underserved populations likely do not have the requisite technology either in the classroom or in the community to utilize additional learning opportunities, particularly those that are commercial products requiring site licenses or parent purchase. Additionally, pragmatic institutional characteristics must be considered, such as the demand for the limited number of devices a school may have, particularly during heavy-use periods such as standardized testing. The trade-off of purchasing networked computer technology versus traditional science equipment should also be considered. Models for achieving the ambitious goals ascribed to blended learning regardless of institutional resources or commitment to science are needed.

While this review encompassed international contributions, it only included one study that pertained to traditionally underrepresented students (Zheng, Warschauer, Hwang, & Collins, 2014). This illustrates a strong need for research that addresses the use of blended learning in diverse settings. For example, there is limited research investigating the differential impacts of blended learning for underrepresented populations of students, including those from rural or low socioeconomic backgrounds. Though the work of Cantrell and colleagues (2006) suggests there may be advantages for traditionally at-risk populations, further research is needed to understand how, why, for whom and under what conditions. It is imperative to know the conditions under which specific elements of science instruction, such as laboratory work, collaborative argumentation or group model building are successful, including for which students and involving which forms of support.

Noted was the absence of research related to certain programs and technologies that, in our experience, are used heavily by K-12 science teachers or are highly publicized for their use. For example, we found no systematic research regarding the following: applications of blended science learning in virtual schools, unique or alternative forms of synchronous instruction, use of the PhET (http://phet.colorado.edu/) or Gizmo virtual manipulatives (http://www.explorelearning.com/), applications of crowdsourcing, out of school experiences (Braund & Reiss, 2006) or citizen science—where students collect and analyze data for active scientific research projects (Dickinson, Bonney, Fitzpatrick, & Louv, 2012). Though there has been some exploratory research into student dispositions toward the Internet and using technology as mediating variables, missing is an attempt to understand non-cognitive factors, such as self-efficacy (which is known to influence cognitive gains; Usher & Pajares, 2008) in blended learning environments.

Conclusion

The results of this study make an important contribution to the teaching and learning of science by more clearly defining the boundaries of our understanding of blending online and face-to-face elements in K-12 science education. This allows researchers as well as practitioners to better temper and balance the rush to adopting a poorly defined, albeit popular method with a more grounded and focused view of the phenomenon, its potential and documented effectiveness. As the direct link between learners and curriculum, science educators are increasingly asked to integrate technology into their lessons in ways that are pedagogically meaningful and authentic to the practice of science. Our understanding of blended learning predicts our capacity to prepare science teachers to effectively implement blended curriculum with their students.

To fully realize the potential of educational technology for all science students, effective models of curriculum and instruction that involve online and face-to-face methods must be developed. Especially as such work moves from focusing on the efficacy of single interventions to the more complex task of utilizing blended learning to achieve the goals of something like the Next Generation Science Standards. Finally, by illuminating the findings, issues, needs and current status of research on the timely and important topic of blended learning in K-12 science education, science educators are better equipped to design and implement empirically-grounded teacher education opportunities.

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World Languages in Online and Blended K-12 Education

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Abstract

This chapter is a qualitative exploration and synthesis of research on online world-language courses in K-12 settings, focusing on such courses' effectiveness and the unique challenges of maintaining the quality of language courses as they move from face-to-face to online environments. It identifies two key factors contributing to K-12 students' world-language online-learning success – self-regulated learning and interaction – while a thorough examination of teacher-level factors highlights the importance of professional development in both technological skills and pedagogical design. The chapter concludes with implications and detailed recommendations for policy and practice in K-12 world-language education, as well as future directions for research in this area.

Keywords: world languages, online learning, effectiveness, teaching practices, professional development

This chapter provides a qualitative synthesis of published work relating to online world-language courses in K-12 settings. It consists of six sections. The first describes the challenges of online world-language courses, and the following three review three main themes: effectiveness; factors predicting online-learning outcomes; and teaching and teacher education. The fifth section provides implications for policy and practice, as well as potential directions for future research, and the sixth, this chapter's conclusions and recommendations.

1. Introduction

Enrollment in U.S. K-12 online education courses increased from 1.8 million during the 2009-10 academic year (Zandberg & Lewis, 2008) to 3.8 million in 2014-15 (Watson, Pape, Murin, Gemin, & Vashaw, 2015). Amid this dramatic increase, it is of urgent importance that the quality of online courses be maintained or enhanced, and that online teaching and learning maximize the effectiveness of online education.

World languages present unique challenges for K-12 online learning. Though computer-mediated communication has potential affordances to support online learning (e.g., being able to communicate without restrictions of time and space: see Hampel & Hauck, 2004), the lack of body language and non-verbal cues are likely to limit both the effectiveness of online world-language courses and students' perceptions of such effectiveness (Lin & Warschauer, 2015; Lin & Zheng, 2015). Cavanaugh's (2001) meta-analysis of 19 studies of the effects of online education on K-12 academic achievement found that, alone among all course-content areas, foreign-language courses yielded significantly negative effect sizes, leading the author to call for a more careful evaluation of such courses in online K-12 settings. A more recent study by Oliver, Kellogg, and Patel (2012) expressed a similar concern: online students enrolled in foreign-language courses had significantly less positive perceptions of their courses than those enrolled in other subjects. A synthesis of research on this topic by Lin and Warschauer (2015) noted that among online higher-education students, perceptions of world-language courses were in line with perceptions of other subjects, which prompts further concern about the effectiveness of online world-language courses at the K-12 level. However, research on such courses has hitherto been conducted in widely dispersed geographical areas and using a variety of methods, and this had hindered the information of any clear consensus about problems and solutions.

2. Research Synthesis: Effectiveness of K-12 World Language Courses

This section reviews studies of the effectiveness of online world-language courses in fully online, blended, and virtual-reality learning environments. Due to the profound differences between first- and second-language learning, studies of English-language education in the U.S. and other English-speaking countries were excluded, except where they dealt exclusively with English-as-a-foreign-language classes.

The majority of published studies relating to online world-language courses date from after 2010. For reasons of space, our review focuses on course effectiveness, rather than on how contextual factors may have affected the findings.

2.1 Effectiveness of Fully Online/Blended Language Learning Courses

In terms of the effectiveness of online world-language courses in K-12 environments, mixed results have been reported. Several studies have indicated that such courses may have negative impacts on learning. For example, Cavanaugh's meta-analysis of studies of the effectiveness of online education as compared to traditional education revealed that, while interactive distance education had positive effect sizes in most subject areas, strong negative effect sizes were detected for foreign-language courses. Similarly, Oliver, Kellogg, and Patel (2012) found that students who took foreign-language courses in a virtual school reported significantly lower satisfaction than those who took other types of online courses in the same school, across all key areas of online learning (i.e., teaching practice, course design, group collaboration, and perceived success). The same study's recommendations for enhancing students' satisfaction with online foreign-language courses included creating authentic language-learning activities, and providing better support for students' individual needs. A recent report on the effectiveness of Michigan's K-12 online courses (Freidhoff, 2017) indicated that the average pass rate in online foreign-language and foreign-literature courses in 2015-16 was 59%, far lower than the 76% average pass rate of their face-to-face counterparts. Within these figures, however, students from rural areas and small towns had much higher pass rates in the online language and literature courses (71% and 74%, respectively) than those from suburban and city areas (58% and 45%, respectively). And Jabeen and Thomas's (2015) study, although conducted among adult learners, suggested that an insufficient quantity of interactions, slow feedback, lack of opportunities to practice the target language online, and inadequate technology training were the key obstacles to effective learning of foreign languages online.

Other studies, however, have reported positive findings regarding the effectiveness of online education. A meta-analysis by Means, Toyama, Murphy, and Baki (2013) compared the effectiveness of online/blended learning against that of face-to-face instruction in both K-12 and higher education, and revealed that online instruction – and especially blended learning – was more effective than its face-to-face counterpart. Although their study did not specifically examine world-language courses, it detected no differences among subject areas, implying that the positive effect sizes of online instruction would also apply to such courses. A recent study by Lin, Zheng, and Zhang (2017) reported generally positive learning outcomes among students enrolled in online high-school-level world-language courses. Though Lin, Zheng, et al. did not directly compare their online learners' outcomes against those of face-to-face learners, their respondents reported high levels of both satisfaction (4.47 out of 5) and perceived progress (4.75 out of 5).

2.2 Virtual-reality Environments

Another emerging type of online-learning environment for world language acquisition is virtual reality. A recent review by Lin and Lan (2015) found that, while the body of research on language learning in virtual-reality learning environments (VLEs) grew substantially in the period from 2004 to 2013, few such studies focused on K-12 settings. Among those that did, a majority revealed an improvement in language-learning outcomes (Rankin, Gold, & Gooch, 2006; Suh, Kim, & Kim, 2010) and/or positive attitudes towards using VLEs in language learning (Ho, Rappa, & Chee, 2009; Zheng, Young, Brewer, & Wagner, 2009).

Suh, Kim, and Kim's (2010) experimental study compared the learning outcomes achieved via traditional face-to-face lectures against those achieved via participation in a massive multiplayer online role-playing game (MMORPG) by 220 students learning English in Korea. They found that students in the MMORPG group outperformed their face-to-face peers in listening, reading and writing. These findings paralleled those of Rankin, Gold, and Gooch's (2006) pilot study, which examined language improvement among intermediate and advanced English-as-a-second-language (ESL) learners. The participants who played Ever Quest 2 at least four hours per week increased their English vocabulary by 40% over four weeks.

As well as improved learning outcomes, language learning in VLE has been found to have positive effects on students' attitudes and perceptions. For example, Zheng, Young, Brewer, and Wagner (2009) employed a quasi-experimental design to examine 61 Chinese 7th graders' English self-efficacy and attitudes. Each child was randomly assigned either to an experimental group, which played MMORPG with native speakers on their own initiative, or to a control group, whose members studied on their own. As compared to the control group, the experimental group reported higher levels of confidence in their English communication, perceived that they had learned more, and found English more interesting. Another study, by Ho, Rappa, and Chee (2009), examined 45 Singaporean 12th graders' learning of English via the game Second Life and an online discussion forum in Singapore. Though the authors did not specifically examine improvement in language skills, they found that the VLE enhanced the participants' interest in the subject and developed their sense of belonging in the online environment. In addition, they found that the students' argumentation skills were strengthened by Second Life's negotiation-of-meaning process.

3. Research Synthesis: Factors Predicting Online-learning Outcomes in Language Courses

As Blake (2008) has contended, it is important for scholars to move beyond mere comparisons of the relative effectiveness of online and face-to-face language courses, as many potentially confounding factors (e.g., individual differences, instructors, and curricula) have not been or cannot be controlled. Among the wide range of such factors that might predict learning outcomes in online world-language courses, the two main themes that have thus far emerged from the literature are self-regulation and interaction.

Self-regulation is one of the strongest predictors of students' learning outcomes in traditional settings (for a review, see Hattie, 2008). There is also a broad scholarly consensus that successful online learning requires a high level of self-regulation skills, such as setting one's own learning goals and self-monitoring one's learning progress (Barbour & Reeves, 2009; Barnard, Lan, To, Paton, & Lai, 2009). Self-regulated learning (SRL), a framework proposed by Zimmerman (2002), consists of two main factors: motivation and learning strategies. Drawing on SRL, Lin, Zhang, and Zheng (2017) surveyed 466 students enrolled in online world-language courses in a virtual school supported by the U.S. state of Michigan. Using structural equation modeling, Lin, Zhang et al. found that motivation did not predict learning outcomes (i.e., satisfaction, perceived progress, or final grades), but online learning strategies positively predicted them. The authors speculated that the insignificance of motivation in their model could have been due to the fact that, in their specific study context, the students' intrinsic motivation was moderate and their extrinsic motivation, low.

Turning to interactions, language learning is – from a sociocultural perspective – an interactive process of exploration and discovery, underscoring the need for mediation and social interaction in the development of meaning (Lantolf, 2006). Social interaction is a key component of language learning because learners develop their language skills through a meaning-negotiation process (Lantolf & Thorne, 2008); and many prior studies of face-to-face learning have documented the importance of social interaction to language development (e.g., Alison & Philp, 1998). In online-learning research, Swan (2003) highlighted the importance of interaction and urged scholars to look beyond final grades. An early study by Hampel and Stickler (2004) reported that, along with collaborative tasks, online students felt participating in intense interactions with their fellow learners was the most exciting aspect of learning and practicing a language, underscoring the importance of interaction in online language-learning environments. Adopting a sociocultural perspective, Lin, Zheng, and Zhang's (2017) aforementioned study of high-school-level online language courses in a state virtual school assessed the relationship between online interactions and learning outcomes. It employed multiple regression analysis to examine how three broad types of interactions – learner-instructor, learner-learner and learner-content (Moore, 1989) – affected students' perceived progress and satisfaction. After controlling for demographic information, motivation and learning strategies, the results showed that learner-instructor and learner-content interactions had significantly positive effects on satisfaction, whereas learner-learner interaction did not affect satisfaction, while learner-content interaction was the only factor that affected perceived progress.

In sum, self-regulation and interaction both appear to be significant contributors to online-learning success. Thus, it is important for the instructors of online world-language courses to help their students improve their self-regulation skills, while also strengthening the quantity and quality of interactions in the online environment.

4. Research Synthesis: Teaching and Teacher Education for Online Language Courses

Studies of education would be ill-advised to ignore teacher-level factors, and this is perhaps especially true of online learning. The preparation needs of face-to-face and online teachers are far from identical, and it is imperative that online language teachers (as, indeed, all other online teachers) receive sufficient professional development (PD) in technology use, pedagogical design, and the integration of technology with pedagogy.

4.1 Teaching Practice

Lin and Zheng (2015) examined online foreign-language instructors' teaching practices, and identified a relative lack of content-related practices such as guiding student knowledge and engaging students with content; and this was matched by a comparatively frequent use of non-content-related practices, e.g., maintaining academic integrity and keeping the course a safe place. These teachers' choices regarding such practices were not impacted by their years of online-teaching experience (contra findings in Bailey & Card, 2009 based on higher-education settings), but did appear to be related to variations in their level of control over course content. Additionally, Lin and Zheng's study shed light on teachers' managerial, social, and pedagogical role changes as they transitioned from face-to-face to online teaching, and their need for more PD in subject-based technology integration. Similar findings were reported by Stickler and Shi (2013), based on their investigation of online spoken-Chinese tutorials' multimodal teacher-student interactions (i.e., interactions involving multiple modalities, such as audio and images). The authors concluded that skillful use of online and other technologies such as audio- or video-conferencing and audio-graphic environments could bridge the gap between teachers' intentions regarding online curricula and what their students actually experience.

4.2 Teacher Education

Only two studies have focused on the training of world-language teachers to teach fully online or blended courses. Both made use of Mishra and Koehler's (2006) Technological Pedagogical Content Knowledge (TPACK) framework. Cheng (2017) developed a Teaching-Learning version of TPACK known as TL-TPACK, comprising five training strategies (practicum, course design, advising, peer cooperation, and reflections) intended to develop trainees' capacity for teaching online courses. Her study highlighted the importance of authentic instructional field experience for pre-service Chinese-language teachers in Taiwan, and found based on content analysis of the participants' reflections that TL-TPACK had improved their technological knowledge, technological content knowledge, and technological pedagogical knowledge. For similar reasons, but working with in-service Chinese-language teachers in the U.S., Tseng (2017) developed an intensive summer training program consisting of both face-to-face and online training components. After six weeks, Tseng's participants' confidence in teaching the target language online had improved, and this was ascribed to the training program's creation of meaningful contexts for communication.

4.3 Technology and Teaching Skills

Teaching approaches used in traditional face-to-face language courses may not be suitable for online environments (Compton, 2009; Lin & Zheng, 2015). For this reason, several studies have investigated and evaluated which language-teaching skills are most appropriate to online settings. Compton (2009) emphasized the different skills needed for teaching languages as opposed to other subjects online, noting the equal focus of beginning-level language courses on the content and the forms of interactions. With the aim of improving training programs for language teachers, Compton proposed a new framework covering three aspects of skills (i.e., technology, pedagogy, and evaluation) at three levels of expertise (i.e., novice, proficient, and expert). She recommended that programs for pre-service teachers' education consider: 1) developing online language-teaching stills through existing courses; 2) developing online teaching skills at different levels of expertise and responsibilities for different roles; 3) revamping existing technology training; and 4) implementing early virtual field experiences and virtual practicums. Comas-Quinn (2011), meanwhile, explored how in-service teachers were impacted by the introduction of blended learning into online language courses. Based on a survey and interviews, the author reported that teachers understood the pedagogical use of new technology, which was essentially aligned with TPACK (Mishra & Koehler, 2006).

When providing training to online world-language teachers, in addition to introducing them to information and communication technology (ICT) and how to use it, it is especially important to guide them to think actively about *how to be* online teachers, rather than passively learning the mechanics of the role. In other words, teachers must not only acquire ICT skills, but also acknowledge the critical importance of their own acceptance of and adaptation to the new pedagogical environment.

Concerning the importance of using technologies suitable to various levels of language learning, Hampel and Stickler (2005) viewed language teaching as a cumulative process, and proposed a skill pyramid with (from bottom to top) seven key competencies: 1) basic ICT competence, 2) technical competence with specific software, 3) ability to deal with the constraints and possibilities of the medium, 4) online socialization, 5) facilitating communicative competence, 6) creativity and choice, and 7) own style. Together, these key competencies illustrate the specific skills that teachers of e-learning courses ideally should have, in the spheres of technology, language knowledge, and the cognitive needs of both the teacher and the learners.

To sum up, research on teaching and teacher education for online world-language courses is still in its infancy. In terms of teaching practices, online instructors appear likely to employ a higher proportion of non-content-related practices. In addition, interactions in multiple modalities are key to improving students' satisfaction and sense of belonging. In terms of teacher education, several early experimental interventions reported improvements in language-teachers' online-teaching skills and confidence, but more research will be needed if we are to understand what components of teacher education and PD are most effective in this area. Regarding technology and teaching skills, several frameworks for online world-language teaching have been proposed, and consistently highlight that merely having technology skills is not sufficient. Rather, understanding how technology can be used for online teaching should be considered a core skill for online instructors.

5. Implications

The prior sections have provided a comprehensive thematic review of the existing scholarship on online world-language courses, including their effectiveness, the factors that predict their students' learning outcomes, and the issues they raise for teaching and teacher education. Based on this review, implications for policy, practice, and future research are provided below.

5.1 Implications for Policy and Practice

Delivering a language course online requires more than simply digitizing current teaching materials and posting them on the Web, or teaching in the same way as in face-to-face settings (Zhang, 2014). Hampel and Hauck (2004) proposed five components that language learners should be provided within computer-mediated learning environments: 1) opportunities for interaction to negotiate meaning; 2) opportunities to hear or read modified comprehensible input; 3) opportunities to produce or write modified comprehensible output; 4) input that allows for a focus on target features of the second language; and 5) a rich context in which the second language facilitates comprehensible input. All five can also be applied to online language learning. As Oliver et al. (2012) noted, good online teaching is more than modeling language output and providing feedback on student work, and socialization and communication are vital to it.

On a macro level, Zhang (2014) concluded that a good online language-course design must be 1) interactive, 2) constructive, 3) intentional, 4) authentic, and 5) cooperative. On a micro level, designing online tasks and activities that can promote interaction is critical, as the literature suggests that a task-based approach normally leads to better learning outcomes than a form-focused one (Blake, 2016). Online materials and tasks should be carefully designed to avoid cognitive overload (Stickler & Shi, 2013) and to promote learner-instructor and learner-content interactions (Lin, Zheng, et al., 2017). Best practices for increasing students' engagement with online content include designing materials based on students' interests and utilizing student-centered practices (DiPietro, Ferdig, Black, & Presto, 2010).

In addition to making pedagogical improvements in course- and task design, online teachers should prepare their students for online interaction, as this will make speaking practice and instruction in the online environment more efficient (Stickler & Shi, 2013). Moreover, given the critical importance of self-regulation in online language learning (Lin, Zhang, et al., 2017), online instruction should help to develop students' self-regulation skills. Chang (2007) demonstrated that the use of just one self-regulatory strategy (i.e., self-monitoring of one's progress towards learning goals) resulted in better online language-learning outcomes.

Providing support and training for online language teachers is essential (Blake, 2016; Lin & Zheng, 2015; Stickler & Shi, 2013), and not only to their development of technological knowledge for online instruction (Cheng, 2017). Lin and Zheng (2015) found that the PD online world-language teachers most needed did not match the PD they actually received. Some high-demand areas, such as accommodating different learning styles and language-based technology integration, should be given much more attention by PD planners and providers.

5.2 Implications for Research

Based on the foregoing research synthesis, several directions for future research can be recommended. First, given the literature's mixed findings on effectiveness, future studies should use research methods other than experimental designs to clarify whether and why online world-language students have lower achievement and/or less positive attitudes than those who take other subjects online, or who take world-language courses in face-to-face settings.

Second, in addition to final grades, Swan (2003) urged researchers to consider alternative measures of learning outcomes. Thus far, such alternative measures have included satisfaction, perceived progress, and students' attitudes (Lin, Zhang, et al., 2017; Lin, Zheng, et al., 2017; Oliver et al., 2012). Given that students' progress in online language courses is not necessarily reflected in final grades or in all four language skills (Blake, 2000, 2011; Lin, Warschauer, & Blake, 2016), it may be helpful to examine improvement in listening, speaking, reading, and writing separately. In addition to these four skills, other aspects of progress, such as identity construction and development, socialization, and pragmatics knowledge, should also be considered as outcomes of online world-language learning (for a review, see Lin et al., 2016).

Third, in terms of factors predicting online language-learning outcomes, the literature has thus far only focused on self-regulation (i.e., motivation and learning strategies) and interaction types (i.e., learner-learner, learner-content, and learner-instructor interactions; see Moore, 1989). Accordingly, future research should consider other individual-level variables such as gender, ethnicity, aptitude, and prior experience of online learning; and contextual factors such as parental involvement, family socioeconomic status, access to computers, availability of mentoring, and online class sizes.

Fourth, though prior studies have identified best practices for online courses (DiPietro et al., 2010), work on best practices for online world-language courses remains limited; and there has been almost no exploration of the relationship between students' learning outcomes and the teachers' use of different practices (e.g., content-related vs. non-content related teaching practice: see Lin and Zheng, 2015). Future researchers are therefore encouraged to investigate whether particular teaching practices promote student learning in online world-language learning contexts.

Lastly, more research grounded in theoretical models with robust research designs is urgently needed. Research on online learning in higher education utilizing the Community of Inquiry (CoI) framework proposed by Garrison, Anderson, and Archer (2001) has confirmed CoI's value in explaining how learners construct knowledge. Thus, using CoI may help to further our understanding of how online instructors' teaching and social presence may affect students' knowledge construction.

6. Conclusions

With an ever-growing number of K-12 students taking online courses, it is important to ensure the effectiveness of all types of online teaching. However, this review has clearly indicated that online world-language learning in K-12 settings is under-researched and under-theorized. First, our review of the effectiveness of online world-language courses found that they appear to face larger challenges than online courses in other subject areas, in terms of both learning outcomes and satisfaction. This chapter also reviewed factors that may contribute to the success of online language learning, and concluded that the existing literature has mainly focused on just two (i.e., self-regulated learning and interaction), often to the exclusion of teacher-level factors. Those few studies that have looked at online world-language teachers indicate that, while such teachers' technology skills for online teaching are important, such skills are separate from – and less important than – their technological pedagogy skills, which enable effective integration of technology into the online curriculum.

This chapter's findings have significant implications for both practice and research. With regard to the former, they imply that online world-language courses should be designed with a view to improving student engagement and interaction. In addition, the current state of PD for online world-language teachers appears to be insufficient in both technology use and pedagogical design. It is recommended that future studies adopt a wider range of both quantitative and qualitative methods to examine online world-language courses from a broader set of perspectives, including not only final academic achievement but also formative assessments that may better capture students' language-skills gains. More studies of teacher education are also needed, to provide more evidentiary support for best teaching practices in online world-language courses.

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PART V

Research on Student Support Structures

Introduction

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Introduction

Moore (1989) identified three types of interactions that are core to meaningful learning experiences: students' interactions with the content, teacher, and peers. First, Moore viewed students' interactions with the course content as "a defining characteristic of education" (p. 2) and an essential part of any online learning experience. In fact, many online courses, such as independent study programs, rely nearly exclusively on student-content interactions (Oviatt, Graham, Borup, & Davies, 2016). Second, Moore (1989) explained that students' interactions with their teacher are "regarded as essential by many educators, and as highly desirable by many students" (p. 2). This is because, as content and pedagogical experts, teachers are able to provide students with personalized tutoring and support. Teachers also provide important feedback as students attempt to apply their content understanding. Furthermore, teachers can provide important affective support as they offer "counsel, support, and encouragement to each student" (Moore, 1989, p. 3). Third, Moore explained that students' interaction with peers "is sometimes an extremely valuable resource for learning, and is sometimes even essential" (p. 4) because the interactions allow students to co-construct knowledge and develop skills that are required to be workforce-ready. However, it is important to note that K-12 online courses commonly have few or no meaningful student-student interactions which places an even greater emphasis on students' interactions with the content and teacher (Gill et al., 2015).

While student-content, student-teacher, and student-student interactions form the core of students' educational experience, students can struggle to engage in these interactions in meaningful ways. Commonly students' failure to meaningfully engage with the course content has more to do with students' inexperience with online learning and their lack of online learning skills than it does with their intellectual abilities to learn and apply the course material (Lowes & Lin, 2015). For instance, online students' ability to use the learning management system is foundational to a successful online learning experience because "the student must interact with the technological medium in order to interact with the content, instructor, or other students" (Hillman, Willis, and Gunawardena, 1994, p. 33). Furthermore, online courses tend to provide students with more flexibility in the learning time, place, and pace requiring students to demonstrate high levels of self-regulation abilities. In addition, online courses rely largely on asynchronous text communication that require students to be more reflective and dependent on their reading and writing skills than is typically required in face-to-face courses (Parsad & Lewis, 2009). The lack of immediate responses to their messages and the absence in visual communication cues can leave students feeling isolated (Palloff & Pratt, 2007). As a result, students' success in online courses is largely dependent on their ability to be self-motivated and self-directed—skills commonly lacking in adolescents (Roblyer, Freeman, Stabler, & Schneidmiller, 2007).

Because of these obstacles to successfully learning online, students require higher levels and different types of support than do their face-to-face counterparts. While, researchers have found that online teachers can form strong supportive relationships with students that help students to overcome the challenges they encounter while learning online (Valasquez, Graham, & Osguthorpe, 2013), developing these relationships and responding to students' needs can be highly time-consuming due to teachers' physical separation and high student loads. Online teachers also have fewer recourses than face-to-face teachers when students reject their support or decline to attend to their communication efforts. As a result, online students find it easier to *disappear* than do students who regularly meet face-to-face with their teacher (Borup, Graham, & Drysdale, 2014; Murphy & Rodríguez-Manzanares, 2008)—as reflected in online learning's high attrition rates (Evergreen Education Group, 2017; Freidhoff, 2017). Thus, K-12 online students need to be provided with more extensive support structures than are typically required in face-to-face environments. While researchers interested in student support structures should continue to examine teacher-provided support, they should also expand their focus to include others who help students to overcome obstacles faced when learning online.

Summary of Chapters

This section of the handbook contains chapters describing the roles that school administrators, parents, facilitators, school psychologists, and librarians play in ensuring students have the support they need to be successful in online and blended courses. In the first chapter, McLeod and Richardson review the limited research regarding school administrators and K-12 online and blended learning. Administrators can both directly and indirectly impact student learning, and McLeod and Richardson note that research conducted in brick-and-mortar environments has consistently found that only classroom teachers have a larger impact than school administrators on student achievement. However, these authors note that research on school administrators in online and blended environments is limited to only a few case studies that fail to form clear lines of research. They summarized, "At best there exist random, scattershot individual studies related to administrators and online or blended learning." As result, McLeod and Richardson expanded their review of the literature to include online programs that prepare administrators for brick-and-mortar schools and brick-and-mortar administrators' perceptions of online programs that prepare teachers for brick-and-mortar schools. While administrators' experiences as online students and their perceptions of online teacher preparation programs can provide important insights into administrators' general perceptions of online learning, it does little to inform our understanding of the roles and responsibilities that administrators fulfill in online and blended programs or how administrators might directly or indirectly improve online and blended learning outcomes. McLeod and Richardson's review of the existing research specific to online and blended program administrators provides a helpful starting point for those who wish to build on the previously existing research. The authors also acknowledge that because this is a largely untouched area of research, almost any new research on the topic would prove to be a valuable contribution.

In the second chapter, Hasler-Waters, Borup, and Menchaca review the literature related to parental engagement in students' online and blended learning. Similar to school administrators, research conducted in face-to-face settings have consistently found that most forms of parental engagement have a positive impact on student learning and performance but research in online and blended settings is lacking. However, the authors noted that the number of research articles published has grown since 2014 when the first edition of this handbook was published. Based on their review of the literature, Hasler-Waters et al. identified four parental roles that appeared to have the most impact on students' learning: (1) organizing, (2) instructing, (3) motivating, and (4) managing. The chapter also describes parents' motivations for enrolling their student in online programs and the four factors that appear to have the largest impact on the types and levels of support that they provide to their students once enrolled (i.e., school policies, parent demographics, student perceptions, and student needs). The most limited area of research related to parental engagement is research examining the actual impacts that parents' efforts have on their students' learning and performance. The few correlation research articles that do exist have resulted in somewhat conflicting results. Based on the limitations of the existing research, the authors identify nine specific research topics that would be especially valuable for researchers to pursue.

In the third chapter, Borup reviews the literature related to online and on-site facilitators. While parents play a critical role in their students' learning regardless of the context, Hasler-Water et al. reported that parents can vary greatly in the quantity and quality of the support that they provide to their children, leaving some students' needs unmet. In an attempt to more equitably and adequately meet students' needs, programs are increasingly requiring that students receive support from a facilitator, also called a mentor or learning coach. Unlike the course teacher, facilitators are not content experts and their primary role is not to teach the course content. Instead, facilitators work to ensure that students engage in learning activities. More specifically, Borup's review of the literature found that facilitators are primarily responsible for establishing relationships with students, fostering learning interactions, monitoring student performance and behavior, motivating students to more fully engage in learning activities, and providing direct instruction when able. In supplemental online programs where students still attend a local brick-and-mortar school, the role of the on-site facilitator is typically fulfilled by an adult who is employed by the brick-and-mortar school such as a teacher, counselor, librarian, or paraprofessional. Because the large majority of their students are not enrolled in a local brick-and-mortar school, full-time cyber schools rely on facilitators who work with students and parents online. Borup highlights that there is especially limited research examining how facilitators are prepared and the impact that facilitators have on student performance. The existing research indicates that students who regularly meet with facilitators are more likely to successfully complete their course and facilitators who have received professional development are more likely to impact their students' learning than those who receive no professional development. Based on these findings it is recommended that researchers seek to better understand best practices that can guide professional development efforts.

In the fourth chapter of this section, Tysinger, Tysinger, and Diamanduros review the literature related to school psychologists in online and blended learning. They note that school psychologists are highly trained professionals who apply psychological principles to assess students' functioning, determine if students are eligible for special services, provide crisis intervention services when needed, and implement programs intended to prevent academic and behavioral problems. For the students they work with, school psychologists play a critical role in helping them to succeed academically, socially, emotionally, and behaviorally. Similar to the research on school administrators, researching examining the roles and impact of school psychologists is extremely limited. In fact, the authors were unable to identify any empirical research on the topic. Instead, the few researchers who have addressed the subject have only published works highlighting the importance of programs to begin to prepare and use school psychologists. As a result, while there is considerable promise for the use of school psychologists in blended and online learning environments, there is a high need for research that examines their actual preparation, practice, and impact.

In the last chapter of this section, Boyer and Kelly review the research related to school librarians in online and blended learning. The authors note that while librarians are commonplace in brick-and-mortar schools, they are underused in online and blended environments and, as expected, there is especially limited empirical research on the topic. Despite the lack of research, Boyer and Kelly note that school librarians are increasingly being used in brick-and-mortar environments to promote online and blended learning by assisting teachers in their adoption of online content and instruction, curating online collections for students to access, helping to troubleshoot technological issues, creating just-in-time tutorials, and promoting students' digital literacy skills. Because of these activities, Boyer and Kelly explain that this is an area especially ripe for research and provide specific suggestions for future research efforts. They also provide helpful policy and practice suggestions for libraries, librarians, library organizations, and per-service programs.

Conclusion

While all of the chapters addressed topics that are under-researched, it seems as though research was most prevalent regarding parents and facilitators with a growing number of empirical research articles that have begun to develop frameworks identifying practices that appear especially impactful on student learning and performance. A few articles have even quantitatively examined the impact that parents and facilitators can have on student performance. In contrast, research examining school psychologists, administrators, and librarians in blended and online learning is especially sparse. The lack of research regarding administrators is especially surprising considering how commonplace their direct involvement is in both supplemental and full-time online programs. The same could be said for research on librarians who are increasingly working to directly and indirectly support online and blended learning. Perhaps the least researched topic was social psychologists and Tysinger et al. found no empirical research on school psychologists related to online and blended learning.

Due to the limited amount of research, all of the chapters drew insights from more established research and frameworks in face-to-face settings. However, research in face-to-face settings should not be generalized to online and blended settings. Thus, these chapters all call for more researchers to place a higher priority on examining student support structures beyond the support that online teachers provide. Each of the chapters also contain implications for practice and research that can provide helpful guidance to those wishing to answer the call for more research on student support systems.

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School Administrators and K-12 Online and Blended Learning

Scott McLeod & Jayson W. Richardson

Abstract

The importance of administrators to school and student success has long been recognized. This chapter examines the research literature on school administrators and P-12 online and blended learning. Unfortunately, despite the growing presence of online learning in both P-12 and higher education, the research literature addressing possible intersections with school principals and superintendents continues to be sparse. Right now, the research landscape is essentially a green field, wide open for any and all explorations. Until a more robust research base exists to inform practice, we will continue to see educators and policymakers implement online learning environments without much guidance from the scholarly literature.

Introduction

The importance of administrators to school and student success has long been recognized. For example, other than classroom teachers themselves, numerous researchers have found that school leadership—both direct and indirect—is the school-related factor that has the greatest impact on student achievement (see, e.g., Leithwood & Riehl, 2003; Marzano & Waters, 2009; Vitaska, 2008), accounting for approximately one-fourth of all school-related learning impacts (Leithwood, Louis, Anderson, & Wahlstrom, 2004). Understanding the actions of leaders at all levels of our educational systems is essential for school improvement efforts and for effective policymaking.

This chapter examines the research literature on the intersection of school administrators and online or blended learning. As the number of online schools and classrooms continues to proliferate rapidly, it is helpful to know how research can inform learning impacts, best practices, obstacles and challenges, and many other implementation issues. While some of the knowledge about effective virtual school leadership may be similar to what is already known from more traditional brick-and-mortar settings, much will be different as learning and teaching migrates to these new technology-mediated and geographically-independent school environments.

Research Synthesis

Unfortunately, despite the growing presence of online learning in both P-12 and higher education, the research literature addressing possible intersections with school principals and superintendents continues to be sparse. The little research that does exist is very fractured. There are no clear lines of study that are being developed by individual researchers or teams of scholars across the country, nor are there places or people that seem to be adopting these research areas as focal points. At best there exist random, scattershot individual studies related to administrators and online or blended learning. The sections below attempt to coalesce the extant literature into some basic categories.

Online Preparation of Traditional School Leaders

The bulk of the peer-reviewed scholarship that exists regarding school administrators and online or blended learning has to do with online preparation of school principals and superintendents. These studies focus on traditional school administrator preparation programs and what occurs as these programs move online in part or in their entirety. These programs are focused on preparing administrators who can lead brick-and-mortar schools, not virtual learning environments. The research on these programs can be organized into several broad themes, including questions about whether online school leadership preparation programs are even appropriate, how to make that preparation most effective, and student experiences within those programs, among others.

Suitability of online or blended preparation of school leaders.

Like for many other professions, much of the early literature related to online and blended learning in traditional preservice school administration programs addressed the suitability of technology-mediated learning spaces for principal and superintendent preparation. For instance, Brown and Corkill (2004), instructors in a wholly-online educational leadership program, offered advocacy and general guidance for online teaching of preservice school leaders. They detailed how online instructors need to be cognizant of emotion, clarity and organization, class instructions, video and audio links, chats, projects, and student competencies. They also noted that online instructors of preservice administrators need to be responsive and caring if they are to create effective online learning environments.

In contrast, Killion (2002) recounted the basics of online learning and then debated the appropriateness of this mode of delivery for the field of educational leadership. After outlining the existing research at that time about the benefits and attractiveness of online learning, she went on to describe some potential pitfalls for school administrator preparation, including content and process quality, hidden costs, and other factors. Killion noted that the work of principals and superintendents in the field is "in the moment" and thus requires attention to "messages delivered not only in words, but also in voice tone and gestures" (pp. 6-7). Killion concluded by stating that "it is difficult to imagine how online learning will build the essential face-to-face interpersonal communication that is the hallmark of an effective leader" (p. 6).

Debates have continued over the past decade about the suitability of online and blended learning spaces for preservice administrators. For instance, both Ghezzi (2007) and Beem (2010) wrote narratives presenting the pros and cons of online educational leadership credentials. While practicing administrators regularly report a need for more flexible credentialing options, determination of how to best operationalize that need often has been a challenge. Both Ghezzi and Beem recognized the reality that teaching and learning in online programs can be very different compared to more traditional brick-and-mortar programs. Both authors comparted the outputs of online preparation to the outputs from traditional face-to-face programs. Ghezzi also noted that blended learning models—defined by satellite connections, distance programs, or videotaped lessons—have long been a tradition in school leadership preparation programs. Moreover, many prospective educational leaders prefer blended or hybrid principal licensure programs over wholly face-to-face or online options (Winn, Leach, Erwin, & Benedict, 2014).

Effectiveness of online or blended preparation of school leaders.

Despite the early reservations of Killion (2002) and others, many school leaders are indeed earning their educational leadership credentials online. Instead of debating the suitability of internet-mediated learning spaces for school administrator preparation, later authors have recognized the inevitability of online learning and instead focused on how to make virtual and blended learning environments more effective for preservice principals and superintendents. One example of this type of research is a self-study by Alvich, Manning, McCormick, and Campbell (2009), which described one university's early efforts to develop a hybrid educational leadership doctoral program. Students met three times per course, with the rest of the coursework and discussion occurring within an online learning management system. Additional fieldwork and dissertation courses also were part of the program, as were occasional campus visits for programmatic events such as defenses. End-of-course evaluations and students' reflective journals were used to assess the quality of the program. High percentages of the students in the preservice leadership program indicated their satisfaction with the blended model. Similarly, Norman (2013) focused his dissertation on analyzing the content, completion rate, and student satisfaction for a practicum in one Florida educational leadership program that shifted from face-to-face delivery to online delivery. Through usage of surveys, interviews, and descriptive statistical analysis of demographic data, Norman found that course outcomes continued to be achieved after the transition. He also reported that student satisfaction and course completion rates remained high.

Other researchers focused on the structure of blended pre-professional course work for school principals and superintendents. For instance, Korach and Agans (2011) focused on one university's approach to incorporating an online learning management system, online discussion threads, and digital portfolios into its school leadership preparation program. Compared to the university's traditional face-to-face program, the authors found that the blended program fostered a community of learners, facilitated authentic leadership, and was "a powerful catalyst for leadership learning" (p. 230). Although the nature of instruction in that program is unclear, the authors noted that questions remained about "effective faculty development for the promotion of constructivism through online technologies" (p. 230). Sabatino (2016) described in detail the development of one university's online educational leadership program designed to prepare leaders of Catholic schools, including the history behind the initiative, its structure, and student assessments. From their interviews of faculty in ten fully online educational leadership programs, Marcos and Loose (2015) noted numerous strategies, program characteristics, and other design and implementation considerations for successful online preparation of school leaders, including cohort models, strong induction experiences, the use of instructional designers, and incorporation of social media into student recognition efforts.

Student satisfaction surveys and end-of-course evaluations appear to be common instruments used to judge the effectiveness of online or blended school administrator preparation courses and programs. For example, Sampson, et al., (2010) compared a hybrid course delivery to that of a fully-online version of the same course using a student satisfaction survey. Students' level of satisfaction was not impacted by the mode of delivery. Moreover, both courses were rated low in similar areas—communication and teamwork—indicating that course content and pedagogy were more critical than the delivery model. Similarly, Sherman, Crum, and Beaty (2010) found that preservice administrators believed that their online course experiences were as equally successful as—but did not necessarily hold an advantage over—their face-to-face classroom interactions.

Experiential aspects of online or blended preparation of school leaders.

Some scholars have focused on the experiences of preservice administrators within online or blended preparation programs rather than the structural aspects of those programs. For instance, Ford and Vaughn (2011) investigated the experiences of a cohort of 14 students who went through a four-year online educational administration doctoral program. The authors discussed faculty and student relationships, technology issues, professional learning, identity, and collaboration. Online identity was a particular emphasis, including how virtual identities interplay with academic learning outcomes. Rusch and Brunner (2013) also studied educational leaders' identity formation in online spaces, including the use of masked, randomized identities to help facilitate both learner and leadership growth. Similarly, Caruthers and Friend (2014) found in their interviews of ten educational leadership graduate students that the sociological concept of a thirdspace can apply to critical pedagogy in online environments and can help school leaders transform their thinking about social justice issues. Finally, in a practitioner-oriented article, Miller, Bennicoff-Nan, and Maestas (2010) presented their own experiences with earning an online doctorate in school administration. These authors discussed why they chose their institutions and detailed their experiences within their virtual programs.

Characteristics of online or blended preparation of school leaders.

Rounding out the research that has attempted to globally assess or describe online and blended preparation programs for administrators who will serve in traditional schools, there also are some studies that have examined particular characteristics of these types of programs. For instance, Tucker and Dexter (2010) described the use of online, electronic cases in several educational leadership programs. Similarly, Rasmussen (2013) discussed the use of participant reflection in online educational administration courses. Both Shinsky and Stevens (2011) and LaFrance and Calhoun (2013) looked at the utilization and perceived benefits of social media and other online tools in preservice administrator courses. Garland and Martin (2004) used interviews to compare online and traditional school leadership cohorts, noting various relationships between preservice administrators' learning styles, program satisfaction, and delivery modality. Israel (2013) investigated whether it is possible to create ethical and resilient school leaders within online course delivery formats. Sherman and Beaty (2007) collected information on the types of distance technologies used by school leadership preparation programs as well as factors that affected greater or lesser usage of those tools. All of these studies help illuminate various aspects of virtual preparation programs for leaders of traditional schools.

Challenges of online or blended preparation of school leaders.

Finally, describing some of the challenges of online preparation for school administrators, Owen (2012) wrote a peer-reviewed fictional case study that focused on a department chair's attempt to build an online option for school administrators. While this case is not empirical, it does portray some of the struggles and nuances that underlie the online preparation of school administrators. Owen's case touched on many aspects that accompany the development of an online school leadership degree, including the perception that online programs are 'degree mills,' student preferences for face-to-face contact, the offering of market-competitive degree programs, faculty preparedness, university infrastructure, recruitment into online programs, and administrative support structures. Although the case study was intended to be a lens on organizational theory, it illustrated the dilemmas that many university educational leadership programs must face as they initiate online or blended learning options for preservice school leaders.

Practices and Preparation of Virtual School Leaders

Although the literature described above discussed the virtual preparation of traditional school leaders, there also are a few reports and studies that address the practices and preparation of leaders of virtual schools. These articles are insufficient, however, to paint a rich picture of virtual school leadership, and we are in clear need of more research that addresses the unique needs of online school leaders. Nonetheless, the existing research provides important insights and is described below.

In her 2010 dissertation, Lee studied the planning and implementation processes of two new virtual charter schools in Wisconsin. Stating that "guidance in planning and implementing these schools is crucial [for translating] educational philosophy into practice" (p. iv). Lee noted that six primary principles should guide virtual school leaders' work at the inception stages: 1) building consensus, 2) defining roles and responsibilities, 3) assessing needs and obtaining resources, 4) collaboration and teamwork, 5) external constraints management, and 6) a time efficiency process. Once virtual schools are up and running, Abrego and Pankake (2010) stressed the critical role of virtual school leaders as builders of organizational capacity and facilitators of organizational culture. Pratt and Pullar (2013) echoed the importance of leaders of virtual schools in their description of New Zealand's OtagoNet distance learning network. School leaders' staffing, instructional supervision, and evaluation work all have been vital to OtagoNet's success. Woodworth, Raymond, Chirbas, Gonzalez, Negassi, Snow, and Van Donge (2015) underscored the importance of principals in online environments, finding that delegation to someone other than the principal of the monitoring of interactions between teachers and families of online charter students was correlated with significant negative impacts on student reading and math growth.

Another study attempted to ferret out the distinctions between virtual school leadership and virtual school management. Quilici and Joki (2011) paired up online principals and teachers who then interacted in a supervision-evaluation cycle. While the virtual school principals viewed themselves as instructional leaders (as defined by the Interstate School Leaders Licensure Consortium, ISLLC), the online teachers viewed their online principals mostly as managers. The authors noted that additional training in cognitive coaching and more frequent human contact could help close the discrepancy in perceptions. Similarly, Beck and Maranto (2014) found in a survey of virtual charter school teachers that personnel practices appeared to be similar to brick-and-mortar public schools but that instructors had more positive views regarding school leadership and climate. A study of 18 cyberschool leaders noted that interactions with students, teacher supervision, professional development, and day-to-day operations often are significantly different in virtual schools than in traditional schools (Richardson, Beck, LaFrance, & McLeod, 2016; see also Richardson, LaFrance, & Beck, 2015).

Salsberry (2010) also discussed virtual school leaders' behaviors within the context of standards. Instead of administrator standards, however, she examined the AdvancEd school accreditation standards. Salsberry went through each of the seven primary accreditation standards and raised questions that were pertinent to leaders of online schools such as 'Does the teacher evaluation system reflect the unique skills, knowledge, and dispositions required for a virtual environment?' and 'How would a leader determine the nature of the [virtual] school climate?' Salsberry's questions are quite helpful when considering what it means to transition traditional conceptions of school leadership into online contexts. Instead of focusing on standards, Fletcher (2012) identified nine strategies, or 'keys to success,' that school leaders should attend to when implementing blended learning programs, including setting ground rules with vendors, ensuring adequate technology support, training teachers to be online content curators, and fostering collaborative experimentation by instructors.

Given the growing prevalence of internet-mediated learning opportunities for both students and educators, even if principals or superintendents are not leading virtual schools they still would likely benefit from some knowledge of and experience with online and blended learning environments. As Wenzel (1998) noted, immersion in and basic understandings of the technologies that are used helps school administrators make informed judgments about support and infrastructure. Additionally, administrators who have some familiarity with online learning spaces are more likely to positively influence the thinking of their teaching staffs, parents, and communities and to facilitate additional virtual learning opportunities.

Unfortunately, despite the admonition by Abrego and Pankake (2010) that administrator preparation programs must "include specific training that ensures that school leaders acquire very specific knowledge and skills on how to reculture their schools and districts as e-learning and/or virtual campuses" (p. 11), most administrators do not get much exposure to the leadership aspects of online learning environments. LaFrance and Beck (2014) conducted a study of all of the school leadership preparation programs certified by the National Council for Accreditation of Teacher Education (NCATE) in order to determine the extent to which preservice administrators were exposed to virtual school settings. They found that only 9% of these university programs offered some type of field experiences in online school settings. Moreover, they also found that "more than 75 percent of NCATE-accredited educational leadership programs [had] no plans to add such a [virtual] field experience" (p. 181). This lack of attention to online school leadership positions is concerning given the rapid increase in virtual schools.

School Leaders and Perceptions of Online or Blended Credentialing

A third, small subset of the literature pertaining to school administrators and online or blended learning addressed the viability of online credentialing for hiring purposes. These studies have focused on the perceptions of those individuals who are in positions to make employment decisions and have investigated the perceived credibility of teacher online credentials by principals as well as administrators' own online credentials.

In regard to teachers, Huss (2007) surveyed over 300 principals in three states to determine their level of concern regarding online teacher preparation programs. Only 2% of respondents said that they would be unconcerned if a teaching candidate applied for employment in their building with a credential that had been attained wholly or almost wholly via the internet, and 59% of the principals said that they would be 'very concerned.' Nearly 95% of the principals stated that online teaching degrees carried less credibility than those earned in traditional, offline programs. Given the choice between two candidates with strong interviews and comparable transcripts, less than 1% of the principals said that they would choose the teacher who was trained online over the teacher from a traditional bricks-and-mortar program.

Similarly, Adams, Lee, and Cortese (2012) surveyed nearly 700 high school principals to see what they thought about online, partly online, and traditional teacher training programs. Respondents displayed a strong preference for coursework taken in traditional residential teacher training programs. Principals expressed particular concerns about the ability of preservice teachers to develop important social and skills in wholly or partly online preparation programs. The authors noted that their results paralleled those in other professional disciplines such as health, business, and university teaching. Faulk's (2011) survey of 72 Texas public school superintendents echoed these findings. Faulk noted that superintendents "appear[ed] to be open-minded to [online preservice learning] but appear[ed] to be unconvinced that it will prepare teachers for the challenges that teachers face" (p. 25).

Regarding principals and superintendents, Ghezzi (2007) postulated that school administrators' online degrees may not be accepted by all school districts and that states may not accept online degrees for school principal or superintendent certification. A pair of articles several years later seemed to confirm the former. In their first article describing a nationwide study of school district human resource directors, Richardson, McLeod, and Garrett Dikkers (2011a) reported that the respondents believed strongly that online principal preparation programs are of lower quality than face-to-face programs and that traditional programs do a better job than online alternatives of preparing candidates for the demands of the principalship. The human resource directors also expressed greater faith in the quality of blended programs compared to those that were wholly online and in online principal preparation programs delivered by traditional colleges and universities compared to wholly online institutions. Additionally, they noted that it was more difficult to assess the quality of online principal preparation programs than it was for traditional face-to-face programs (see also Richardson, 2010).

A second article from Richardson, McLeod, and Garrett Dikkers (2011b) delved into the treatment by school districts of administrative applicants with online credentials. Human resource directors from across the United States consistently emphasized their concerns about principal candidates who were trained wholly or even partly online. Nearly two-thirds of the directors stated that they would treat candidates who were prepared wholly online differently during the hiring process and many reported that they would not even consider those candidates for employment. Another challenge noted by the respondents was a felt need for additional district investigation into the quality of online principal preparation programs, which thus required additional time and/or personnel. The majority of urban school district human resource directors felt capable of assessing the quality of online preservice principal programs, while the majority of rural district directors felt exactly the opposite.

Miscellaneous Studies of Administrators and Online or Blended Learning

The remaining studies that exist at this time regarding school administrators and online or blended learning represent a mixed bag of topics. Areas of study include school leaders' general perceptions of online learning, professional development, policy considerations, evaluation tools, and other issues. Each of these articles is discussed briefly in the paragraphs that follow.

Picciano and Seaman (2007; 2009) found in a pair of surveys of district-level administrators that online learning opportunities are growing rapidly and are meeting a variety of student and school system needs. They also found that most school districts rely on multiple online learning providers and that virtual coursework was considered especially useful by the leaders of small, rural school districts.

As part of a larger dissertation of online secondary coursework in Indiana, Briggs (2011) found that high school principals in the state were interested in utilizing online learning to assist with student graduation rates but lacked guidance from the state regarding implementation and accountability guidelines. In another study of Indiana high school principals, Rayle (2011) found that using online learning for credit recovery and for retaking courses was believed to be some of the most effective uses of online learning for students. Other effective uses of virtual classes were considered to be offering courses not otherwise available, meeting the needs of at-risk students, and increasing the number of possible electives. Respondent principals also reported that course costs and the lack of course quality were significant barriers to their schools' ability to offer online classes for students but that technology infrastructure, bandwidth, and the master contract with teachers were less important.

An older investigation by Heidlage (2003) found that Catholic high school principals across 15 states were cautiously supportive of online courses as long as they were primarily for supplemental, elective purposes, had time limits for course completion, and also included limits on the number and types of virtual classes. Brown (2009) surveyed and interviewed virtual high school administrators to determine how they thought about the purpose and potential of their schools. Respondents believed that key purposes of virtual schools were to individualize learning experiences for students and to reform traditional education systems.

Batley (2009) investigated the perceptions of principals and other educators associated with a single online entity, the Louisiana Virtual School. She found that the administrators for the school were considered to be responsive to its curricular needs and that they perceived online learning as an effective learning vehicle for students.

Black, Ferdig, and DiPietro (2008) collected and discussed a variety of evaluation instruments that were helpful for school leaders. The evaluative tools profiled by the authors covered students, teachers, curriculum, technology, course-specific features, and other areas of virtual learning. The authors also highlighted the need for additional or better assessments for virtual learning contexts and advocated for better use of existing data.

On the policy front, Baker and Bathon (2013) outlined model legislation for virtual schools and provided detailed recommendations about financing and quality monitoring. Although their white paper was not aimed directly at online school leaders, it does pave the way for these leaders to understand possible financial models that may impact their own virtual or blended programs. In his article aimed at superintendents, Glass (2010) pleaded for school leaders to ask tough questions about teaching quality, authenticity, and accounting practices when considering online learning providers.

In addition to formal online coursework for school leaders, Ertmer, et al. (2002) reported that online professional learning opportunities for practicing administrators can be an effective means of enhancing their technology leadership knowledge and skills. Over a decade later, both Cox (2012) and Brennan (2013) affirmed that principals' participation in informal virtual communities of practice enhances their ability to be effective organizational change agents. These last studies reinforce the potential power of online learning environments—either formal or informal—for practicing administrators.

Summary

Although it is challenging to synthesize the extant literature on school administrators and blended learning given both its scarcity and its diffuse coverage, a few highlights are worth noting. First, the bulk of the research has focused on online preparation of traditional brick-and-mortar school administrators, with a few studies on the preparation of virtual school leaders. As a result, the current research base does little to advance our understandings of what it means to be an effective leader of online or blended learning environments on a day-to-day basis. Second, research regarding perceptions of online learning appears to be the second largest area that has been studied. Since it is clear by now that blended learning models are usually a question of how, not if, most future research probably should focus more on implementation concerns rather than merely philosophical aspects. Finally, this leadership sector of virtual schooling research appears to be wide open for scholars who wish to claim it as their primary field of study. We encourage some researchers to take up the challenge of becoming the go-to experts in this area.

Implications for Policy and Practice

Given the dearth of research on administrators and online/blended learning, it is difficult to conclude anything other than that we really do not know much about what it means to be a leader of virtual schools. Aside from anecdotes and personal testimonials—and a few descriptive articles aimed at practitioners—there is not a solid foundation of empirical research to inform our understandings of the administrative complexities that accompany being a leader of online learning environments.

The scholarly literature appears to indicate that, like for traditional schools, administrative supports are crucial to the success of virtual learning environments but that those supports take different forms when moved from brick-and-mortar settings to online settings. For instance, assurance of quality learning and teaching, observation and evaluation of faculty, student discipline, course calendars and timelines, employee induction and professional development, and many other aspects of schooling all can look quite different in blended environments. Administrators who are taking on virtual school leadership roles—either full- or part-time—should attempt to tap into the tacit knowledge of other leaders who already are in these roles. Even after the research and practice literature matures, current virtual school principals and directors often will be the best source of information about how to do the job effectively. As such, virtual school administrator interviews, internships, job shadowing, and other mechanisms for leadership development should be the norm for prospective leaders of blended learning. Also, given the widespread agreement that blended learning environments are qualitatively different than traditional learning spaces (see, e.g., Beem, 2010; Ghezzi, 2007), school administrators that will be leading virtual learning programs should experience such environments beforehand as both learners and teachers.

Although Beem (2010) concluded that online preparation of traditional school administrators is the way of the future, the existing research shows that virtual educational leadership preparation is still murky territory where acceptability, quality, and rigor are questioned at every step. Accreditation and other quality indicators need to be affirmed for all educational leadership programs, whether tradition, online, or blended. This will mean judging programs based on course content, experiences, and impacts, not simply mode of delivery. School districts also need assistance from national organizations, researchers, state departments, or others regarding the assessment of the effectiveness of online administrator preparation programs. Currently there exist few guidelines for how to think about virtual preparation of school leaders. Organizations such as the University Council for Educational Administration, the National Council of Professors of Educational Administration, and iNACOL should be working together to create useful, research-based recommendations and practice guides.

In regard to preparation of virtual school leaders, current educational leadership programs must pay greater attention to effective facilitation and support of those learning spaces, including more discussion of the leadership practices that are unique to online environments and perhaps required leadership field experiences in virtual settings. Since virtual learning in elementary and secondary schools continues to grow at a rapid pace, school administrator preparation programs that continue to ignore online and blended learning will become increasingly disconnected from the realities and needs of modern schools.

Implications for Research

The absence of a substantive literature base on school administrators and online/blended learning mirrors the larger research scarcity regarding school leaders and digital technologies (see, e.g., McLeod & Richardson, 2011; McLeod, Bathon, & Richardson, 2011). Even though computers, the internet, and other technological tools are completely transforming our information, economic, and learning landscapes, educational leadership scholars have not kept up. Grave deficiencies exist in the research literature and, unfortunately, only a few researchers are even trying to study these issues (McLeod, 2011).

Kowch (2009) noted that cyberschools represent perfect opportunities to bring together what we know about effective school leadership with emerging understandings and best practices about educational technologies. Distributed leadership practices, improvement in school policy and governance mechanisms, new instructional leadership opportunities, and dynamic systems oriented toward substantive change can and should be encompassed within the realm of online and blended learning in elementary and secondary schools. A more robust research base is needed, however, to inform and support the online learning movement, which is proceeding forward rapidly despite scholars' comparatively-slow progress.

The lists of questions posed by Vail (2002) and Salsberry (2010) may be excellent places to begin for scholars interested in the intersections between school leadership and online and blended learning. Right now, the research landscape is essentially a greenfield, wide open for any and all explorations. Researchers who are unsure where to start can examine the existing literature base for traditional educational leadership roles and then ask how those findings may be different if extrapolated to virtual school settings. Essential leadership functions of curriculum and instruction, professional development, management and operations, budgeting and finance, supervision and evaluation, law and policy, and so on all take new forms and require new considerations when transitioned from brick-and-mortar institutions into online learning spaces and structures.

Conclusion

Because there is so little of it, the existing literature on school administrators and online/blended learning fails to tell us much. Until a more robust research base exists to inform practice, we will continue to see principals, superintendents, virtual school directors and companies, and policymakers implement online learning environments without much guidance from the scholarly literature. Given the rapid expansion of online learning in elementary and secondary schools, much greater research attention is needed to the leadership necessary for effective facilitation of internet-mediated school and classroom structures.

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Parental Involvement in K-12 Online and Blended Learning

Lisa Hasler-Waters, Jered Borup, & Michael P. Menchaca

Research indicates children generally fare better in traditional schools when parents are involved. However, scant research exists concerning parental involvement in alternative settings such as blended and online schooling. Since 2014, when this chapter was originally written, new research on this topic has emerged including studies focused on students with disabilities enrolled in online settings. Overall, this chapter continues to affirm that: (a) categorization of technologically-mediated schools is ill-defined; (b) levels of parental involvement vary and are influenced by many factors; (c) links between parent involvement and student achievement exist in alternative settings but further research is needed. There are implications for public policy. This chapter provides specific suggestions for further research.

Keywords: Parental involvement, parental engagement, learning coach, online learning facilitator, cyber schooling, virtual schools, K-12 online learning

Introduction

Decades of research have shown that children do better in traditional school settings when parents or guardians are involved in their education (Baumrind, 1971; Dornbusch, Ritter, Leiderman, Roberts, & Faraleigh, 1987; Eccles & Harold, 1993; Epstein, 1986, 1995; Jeynes, 2010; Lareau, 2011; Lareau & Horvat, 1999; Sui-Chu & Willms, 1996; Zellman & Waterman, 1998). However, research concerning parental involvement in K-12 online and blended schooling is relatively uncharted. Such a paucity of research may be the result of the newness of K-12 online and blended learning or the difficulty of gathering information from sources outside the actual school. More concerns arise when populations, such as students with disabilities, are not properly identified and/or are underrepresented (Fernandez, Ferdig, Thompson, Schotke, & Black, 2016).

This chapter provides a review of current research examining parental and guardian involvement in K-12 online and blended learning environments. From this review, three significant themes emerged: (a) a continuum of parental involvement; (b) links between parental involvement and student achievement; and (c) behaviors, roles, and perceptions of parental involvement.

After briefly explaining the search methodology for this review, we begin the chapter by defining the various school settings in which the research reviewed has taken place. We then operationally define the concept of *parental involvement,* providing parent demographics and parent rationales for enrolling children in online or blended school settings. Next, we describe relevant theories. We conclude the chapter with implications for policy and practice and recommendations for continued research.

Research Synthesis

Search Methodology

A systematic process was used to conduct a search for literature and research concerning parental involvement in K-12 online learning. This process involved using a number of online tools, such as Google, Google Scholar, ERIC Clearinghouse, ProQuest, Academic Search Premier, and both the University of Hawaii at Manoa and George Mason

University libraries to access refereed journals, conference proceedings, dissertation indices, and reports available from governmental organizations. Terms used in the searches included but were not limited to: parental involvement and/or familial involvement combined with learning coaches, virtual schools, K-12 online learning, cyber schools, cyber charter schools, and online charter schools.

Settings Defined

In general, the term K-12 online learning refers to online learning for elementary and secondary school students. The term virtual schooling describes programs that allow students to supplement their brick-and-mortar schools' courses with one or two online courses (Hasler-Waters, Barbour, & Menchaca, 2014). Cyber schools represent schools which serve students who are primarily enrolled online (Watson, Murin, Vashaw, Gemin, & Rapp, 2012). Online charter schools, also called cyber charter schools, are defined as K-12 online publicly funded schools, which are governed by state charter policies and rely on online learning and teaching for a significant portion of delivery and which may also involve home and traditional school practices (Hasler-Waters, et al., 2014). Finally, the Clayton Christensen Institute recently defined blended learning as a formal education program in which a student learns: (a) at least in part through online learning, with some element of student control over time, place, path, and/or pace; (b) at least in part in a supervised brick-and-mortar location away from home; and in which (c) the modalities along each student's learning path within a course or subject are connected to provide an integrated learning experience (Christensen, Horn, & Staker, 2013).

Specific to blended learning, the Christensen Institute has categorized learning practices into four models: (a) Rotation, (b) Flex, (c) A La Carte, and (d) Enriched Virtual. Within blended learning contexts, Rotation occurs when students rotate between various modalities and at least one modality involves online learning. This Rotation Model includes an emerging classroom practice called A Flex approach includes online learning as a main modality but may include offline activities. A La Carte may have students take entirely online courses or experiences while still relying on brick and mortar experiences. Finally, Enriched Virtual has students divide time between immersed online and brick and mortar experiences, but with the primary model being virtual. While these terms are significant and occur in the literature often, they primarily relate to blended environments versus completely online ones. However, because of the popularity of the terms, some authors use them beyond blended learning environments.

Thus, a significant challenge to identifying and categorizing online and blended schooling is that these areas and terms continue to evolve. However, since the purpose of our chapter is to examine parental involvement in the broadest spectrum of K-12 online learning, a comprehensive taxonomy is used to describe K-12 online learning. Table 1 provides typical terms found in the research and how these are defined.

Table 1. Terms and Definitions for K-12 Online Learning

Term	Practice
Virtual Schooling	Supplemental online learning; sometimes identified as A La Carte
Cyber Schooling	Full time online learning, with little to no brick and mortar schooling experiences; sometimes identified as Flex model
Online Charter Schooling	Full time online learning with brick and mortar practices; sometimes identified as Enriched Virtual
Blended Learning	Primarily brick and mortar based schooling with some online work; sometimes identified as Rotational

Parental Involvement Defined

While the term *parent* typically refers to those with legal guardianship of a child, schools and governments also commonly use more inclusive definitions. For instance, the No Child Left Behind Act (2002) defined parent as “a legal guardian or other person standing in loco parentis” (p. 2088). Similarly, the Individuals with Disabilities Education Act’s definition of parent included “an individual acting in the place of a natural or adoptive parent including a grandparent, stepparent, or other relative with whom the child lives” (p. 1401). However, some researchers such as Black (2009) have defined parent more narrowly to only include “biological parents or those placed in a guardianship role as supervisors of a student enrolled in a virtual school” (p. 17). In contrast, Borup, West, Graham, and Davies (2014) argued that the term parent in K-12 online and blended settings should be defined more broadly and that the role of a parent “can be performed by one or many individuals whose relationship with the student extends beyond the course” (p. 118). For the purpose of this chapter, we adopted an inclusive definition for parent: An adult, not an employee of an online program, who has a long-lasting relationship with the student and a legal or ethical responsibility to care for the student.

Although some have used the term *parental engagement* to emphasize “reciprocity and mutual commitment” (Pushor & Ruitenberg, 2005, p. i), parents’ activities to support students’ learning are commonly referred to as parental involvement. Parental involvement is highly complex and idiosyncratic; a comprehensive list of all possible types of involvement can actually distract researchers from best practices (Ferdig, Cavanaugh, DiPietro, Black, & Dawson, 2009).

Graham, Henrie, and Gibbons (2014) have found research of parental involvement in face-to-face settings is well established and contains widely accepted parental involvement frameworks whereas parental involvement in online and blended settings is less mature and the field has struggled to establish accepted frameworks. While differences in student populations and learning environments prevent generalizations, parental involvement frameworks developed in face-to-face settings can provide important insights to those examining K-12 online and blended environments. As a result, the remainder of this section will summarize two well established frameworks for examining parental involvement in face-to-face settings as well as three frameworks designed specifically for K-12 online and blended environments.

Based on data provided by 3,700 face-to-face elementary school teachers and principals and 1,200 parents, Epstein (1987) developed a framework containing four types of parental involvement: parenting, communicating, volunteering, and learning at home. Parents’ first responsibility was to fulfill their basic parenting responsibilities by meeting students’ basic physiological (e.g., food, clothing, and shelter) and academic (e.g., a place to study and school supplies) needs. Second, parents should participate in school-to-home communications. Third, parents should volunteer to assist with school activities and attend extracurricular events. Finally, parents should be involved in learning activities at home and help their students to develop the academic and social skills they need to be successful (Epstein, 1987).

Hoover-Dempsey and Sandler's (1995, 2005) model of parental involvement only identified two types of parental involvement: involvement at school and involvement at home. However, they explained that both types of involvement could impact student outcomes based on the following four mechanisms: (1) encouraging student engagement, (2) modeling appropriate behaviors and attitudes, (3) reinforcing students' positive engagement, and (4) instructing in the content and learning skills. Liu, Black, Algina, Cavanaugh, and Dawson (2010) applied Hoover-Dempsey and Sandler's framework to K-12 online learning by creating and validating a survey instrument that measured each of the four outlined mechanisms, making it one of the few validated instruments in the field of K-12 online and blended learning.

However, without adequate case study and exploratory research it is unknown if the above frameworks capture all of the important types of parental involvement in K-12 online and blended learning settings. For instance, some researchers have suggested that parents have greater responsibilities online than they do in face-to-face courses (Beck et al., Maranto, & Lo 2013; Hasler-Waters, 2012) and Hasler-Waters (2012) found that the face-to-face frameworks did not capture the full range of behaviors parents engaged in when supporting their students in online schools. As a result, Borup, West, Graham, and Davies et al. (2014) developed the Adolescent Community of Engagement (ACE) model to specifically describe ways that parents could impact students' affective, behavioral, and cognitive engagement. Using K-12 online and blended learning research, Borup et al. (2014) built on the above frameworks by identifying the following six types of parental engagement that positively impacted student engagement: (1) nurturing caring relationships and ensuring that basic needs are met, (2) monitoring students' engagement activities and performance, (3) motivating students to fully engage in learning activities, (4) organizing students learning environment and schedule, (5) volunteering to assist with extracurricular activities, and (6) instructing students in the course content and learning skills. Borup et al. also acknowledged that students required an extensive support system that included teacher and peer engagement in addition to parental engagement.

The Challenge with Demographics

To date, most studies focus on online student demographics and little attention has been paid to the demographics of parents whose children are studying online. Some researchers have suggested that compared to brick-and-mortar school enrollment, these alternative schools serve a less diverse population. Welner, Hinchy, Mathis, and Gunn (2013) found that these schools serve relatively few students who are African-American or Hispanic, lower income, or need special education services. In fact, a recent study conducted by the National Education Policy Center (2015) found that in full-time virtual schools, almost 70% of the students in virtual schools were white non-Hispanic, compared to the national mean of 54%.

Addressing students with special needs due to health or disabilities is an area that has gained attention since we last reported on this topic. There were numerous studies and reports focusing on this demographic of students and their parents. A group of researchers conducting studies concerning students with disabilities enrolled in three different state-led virtual schools discovered that in one of these states, 24.3% of parents reported children with special health care needs. This figure is higher than traditional schools where 13.3% of students typically have a disability (Fernandez, et. al., 2015).

When the demographic profiles of parents were examined from the research reviewed for this chapter, most parents had at least some college education and were of middle-income families . However, these demographics could not be generalized because not all of the studies sought broad representation of the family populations for the schools involved in their study.

Reasons Why Parents Enroll Their Students

Students who are enrolled online school are there because their parents typically make an have made an active choice to enroll them in these alternative schools (Beck, Egalite, & Maranto, 2014; Beck & Maranto, 2013; Erb, 2004). Research indicates that parents choose to enroll their students in online schools for a variety of reasons. For instance, Erb (2004) discovered that sometimes there are “push” factors that drive parents and their students away from brick and mortar school settings. She described these factors as negative incidents that occur at brick and mortar campuses, such as bullying or health and safety. Similarly, Borup and Stevens (2016) reported that some parents enrolled their students in online charter schools in response to brick and mortar schools’ failure to protect their students from “verbal and physical aggression from other students” (p. 234). Some parents choose these schools because they are convenient for students whose health may prevent them from traveling to and from a campus (Ahn, 2011; Fernandez, et. al., 2015). Cwetna’s (2016) analysis of 87 survey responses and six interviews found that parents primarily enrolled their students in supplemental online courses to avoid distractions and negative social environments.

Parents may also enroll their students in these schools because they offer increased learning opportunities, serve rural and otherwise isolated areas, align with parent values, and/or offer flexible schedules to accommodate students who may be young professional actors or athletes (Ahn, 2011; Archambault & Kennedy, 2017; Borup & Stevens, 2016; Erb, 2004). Relatively recent studies have also shown that the promise of individualized learning and customization also influence parents as they choose these alternative schools (Archambault & Kennedy, 2017; Borup & Stevens, 2016; Marsh, Charr-Chellman and Stockman, 2009).

Others might enroll their children because they may have been struggling at brick and mortar campuses or may have come from at-risk backgrounds (Darrow, 2010; Hubbard & Mitchell, 2011). Home school parents may also enroll their students in online courses because they want their students to continue learning from home but need the support that an online teacher can provide. Borup and Stevens (2016) reported that while parents enjoyed homeschooling their students, they enrolled their students in a full-time online charter school when the curriculum became too challenging and so that their students could earn a traditional high school diploma. These two reasons may explain why research at an online charter school found that a large portion of students were formerly homeschooled (Borup, Graham, & Davies, 2013).

A rather new phenomenon in why parents may choose these schools for their children reflects market-based factors. In this case, parents choose to enroll their children in these full-time online schools based on an assumption that school-choice provides a possibly superior option to their public schools (Barbour, 2017; Connell, 2016). What confounds this trend is that students enrolled in these schools are not necessarily performing as well as or better than their traditional school counterparts. This is problematic because often there is little oversight or accountability demanded of these schools and parents might not be fully aware of how these schools fare before they enroll their children in these schools.

In their study concerning parental involvement, Beck, Maranto, and Lo (2013) concluded that because parents who enroll their children in these alternative schools have to make an active choice, they represent a population that differs in important ways from their traditional school counterparts. These differences and reasons are worth examining and may provide important clues concerning how to affect student achievement in K-12 online schooling.

Three Significant Research Themes

Although new research is continually emerging, currently there is limited research concerning parental involvement in K-12 online schooling. In this chapter, we examined a few existing studies and identified three significant themes regarding parental involvement: (1) a continuum of parental involvement; (2) parental involvement and links to student achievement; and (3) parental behaviors, roles, and perceptions. Since this chapter was originally written, these factors have not changed significantly. What has changed though is the additional focus on parents of students with disabilities who are enrolled in these schools. We address these changes in each of the categories described below.

Continuum of Involvement

Several researchers have indicated that parents need to be engaged in students’ learning at a high level when students are enrolled in online courses as compared to face-to-face, especially when students are learning from home (Liu et al., 2010; Sorensen, 2012; Borup, Stevens, & Hasler-Waters, 2015). The level or amount of parental involvement in K-12 online schooling may be considered along a continuum which ranges from little to full involvement. Studies that have explored the levels of parental involvement point to several factors which tend to influence their involvement in these schools. These factors include (a) school policies, (b) parent demographics, (c) student perceptions, and (d) student needs.

(A) School Policies. Policies concerning the level of parental involvement, their roles, and their responsibilities seem to be lacking or inconsistent across schools. When we first wrote this chapter, several researchers found that parents of students enrolled in K-12 online schools asserted they were not always well informed of the level of involvement they were expected to undertake (Boulton, 2008; Hasler-Waters & Leong, 2014; Litke, 1998). These researchers surmised that parents' lack of understanding expectations may have led to some student challenges and teacher frustrations as they attempted to work with parents in these alternative settings. For instance, in Litke (1998), teacher participants identified school weaknesses as lack of parental involvement and lack of opportunity to build relationships with parents, while a school strength was student success attributed in part to supportive parents. Curiously, both Litke (1998) and Hasler-Waters and Leong (2014) found that parents expected more from teachers, and teachers expected more from parents. Boulton (2008) asserted that schools needed to provide parents with clear policies detailing expectations for parental support, without which parents would fail to understand the level of commitment required.

Current research still finds inconsistencies in policies concerning parental involvement. The Center on Online Learning and Students with Disabilities (COLSD) conducted a series of comprehensive studies with parents of students with disabilities enrolled in these schools. The study reported that supporting students with disabilities in these schools is more complex, and often requires greater collaboration between parents and the schools. One of the significant findings from their studies suggested that a " …critical element of the process was to manage parental expectations," and further, that "…calls awareness to increased parental participation needs" (Franklin, Rice, East, & Mellard, 2015, p. 6). The Individuals with Disabilities Education Act (IDEA, 2004) is the federal law that requires schools to serve the educational needs of eligible students with disabilities. This act mandates that parents be involved in the education planning for their students. Franklin, et al., 2015) found that districts welcome parental involvement and parents play an integral role in their child's IEP (individualized education plan). However, their studies concluded that there were no "clearly delineated systems" for their involvement and there were inconsistencies between the levels of parental participation schools required.

Conversely, 66% of the 119 parents whose children had disabilities and who took part in the Burdette and Greer (2014) study reported that they either agreed or strongly agreed they were well prepare to make decisions concerning their children's online instructions. Furthermore, participants reported that their school frequently communicated with them about their children's' learning and 62% agreed or strongly agreed that the support they receive was very good.

Policies concerning communication between schools and parents of students enrolled in these schools is also a topic of importance. A study conducted by Cavanaugh et al. (2009) set out to discover whether online schools had written policies regarding communications with parents among other stakeholders. They collected responses from 108 K-12 online schools and found that 43 out of 81 responders had school policies in place regarding the amount and content of teacher communications with parents. The researchers found that the teachers in these schools had substantial responsibility for communicating and enforcing these policies. Importantly, they also learned that in some schools, not all parents were aware of the policies.

In a more recent study, Curtis and Werth (2015) found that parents perceived that the transparency and ease of access to student information afforded by the school's learning management system (LMS) was a useful form of communication. The LMS gave parents the tools they needed to assist their children. For instance, parents could use the LMS systems to track student progress, track student schedules, track due dates and access lessons and homework. Thus, transparency of and access to information becomes an important form of school communication.

(B) Parent Demographics. that Might Influence Involvement. Limited research exists regarding parent demographics. Further, national centers for school demographics, such as the National Center for Educational Statistics, do not have specific demographic profiles of parents whose students attend virtual, cyber or online charter schools, or blended learning classrooms. Of the little research available, one study found some evidence suggesting parent demographics might also influence level of involvement. Beck et al. (2013) conducted a level of satisfaction study of 232 parents and 269 students in a grade 7 to 12 cyber school. They discovered that similar to traditional school settings, more parental involvement led to increased satisfaction with school between parents and students. However, because parents had to make an active choice to attend the school, they may differ from traditional school parents. This may explain why some of the factors, like gender, special education, and race did not have the predicted impact on parental involvement and were contrary to those found in prior traditional setting studies. Latino parents in the cyber charter school were significantly more actively involved than white parents. Ultimately, the results indicated that the cyber charter school setting presented unique conditions for which prior findings of parental involvement may not be the same. Of the studies concerning the parents of student with disabilities, Fernandez, et al. (2016) noted that "…children whose parents had a bachelor's degree or higher were more likely to perform better in online schools" (p. 69). The need for further research on parent demographics is evident in the wide range of findings from just these few studies.

National survey research from Gill et al. (2015) provided the most comprehensive description of student demographics at online schools. They found that the percentages of students with disabilities was similar across online charter schools and face-to-face schools (14%). However, "online charter schools have an overrepresentation of white students and an underrepresentation of Hispanic students" (p. xii). These researchers argued that this underrepresentation of Hispanics in online charter schools and not in face-to-face charter schools may be the result of "lower knowledge of options among students and parents who might be immigrants and not speak English as a first language" (p. 6).

Teachers in Borup's (2016) study also described some general trends in parental involvement based on their background: "In general, teachers found that those who previously homeschooled their students needed to be 'willing to step back' and those whose students previously attended brick-and-mortar schools needed to be willing to take a step forward" (p. 79). Teachers explained some parents needed to take a step back because they did not allow their students the freedom to assume control over their own learning. Teachers also suspected that a small number of parents actually completed work for their students, either intentionally or unintentionally. One student in another case study actually confirmed this perception by admitting his mother completed the "busy work" so he could focus more important assignments (Borup, Stevens, & Hasler Waters, 2015).

(C) Student Perceptions. Studies examining student perceptions of parental involvement suggested that students highly valued their parents' involvement and found it motivational. In Litke's study (1998), students ranked the level of their own parents' involvement in their schooling. There were three types: absentee, supportive, and participatory. Absentee meant that parents were minimally involved, while participatory meant that parents were fully engaged. Two of the students who rated their parents' involvement as absentee eventually dropped out of the cyber school and returned to traditional school, primarily because they were failing. The third student who ranked his parent as absentee went on to complete the program with better than average grades. Litke summarized that while student success rates appeared to improve when they ranked their parents' involvement as either supportive or participatory, "success was not guaranteed in any category" (p. 7). He also discovered that teachers, parents, and students agreed that when students assumed responsibility for their learning, they did well academically.

Boulton (2008), nearly a decade later, noted similarly that students who did not complete virtual courses reported a lack of continued support from their parents. Likewise, Borup, et al., (2013) measured learner-parent interaction between high school-aged students enrolled in an online charter school and their parents and discovered that students in fact viewed interactions with their parents more motivational than their parents indicated. Borup et al. (2013) concluded that this was a possible indication that parents did not fully understand the impact that their involvement had on their student's learning.

Guided by the ACE framework (Borup et al., 2014), Oviatt, Graham, Borup, and Davies (2016) surveyed over 1,000 online independent students at the start of a semester regarding students' perceived support needs and who they anticipated would best provide them with the support they required. Students indicated most frequently that their parents would be the one to offer support on all but one of the survey items. However, when surveying students at the end of the semester, Oviatt, Graham, Borup, and Davies (accepted) confirmed that parents played an especially important role in students learning. Oviatt and his colleagues summarized that students reported receiving the most assistance from their parents, more than twice as much as from those acting in the teacher or peer roles. Although at the start of the semester many of the students reported that they would like to receive parental support, by the end of the semester there were significantly few students who reported actually receiving parental support.

All studies suggested that parents might not have fully understood the motivational value of their involvement for their children. These studies implied that for students, their parents' involvement was important. More research should be conducted to better understand how to help parents comprehend the significance of their involvement.

(D) Student Needs. Studies concerning student needs suggest that parents tend to increase their level of involvement when a student is struggling or failing. In his study of virtual school students and parental involvement, Black (2009) found intriguing evidence that might explain this phenomenon. From his investigation of 435 parents and their students enrolled in virtual school courses, he discovered a significant negative correlation between parental instructional support and student achievement. He posited one explanation that suggested when students struggled academically their parents tended to offer them more support. Like Black (2009), the researchers indicated that because school policy required teachers to contact parents when students were struggling academically, parents were more compelled to be involved. The results from two qualitative studies further underscore that when students struggle parents tend to become more actively engaged (Curtis, 2013; Hasler-Waters, 2012). These findings are consistent with research in traditional schooling settings (Fan & Chen, 2001; Zellman & Waterman, 1998). Gill, et al., (2015) national survey also found that in online charter high schools expected less involvement from parents as compared to their online elementary and middle school counterparts who teach students who tend to have less self-regulation and metacognitive skills.

Recent studies still report the same type of findings that when students struggle, parents deepen their involvement, and when students show motivation, parents decrease their involvement. Curtis and Werth (2015) found that parents who indicated their students were not as successful were very involved with their children's learning. Some parents reported that they would sit with their children for "every lesson" (p. 187). In another recent study conducted by Burdette, et al., (2015), over a quarter of the parents reported spending up to three hours per day working with students. Ortiz, et. al. (2017) found that parents of K-8 students reported their primary role in helping their children was to help them learn content and that parents assumed considerable responsibility for imparting content knowledge to their children. Parents reported that their time was spent helping their children learn the content, behavior skills, and organizing their work time. The researchers were concerned whether parent instructional support, or training to deliver such instructional support, was of the caliber given by highly qualified special education instructors. The researchers were concerned that since most parents were not certified special education instructors, yet were expected to provide these services, and since this is a requirement of the IDEA (2004), "this situation could be considered an IDEA compliance breach" (p. 85).

Student Achievement and Parental Involvement

While there is a dearth of research concerning student achievement among the various forms of K-12 online learning, the literature that does exist is varied. Research on student achievement in virtual and blended schooling suggests similarity to traditional school student achievement levels (Means, Toyama, Murphy, Bakia, & Jones, 2009). However, more recent investigative reports and state audits have shown that students enrolled in cyber and online charter schools are not faring as well academically compared to their traditional school counterparts and are dropping out at higher rates (Barth, Hull, & St. Andrie, 2012; Charter school performance in Pennsylvania, 2011; Freidhoff, 2016, 2017; Glass & Welner, 2011; Layton & Brown, 2011; Ryman & Kossan, 2011; Saul, 2011; Taylor et al., 2016). Even studies focused on students with disabilities have shown inconclusive evidence that these alternative schools help students to achieve (Fernandez, et al., 2016). There is even less known about the impact of parental involvement and student achievement in K-12 online schooling.

One early study concerning parental involvement and middle school students enrolled in an online school cyber school indicated there may be a link between parental involvement and student success (Litke, 1998). However, Litke warned that student success was also linked to other important factors, such as whether students accepted responsibility for their own learning and that a combination of student and parent commitment was ultimately the best anecdote for student success. Litke (1998) posited an inverse relationship between the amount of responsibility students accepted for their own learning and the amount of parental involvement required for student success. Over a decade later, Curtis (2013) corroborated this by finding that parents of successful online students reported they did not need to spend as much time monitoring their students once they had established good working routines.

Black (2009) conducted a quantitative study to measure parental involvement in virtual schooling. He found a positive relationship between parental praise of their children's schoolwork and student performance. Conversely, he found a significant negative relationship between parents' reported level of engagement in instructional activities and student grades. Black hypothesized that parents lacked the knowledge and skills to adequately aid their students' learning, or, as previously discussed, they increased their involvement only following poor academic performance by the student.

When Borup et al. (2013) studied student and parent perceptions of interactions they learned that students reported spending over 300% more time interacting with their parents on school matters than with their teachers. The researchers asserted that this pointed to parents' crucial role in their online student's education. Additionally, the study found the majority of parental interactions were not significantly correlated with student course outcomes, and in fact, most were negatively correlated. This finding corroborated Black's (2009) finding. However, Borup et al (2013) surmised that to assume that a high level of parental involvement is required in order for students to achieve oversimplifies the matter – a caveat reflected in Litke's (1998) conclusions that parental involvement should not be the only measure of student achievement in K-12 online schooling.

For students with disabilities, there is also the element of the individualized educational plan (IEP) that drives the educational support for these students. IEPs are individualized plans to guide the academic success of a student through the various pedagogical and support structures designed especially for a student, whether they are in a traditional or online school. These students also often have assigned to them a certified special educator (Burdette, et al., 2014). Additionally, parents of these students, who are enrolled in online schools, have reported that they spend a significant amount of time helping their students to learn (Ortiz, et al., 2017). Yet, the evidence of how these students fair in virtual schools compared to their experiences in traditional schools is still inconclusive. Fernandez, et al., (2016) conducted two studies of students enrolled in virtual schools. Their first study, which included three state-led virtual schools, found that students with health care needs were "significantly more likely to have lower grades in online classes then in their usual traditional classes" (p. 69). However, in the second study, which focused on just one state-led virtual school, they found no significant grade difference between the online and traditional coursework. The researchers suggested that students who need extra support could potentially benefit from this type of schooling when the right support is provided to them. Equally as important to the *right support*, students must also be active participants in their own learning (Curtis and Werth, 2015).

Overall, these studies suggest that parental involvement and student academic achievement in these online schools may be linked. Moreover, these studies suggest parents need support in developing skills and knowledge to effectively support their students in online settings. Further, parents need to understand that their involvement could have a positive effect on their children's academic achievement. Recent studies focused on students with disabilities in these schools found that, with the right support, virtual schools may benefit these students.

While several years have passed since we last updated this chapter, there were no specific studies found concerning blended settings and parental involvement linked to student achievement, and research should be conducted in this area.

Parent Behaviors of Support and Perception of Their Roles

Since this chapter was first published in 2014, a number of studies have emerged concerning how parents engage in supporting their children, including students with disabilities enrolled in these alternative schools. These studies look specifically at parent roles and behaviors of support in online schools for students in grades K-12 and capture a more in depth understanding of perceptions parents have of their roles and the types of behaviors parents engaged in when they support their children.

Importantly, recent research has pointed to problems that arise when parents underestimate the nature of their role and the type of commitment required to support their children's success in these alternative schools. A study conducted by the National Education Policy Center (Molnar, et al., 2015) found that parents' early perception of their role in virtual settings is to provide encouragement and support. Yet, parents are heavily relied upon in virtual settings to engage in roles that could be equivalent to those assumed by certified teachers. However, these parents may not be sufficiently prepared (Burdett, et al., 2014; Molnar, et al., 2015; Ortiz, et al., 2017). As such, parental involvement can be problematic in virtual schools if parents assume teaching roles for which they are not properly prepared for or not licensed in. An over-reliance on parental support where parents become "teachers" could mean institutions then do not meet appropriate percentages of *certified* teachers.

In general, parents help students to organize their work, guide them through schoolwork, and motivate them to make progress. Table 2 summarizes what the literature and research has thus far described about the tasks parents perform in these school settings. The italicized tasks represent new descriptions resulting from more recent research.

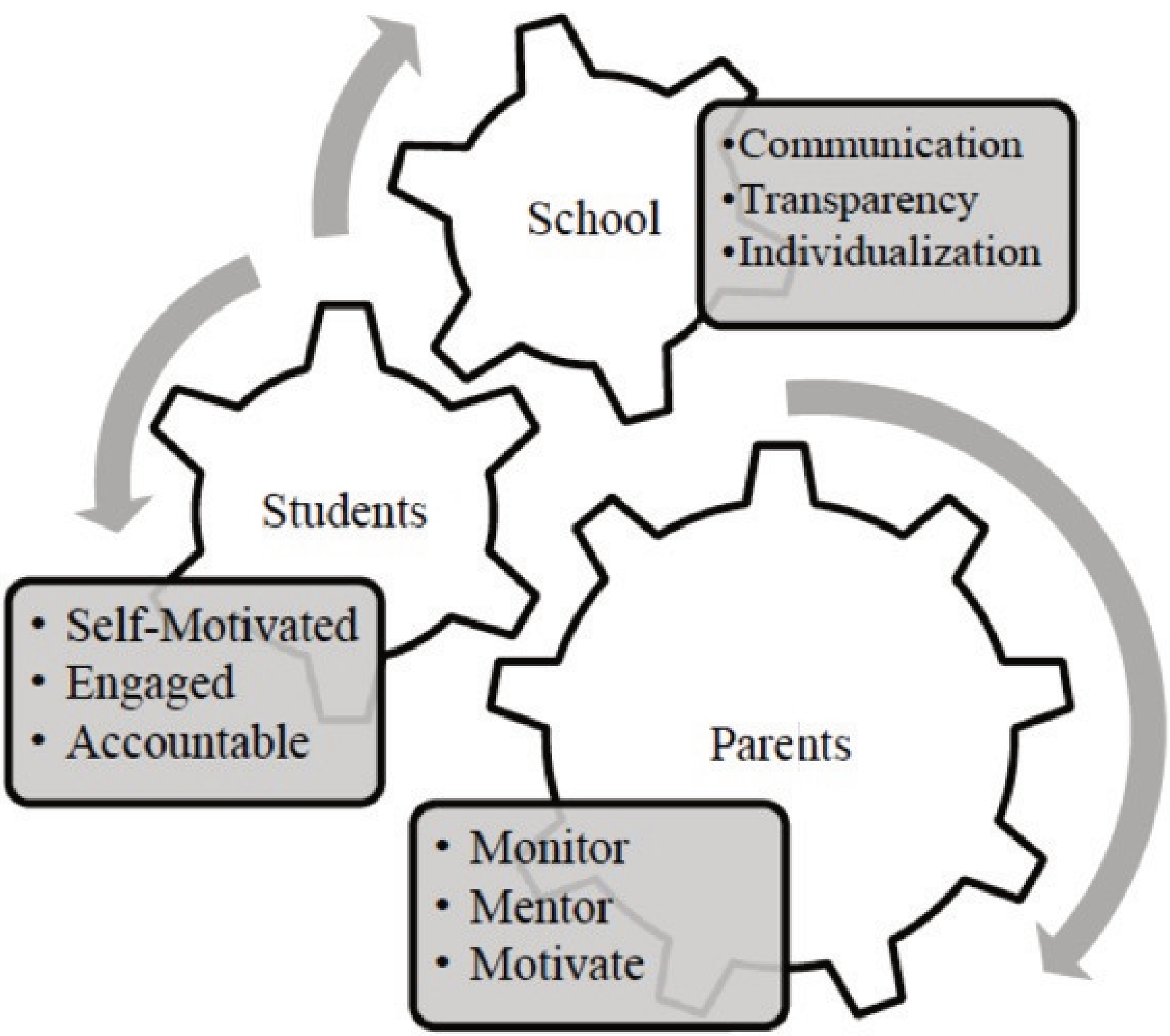
Table 2. What we know about parent roles

Parent Role	Description
Organizer	• Plans daily schedule, lesson plans, activities; gathers/collects materials • *Helps child to develop his own organizational skills (executive function); uses LMS to access and track homework*
Instructor (guide)	• Provides one-on-one instruction and tutoring • Shares educational experiences with students to help them learn and work through content • Constructs knowledge with student
Motivator	• Motivates student to progress and to work through problems • *Uses rewards to incentivize*
Manager	• Keeps track of student progress • Manages student's time/schedule • Disciplines student • Monitors student progress • *Communicates and coordinates with the school and special education teachers to implement child's IEP*

Table 2 provides an overview of the types of tasks typically associated with parents whose students are enrolled in K-12 online learning. Hasler-Waters (2012) analyzed the depth of parent behaviors in an online charter school. She used the Hoover-Dempsey Sandler (HDS) Model for Parental Involvement (Hoover-Dempsey, et al., 2005a), a framework to measure parent behaviors of support in traditional schooling, and discovered that parents of children in online schooling also engaged in the four mechanisms of behavior described by the HDS Model of Parental Involvement: encouragement, reinforcement, modeling, and instruction. However, she discovered that parents also practiced two other parent behaviors, adapting and leveraging. Adapting was described as a behavior in which parents adjusted instructional strategies, learning environments, daily schedules, and even their own belief-systems to accommodate their children's learning needs. Leveraging resources was defined as the behavior in which parents would access support and materials from a variety of sources to meet their children's learning needs. She added that these coaches faced significant challenges including shortage of time, complexity of the role, and lack of immediate access to teachers.

Curtis (2013), who conducted a mixed methods study to investigate student achievement in a full-time, online learning environment and the effect that parents have on student success, learned that parents perceived there were three important facets that led to student success in the online environment. These facets included parents, the school, and the student. She illustrated these facets in a model to represent the interlocking connection between each element (see Figure 1).

Figure 1. Themes of Parental Involvement, Curtis (2013)



Her study revealed that the parents who reported that their children were successful in this environment perceived that success was due in part to the fact that their students were responsible for their own learning, were self-motivated, and were engaged and accountable for their work. Conversely, the parents who reported that their children were unsuccessful in this environment perceived that this was due to the fact their students were not self-motivated and did not organize their workload well.

Following the development of the ACE framework, Borup et al. (2014) and his colleagues (Borup, 2016; Borup et al., 2015) used the framework to guide two case studies examining parental engagement at a full-time charter high school. The first case study relied on interviews with 9 parents and 10 students and the second case study relied on teacher surveys (n=15) and interviews (n=11). Parents, students, and teachers agreed that parents could assist students by:

- Advising and mentoring students
- Organizing and managing students learning schedule and physical space
- Fostering communication with the teacher and between students and teachers
- Motivating student to fully engage in learning activities
- Monitoring student performance and engagement
- Nurturing and mentoring students
- Instructing students when able.

The authors concluded that while the ACE framework was helpful in guiding their research, they also identified two responsibilities not previously described in the framework. The ACE framework assigned fostering communication as a teacher's responsibility but in their case studies it was identified as an important parental responsibility as well. The ACE framework also did not identify advising and mentoring students in larger educational decisions such as enrolling in online courses. Conversely, the ACE framework explained that it was important for parents to volunteer to support students in extracurricular activities. While Borup and his colleagues (Borup, 2016; Borup, Stevens, & Hasler Waters, 2015) found that parents' responsibilities were more extensive than previously believed, they also found that parents were not always prepared or willing to assume the level of responsibilities and support that students required. As a result, they recommended that online programs do more to inform and support parents in their efforts.

Studies concerning students with disabilities, who are enrolled in online schools, have provided important contributions concerning parental roles when supporting this student population. Parents are important members of the instructional team and there is an increased need to coordinate with them to support their children's learning (Franklin, et al., 2015). This is due in part to the IDEA (2004), which requires that schools involve parents in decisions concerning their children's education. In these alternative school settings, parents take on a more significant role as they are more actively engaged in the instruction, curriculum selection, assessments, scheduling work time, and helping their children to develop the types of executive functioning skills that will facilitate their learning (Burdett, et al., 2014; Ortiz, et al., 2017). Parents have reported that they have assumed considerable responsibility for the education of their children, and that their primary role was as the educator. As previously mentioned, researchers have raised concern that these parents are assuming heavier roles and responsibilities that might be equivalent to the load a teacher would assume. This is cause for concern because it is not clear whether parents have had the proper training and support to provide the instruction and pedagogical strategies to benefit student learning (Barbour, 2017, Burdett, et al., 2014; Ortiz, et al., 2017).

Furthermore, the parents of students with disabilities in online schools are also taking on the role of medical aide, which requires providing their children with their medications that will help facilitate their learning. This role possess an interesting question when considering the requirements mandated under the IDEA (2004), which specifies that schools assume certain medical responsibilities for these children to support their learning. But because these students may never be physically present on school grounds, the parents assume this responsibility.

Such research suggests that parental roles and supportive behaviors are amplified in full-time cyber or online charter school settings because parents will fill in when the teacher is absent or at a distance from the student. This is significantly increased for parents of students with disabilities because they are also assuming the role of medical aide and must be more actively involved with the student's school to fulfill IDEA (2004) requirements.

Of the more recent studies concerning students with disabilities, one indicated that parents reported that their involvement with their children who were in blended learning environments was less critical than when their children were enrolled in fully online models (Franklin, et al., 2015). More research concerning parental involvement with their children who are enrolled in blended learning environments could contribute to a better understanding of how to help students succeed in these non-traditional learning environments.

Implications for Policy to Practice

Liu et al. (2010) suggested that parental involvement in virtual schools could help students persevere through the challenges of learning in an online environment and boost their ability to acquire and practice the skills necessary to be successful. Others have suggested that when there is a lack of teacher presence in K-12 online settings, parents may play an even more important role than in traditional school settings (Russell, 2004; Weiner, 2003). Current studies are raising more concern over whether parents, especially those whose children have disabilities, have received the type of training and support necessary to guide their children's learning in these alternative schools (Burdette, et al., 2014; Curtis & Werth, 2016; 2014; Ortiz, et al., 2017). Moreover, parental involvement can be problematic in virtual schools if parents assume teaching roles for which they are not properly licensed. An over-reliance on parental support where parents become "teachers" could mean institutions then do not meet appropriate percentages of certified teachers (Molnar, et al., 2015). Studies showing that parents are making decisions to send their children to these schools because of perceived market value, also referred to as market-based decisions, rather than reliable data demonstrating student academic success, is problematic. This is in part because it discounts school accountability measures but also because education is complex and market factors do not necessarily produce better outcomes. The National Education Policy Center (Molnar, et al., 2015) recommends that these schools be regulated for growth and geography, as well as conduct research on parental effectiveness to support their children's academic needs.

The implications arising from the research presented in this chapter suggest that policy should be developed to help encourage and improve parental involvement, when their children are enrolled in K-12 online schooling, in ways that promote student academic success. Additionally, policy should find ways to support efforts to educate parents on the depth of commitment that is required to help their children succeed in these alternative schools.

Policy concerning parental involvement in K-12 online learning should focus on issues that would enrich student academic achievement, increase high school graduation rates, and prepare students for college and their careers. For instance, policy-makers, school administrators, teachers, and parents need to support policies which would: (a) provide effective training and support for parents as educational facilitators for their own students, especially concerning instructional support for students; (b) encourage effective parental involvement to support, guide, and motivate their own students; and (c) articulate and communicate guidelines concerning parental roles and responsibilities. Franklin, et al. (2015) issued an urgent call for research focused on students with disabilities which could help policy planning and decision making to support these students.

A number of the studies described within this chapter have suggested that parents may need training on pedagogical strategies to support their own students (Black, 2009; Borup, et al., 2013; Curtis, 2013; Hasler-Waters, 2012). Some of the more current research emerging from audits, investigations, and research concerning full-time, online schools is troubling. Students in these schools are falling behind their traditional school counterparts and dropping out at high rates (Barth, et al., 2012; Darrow, 2010; Glass & Welner, 2011; Hubbard & Mitchell, 2011). While these studies do not link parental involvement to these troubling outcomes, we suggest that policy that supports the effectiveness of parental involvement in these schools could prove to be one strategy for improving student opportunities for success. Further, we believe that policy should improve school-parent communications in order to guide parents along the continuum of parental involvement in various K-12 online settings.

Implications for Research

There are a number of pressing concerns surrounding K-12 online learning for students. These concerns provide compelling evidence that the field needs to engage in more research in order to better understand how to help students achieve in these unique environments. To this end, the authors recommend nine areas of research:

1. *Exploring the continuum of parental involvement.* Research discussed in this chapter has shown that the amount of time a parent is involved supporting the K-12 online student is not as important as the quality of support the parent lends (Borup et al., 2013; Litke, 1998). Further, some studies in the chapter contend that parents increase their level of involvement when students struggle or fail. More research needs to be conducted to understand what type of assistance students need over the course of their K-12 online experiences and how to support, engage, and encourage parents to effectively support their students as they traverse the continuum of involvement.
2. *Exploring how parents can encourage their children to practice techniques associated with online learning success.* Several of the studies included in this chapter asserted that part of the equation leading to student success requires that students take responsibility for their own learning (Boulton, 2008; Curtis, 2013; Litke, 1998). Research should be conducted to evaluate how parents can encourage and support students in taking responsibility and practice the skills necessary for learning successfully online.
3. *Examining the links between parental involvement and student academic achievement.* Several studies in this chapter found significant links between parental involvement and student outcomes (Black, 2009; Borup et al., 2013; Franklin, et al., 2015; NEPC, 2015). Researchers recommend that more research should be conducted with broader and larger participant populations.
4. *Conducting research to gain deeper understanding of complexities.* The authors of this chapter agree and recommend more qualitative studies should be conducted in order to understand the deeper, more complex connections between parental involvement and student achievement.
5. *Understanding the nature of parent-student interactions.* Several studies alluded to the importance of examining parent-student relationships in order to better understand the dynamics of these interactions and how they impact student achievement (Borup et al., 2013; Boulton, 2008; Curtis, 2013; Hasler-Waters, 2012). The authors of this chapter agree and recommend that future research examine this dynamic, multi-dimensional topic through longitudinal and qualitative studies.
6. *Examining parental involvement in blended and flipped classrooms.* It has been suggested that these relatively new schooling practices should be studied to determine if the distance between teacher and student could be mitigated with parental involvement (Curtis, 2013). The authors agree and recommend that future research include a focus on blended and flipped classrooms to discover how parental involvement would be most effective within classrooms that include teacher presence.
7. *Examining links between parent demographics and student support.* The authors of this chapter noted that very little research has been done concerning the demographics of parents whose children are enrolled in K-12 online learning. Additionally, one study concerning an online charter suggested that the unique nature this school and the active choice parents made to enroll their students in this school skewed what is typically found of parental involvement in traditional schooling (Beck et al., 2013). More research needs to be conducted concerning the demographics of parents whose children attend these alternative schools and the links between their demographics and involvement.
8. *Capturing student perceptions of parental involvement.* Three studies captured student perceptions concerning parental involvement and found evidence that students attribute part of their school success to their parents and value their involvement (Beck et al., 2013; Borup et al., 2013; Curtis, 2013). The authors of this chapter believe that capturing student voice is vitally important to understanding how parents can most effectively support their own children and urge researchers to more closely examine student perceptions.
9. *Developing frameworks that explain and hypothesize.* The current body of research has yet to clearly identify and define variables associated with parental involvement in K-12 online learning. Although this is typical of research examining a relatively new phenomenon, researchers should begin to establish theoretical frameworks that not only define relevant variables but also present a testable structure that hypothesizes how the different variables are related, similar to frameworks found in more established domains (Graham, Henrie, & Gibbons, 2013; Whitten, 1998). Although two frameworks have been created that provide a testable structure (Hoover-

Dempsey & Sandler, 1995, 2005; Borup et al. 2014), little empirical research has been conducted to test these hypotheses.

Conclusion

This chapter mostly focused on K-12 supplemental and full-time online learning and parental involvement and how the parent might serve to close the gap when the teacher and student are separated by distance. However, research in this area of K-12 online learning is only beginning to surface. This is particularly true of students with disabilities. Studies of parents of these students have indicated that there is a critical need to help parents understand what is expected of them and provide them with the support that is needed to help their children to be successful in these schools.

The authors of this chapter urge researchers to continue to examine, investigate, and explore parental involvement in these unique school settings in order to add to the body of knowledge and inform policy and practices to improve student achievement within K-12 online environments.

The research has examined how parental involvement can be viewed along a continuum of support, where some parents are more involved than others. The research has posited that this could be explained in part because some parents get more involved when they see their students struggling with the content or when they have received failing grades (Black, 2009; Borup, 2013). Others have suggested that since parents must proactively choose to place their students in these schools they may be motivated to increase their involvement by factors other than those faced by parents of traditional school students (Beck et al., 2013). Some research also has found that parents, whose students who are self-motivated, responsible, engaged, and well organized, believe that they can ease off their support (Curtis, 2013; Litke, 1998). Parents of students with disabilities have additional responsibilities for communicating with their children's schools to ensure that their students are being supported under the IDEA (2004). These parents are heavily relied upon by the schools as a critical member of the education team even though they may not be properly trained (Franklin, et al., 2015; Ortiz, et al., 2017).

Research conducted by Black (2009) and Borup et al. (2013) begins a much-needed examination of how parental involvement in these unique settings may contribute to student academic success. For instance, these researchers have found that some types of parental involvement, such as instructional support, have not yet been proven to be as effective for student achievement as others, such as student encouragement and student reinforcement. Even more recent research conducted with parents whose children have disabilities has found inconclusive evidence that parental involvement leads to student success in these schools (Fernandez, et al., 2016).

More work needs to be done to develop a comprehensive understanding of the types of parental involvement that lead to student academic success or how to measure the quality of support parents are lending to their own students. Indeed, the NEPC (2015) has stated that research is critical given the lack of accountability and regulation of these schools and not just on connections to academic achievement but also to establish exemplars and models for virtual environments where parents serve as *de facto* educators and perform other educational support roles for their children.

Some of the research contained within this chapter has explored the less tangible aspects of parental involvement through qualitative studies (Curtis, 2013; Hasler-Waters, 2012; Litke, 1998). These studies have shed light on the complex nature of parent and student interactions by exploring the behavior, roles, and perceptions of parents whose children attend online charter schools and hint at how parents might fill in a much-needed gap when teachers are not present.

Finally, there is a dearth of research concerning parental involvement in blended learning environments. Some believe that this newly-formed practice of schooling could supplant full-time online learning because traditional schools can take advantage of employing this model within their existing practices (Christensen et al., 2013). Franklin, et al. (2015) discovered that parents believed their support was less critical in blended learning settings that in other forms of virtual schooling. Curtis (2013) surmised that blended and flipped classrooms could mitigate the distance between teacher and student found in purely virtual school settings. We agree, but caution that these school settings are still untested and require more research in order to best understand how to affect student achievement.

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31

On-site and Online Facilitators: Current Practice and Future Directions for Research

Jered Borup

Abstract

Although K-12 online enrollments continue to grow, student attrition rates remain high. Some have suggested that K-12 students lack the metacognitive and self-regulation ability to succeed in a highly autonomous online learning environment and require auxiliary support. In response, many programs have begun to implement facilitator models to provide students with the support that they need. This chapter reviews the existing literature on two of those facilitator models: on-site and online facilitators. The existing research has primarily identified and described facilitator roles: fostering relationships, monitoring, and instructing. Although research examining the actual impact of facilitators on learning outcomes is limited, the emerging research indicates a positive effect—especially when facilitators receive professional development. The chapter concludes with implications for future research and policy.

Keywords: facilitator, mentor, coach, attrition, support systems

Introduction

Although the estimated number of K-12 online students can vary greatly, one thing remains clear—K-12 online student enrollments have grown dramatically over the past decade (Evergreen Educational Group, 2017). This growth has come with some apprehension with policy makers and researchers. The concern that has garnered the most attention is online learning's high student attrition rates (Freidhoff, 2016, 2017; Patterson & McFadden, 2009; Taylor et al., 2016). Although the cause is unknown and likely complex, some have hypothesized that the high attrition rates are a reflection of K-12 learners' low levels of self-regulation and meta-cognitive abilities which are necessary to succeed in a flexible and autonomous online environment (Cavanaugh, 2007; Moore, 1993, 2007; Rice, 2006; Hartley & Bendixen, 2001). Students' lack of meta-cognitive skills can also make it difficult for them to adapt to new online learning models which require different learning skills than those needed in face-to-face environments (Cavanaugh, 2009; Ronsisvalle & Watkins, 2005). Lowes and Lin (2015) summarized that online learning can be especially challenging for students because they "not only need to learn a subject online but need to learn how to learn online" (p. 18).

Recently there has been a shift from determining if online learning is right for specific students to determining which supports specific students need to be successful in online courses (Rose, Smith, Johnson, & Flick, 2015). While online teachers can provide students with a high degree of support, some programs have high teacher-student ratios making it difficult for teachers to interact with students on an individual and personal level (Hawkins, Barbour, & Graham, 2011) which can result in students feeling isolated and unmotivated to learn (Palloff & Pratt, 2007). Even in programs designed for high levels of teacher-student interaction, teachers find it difficult to provide the types of support that students require at a distance in part because students can easily ignore their efforts. Some online programs have attempted to lower student attrition and increase student learning by better utilizing facilitators (also referred to as learning coaches, mentors, and shepherds) who provide additional support to that which is already provided by online teachers and course designers (Drysdale, Graham, & Borup, 2014, 2016; Harms, Niederhauser, Davis, Roblyer, & Gilbert, 2006). Many programs rely on parents to act as students' primary facilitator (see Waters, Borup, and Mechaca's chapter in this handbook). However, parents commonly have other demands on their time that prevent them from providing students with the level of support that they need. Furthermore, parents who can provide students with high levels of support may not have the knowledge and skills to do so because they are unfamiliar with effective online learning strategies. As a result, programs are increasingly relying on program-provided facilitators who contribute an added layer of support to students beyond what the online teacher provides.

Roles Defined

Face-to-face teachers have traditionally designed, facilitated, and instructed their courses (Davis & Ferdig, 2009). Harms et al. (2006) explained that in online and blended learning environments these roles can be individual positions: (1) instructional designers who create course content, learning activities, and assessments, (2) teachers who provide content expertise and assess student learning, and (3) facilitators who provide students with auxiliary and affective support. Ferdig, Cavanaugh, DiPietro, Black, and Dawson (2009) added that this type of division of labor is less common in smaller or newer programs and is more likely to develop in time as programs become more established. Harms et al. (2006) also acknowledged that there is "considerable overlap" between the roles and explained that a single individual could fulfill multiple roles in an online course.

Unlike online teachers, facilitators are typically not content experts. Rather, facilitators provide students with auxiliary support and ensure that "everything is working smoothly and order is maintained" (Hannum, Irvin, Lei, & Farmer, 2008, p. 213). In other words, facilitators need to be experts in the learning processes—not the content. More specifically, Harms et al. (2006) explained that facilitators should:

- understand students on a personal level and act as a mentor;
- aid students in the development of study, organization, and self-regulation skills;
- encourage communication between students, parents, and instructors;
- monitor student grades and overall course progress; and
- counsel students on course enrollments.

Wicks (2010) added that facilitators should assist students "on items such as study skills, social issues, attendance, and school events" (p. 31). This type of support is especially important because the transition from a face-to-face to an online learning environment can be difficult for K-12 students who lack some of the academic skills that online learning requires. For instance, younger students tend to have low self-regulation and metacognitive abilities making it difficult for them to learn in the more autonomous and student-centered online learning environment. As a result, in order to be successful online, students must not only learn the content but also need to master a new approach to learning (Lowes & Lin, 2015).

As listed above, facilitators are charged with developing close student-facilitator relationships. These relationships are especially important because they can be foundational for cognitive outcomes (Garrison, Anderson, & Archer, 2000) and can deter academic dishonesty (Harms et al., 2006). On-site facilitators who share the same physical space with students can more easily motivate students and can be a valuable resource for teachers to contact when students' course activity is low (Murphy & Rodriguez-Manzanares, 2009). When these facilitators simultaneously work with multiple students in the same environment, they may have the added responsibility of classroom management and facilitating learner-learner interactions (Staker, 2011). Facilitators may also be asked to help students troubleshoot technological problems (de la Varre, Keane, & Irvin, 2011; Hannum, et al., 2008). However, some programs view assistance with technological problems as beyond the scope of the facilitator's responsibilities (Barbour & Mulcahy, 2004).

Consistent with these roles, Borup, West, Graham, and Davies (2014) summarized three broad facilitating responsibilities: (1) nurturing, (2) monitoring and motivating, and (3) encouraging communication. First, nurturing was defined as developing caring relationships with the students and helping to ensure that the learning environment is safe and secure. Second, monitoring and motivating responsibilities include the need to monitor student engagement with the content and motivate students to more fully engage when necessary. Lastly, Borup et al. (2014) explained that facilitators have the responsibility to encourage communication between all members of the learning community—including parents.

Facilitator Models

Three primary facilitator models have been employed in K-12 settings: (1) on-site facilitators, (2) online facilitators, and (3) parent facilitators. This chapter will focus on the on-site and online facilitator models while Waters, Borup, and Mechaca's chapter in this handbook will discuss the parent-facilitator model. The distinguishing difference between the on-site and online facilitator models is the location of the facilitator. Online facilitators are physically separated from students while on-site facilitators share the same physical space with students—typically at students' brick-and-mortar school. Ferdig et al. (2009) acknowledged both of these models when they said that facilitators "may interact with students online or may facilitate at the physical site where students access their online course" (p. 487). This section will describe both models, beginning with on-site facilitators.

Harms et al. (2006) proposed a model that blended students' online interactions with an online teacher and face-to-face interactions with an on-site facilitator located in students' brick-and-mortar school (see Figure 1). Because the majority of online students enroll in online courses to supplement their face-to-face coursework, the on-site facilitator model is the most predominate. The roots of this model can be found in early distance education programs that mailed or faxed learning materials to a student's brick-and-mortar school. The school would then provide the student with a scheduled time to learn and an adult to supervise and facilitate the student's learning (Barbour & Mulcahy, 2004; Russell, 2004). Later, correspondence courses relied on expensive and, at times, unreliable technologies that required students to learn in a lab environment with an adult present to provide supervision and technological support. Once online communication technologies became reasonably accessible and courses largely moved to asynchronous learning models, students were no longer required to attend a lab environment to access the course or participate in learning activities. However, some programs still required students to attend a facilitated lab as a means of providing students with the structure and support they required to successfully complete the course. This is a popular option for rural schools because "it enables a school to have a certified teacher available when one is not locally present, while still providing students with the structure and opportunities afforded by regular class meetings" (O'Dwyer, Carey, & Kleiman, 2007, p. 291). Other programs assigned students to an on-site facilitator but did not require regular lab attendance, thus affording students with a high degree of flexibility in when and where they worked. The role of facilitator can be fulfilled by various school employees such as teachers, administrators, secretaries, librarians, counselors, and athletic coaches (de la Varre et al., 2011; Hannum et al., 2008; Harms et al., 2006).

An increasing number of students are enrolling in full-time online programs and study almost exclusively at home—never stepping foot in a brick-and-mortar school (Evergreen Educational Group, 2017). Although full-time online students do not have the opportunity to work with an on-site facilitator in a brick-and-mortar setting, their needs remain the same. As a result, some online schools have attempted to provide these students with on-site facilitators by creating physical centers where students and facilitators can gather (Cavanaugh, 2009)—a model commonly practiced in open universities worldwide (Moore, 1995; Tait, 2001). However, these types of centers can be expensive and impractical for K-12 online programs (Roblyer, Davis, Mills, Marshall, & Pape, 2008). For these programs, the use of an online facilitator model is a more practical option (see Figure 2). Online facilitators provided by the school are most applicable for high school students; whereas, elementary online programs rely more heavily on the parent-facilitator model (Wicks, 2010). Similar to face-to-face teachers, at times online teachers are asked to both teach the content and ensure students understand and remain engaged in the process of learning online (Kennedy, Cavanaugh, & Dawson, 2013; Borup et al., 2014). However, fulfilling both roles for all of their students can be burdensome and some schools have created more formal online-facilitator programs using paraprofessionals or teachers to act as facilitators for a more manageable number of students (Drysdale et al., 2014, 2016). For instance, Drysdale et al. (2014, 2016) described one cyber charter school's *shepherding* program that required each online teacher to facilitate, or shepherd, 15-20 students' learning by proactively contacting their assigned students in an attempt to form close trusting relationships that would allow them to better understand and advocate for their needs. Interestingly, students and their parents were not informed of the program in an attempt to make the shepherds' attempts appear more authentic and natural. The George Washington University Online High School (GWUOHS, 2016) developed a similar program that required online teachers to assume the additional role of facilitator, or advisors, to a portion of their students. According to their student and parent handbook, facilitators were required to meet with each student weekly to "discuss academic and non-academic concerns" (p. 16) across all of the students' courses. In addition,

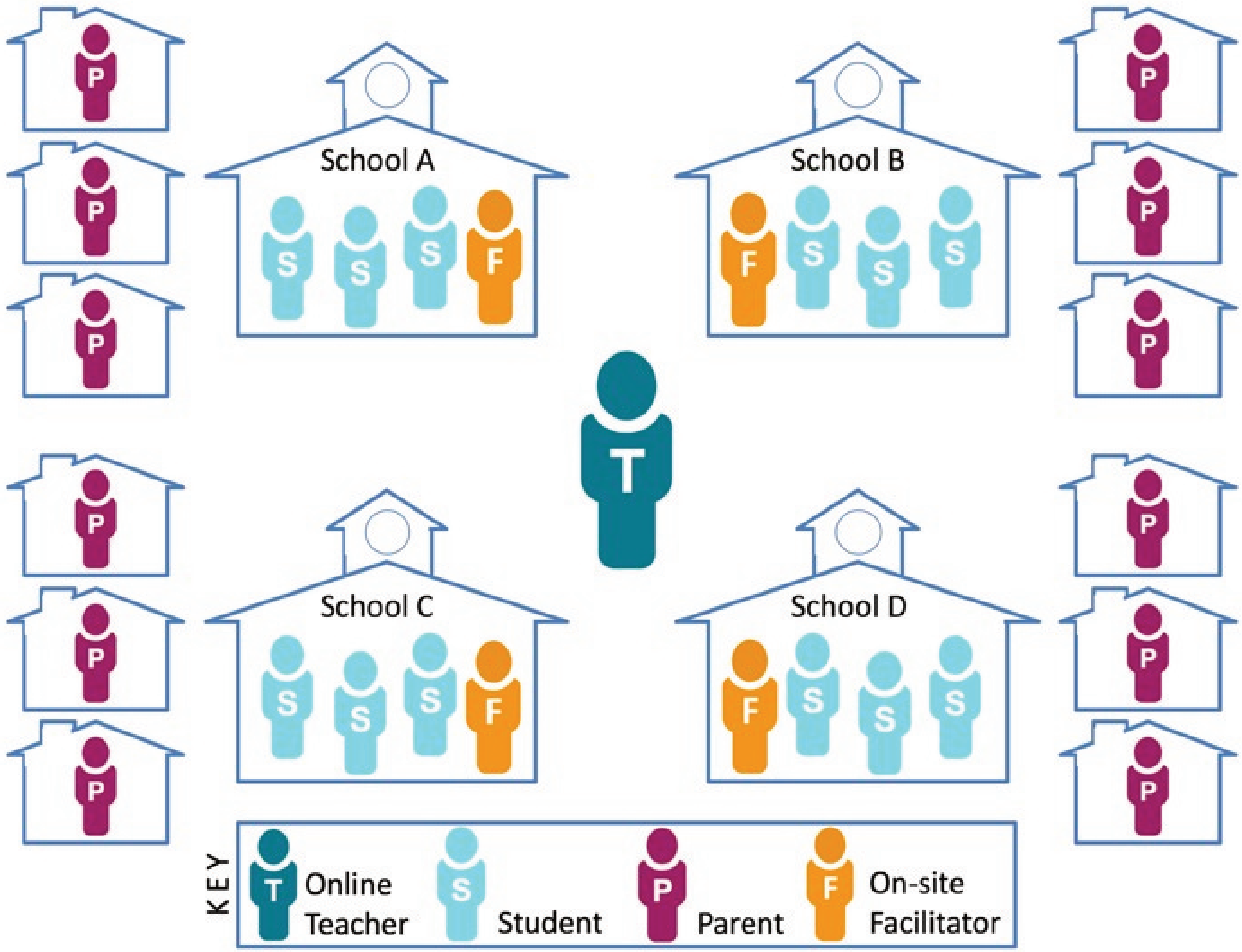

Figure 1. Learning model where students receive support from on-site facilitators and online teachers.

facilitators meet with parents of their advisees monthly to ensure they are "fully aware of the student's academic progress and to proactively address any questions or concerns" (p. 16).

Regardless of their physical proximity to the student, facilitators can vary greatly in their levels of involvement. For instance, some on-site facilitators consistently and proactively work with their assigned online students while other on-site facilitators take a much more hands-off approach choosing to monitor students' progress from a distance and only intervening when they recognize issues with students' engagement or performance. A participant in Fisher's (2015) research likened her "job as an online facilitator to being a doctor on call" (p. 56) because she tended to respond to students' needs when asked to do so. As a result, while we identify two major facilitator models—online facilitators and on-site facilitators—there is great variability within those models. Furthermore, facilitators level of involvement can vary based on the time of the semester. One mentor explained that "the beginning of the semester and the end of the semester…are crazy" (Borup & Stimson, 2017, p. 11).

Research Synthesis

Guided by the identified facilitator roles discussed above, in this section we will discuss the literature that has explored how facilitators fulfill their roles and their impact on learning outcomes.

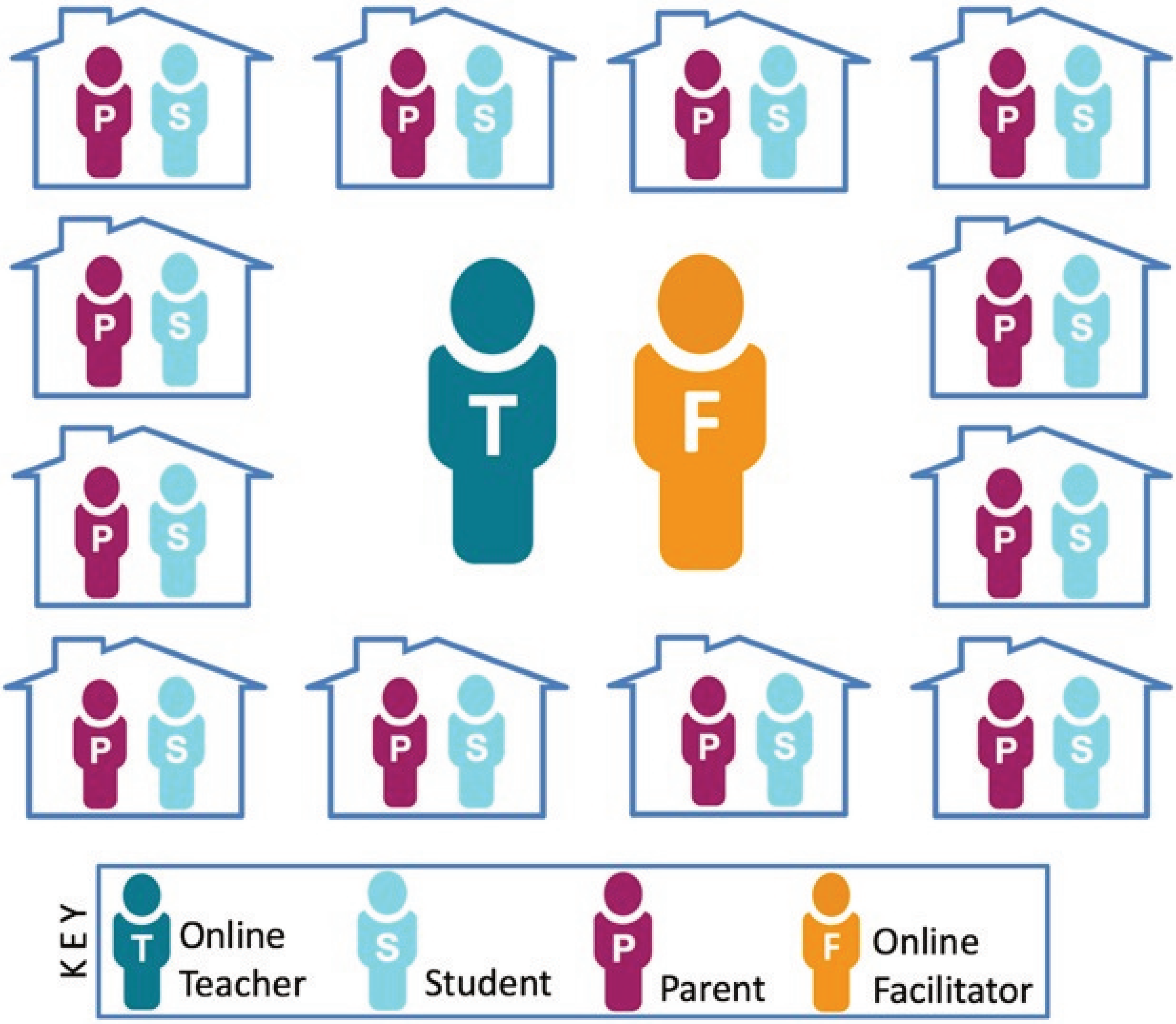

Figure 2. Learning model where students receive support from online facilitators and online teachers.

Fostering Relationships with Students

Although it is possible for online teachers to form close relationships with students (Velasquez, Graham, & West, 2013a; Velasquez, Graham, & Osguthorpe, 2013b), high teaching loads and other demands on their time can make it difficult to do so (Drysdale et al., 2014; Hawkins, Barbour, Graham, 2012). For instance, Hawkins et al. (2012) qualitatively analyzed interviews with eight online teachers at a large virtual high school with high teacher-to-student ratios and found that teachers largely spent their time grading assignments and providing students with feedback, leaving little time for relationship building activities. Similarly, O'Dwyer et al. (2007) found that the majority of the 231 online students who they surveyed indicated that their interaction with the online teacher was lacking and felt like "it should have been a lot more" (p. 301). As a result, some online programs have implemented facilitator models in an attempt to provide students with the supportive relationships that they need while allowing the instructor to focus on their job responsibilities that require content expertise.

Methods used to encourage interactions and foster relationships can vary for on-site and online facilitators. Online facilitators rely primarily on asynchronous text communication that is absent of non-verbal cues, making it more difficult to establish facilitator-student relationships and can leave students feeling isolated (Palloff & Pratt, 2007). On-site facilitators engage largely in face-to-face communication that contains a high level of social and non-verbal cues that can make forming relationships easier (Graham, 2006; Pettyjohn, 2012). In her dissertation research, Charania (2010) found that on-site facilitators' physical presence "can add a personal touch, otherwise missing in distance education" (p. 85). Murphy and Rodriguez-Manzanares (2008) explored the differences between online and face-to-face interactions by interviewing 13 teachers and seven management/support personnel at a Canadian virtual high school whose students were also enrolled in brick-and-mortar schools. Participants believed that they could easily form rapport with students face-to-face because their interactions were spontaneous and informal, often occurring outside of the classroom. In contrast, teachers' online communications tended to be more planned and formal, making it difficult to quickly form trusting relationships with students. However, the private nature of their online communications appeared to benefit shy and self-conscious students by helping them feel more comfortable asking questions and seeking help (Murphy & Rodriguez-Manzanares, 2008). This was confirmed, by online teachers in Borup and Stimson's (2017) research who explained that observant on-site facilitators could "overhear and observe" things that they were unable to do at a distance. One online teacher explained that because she largely communicated with students using text, she did not know if a student was a fan of the University of Michigan's football team unless the students told her as much but that an on-site facilitator could easily recognize that interest "if they've got a Michigan t-shirt or if they talk about going to the game with their friends as they're walking in the classroom" (Borup & Stimson, 2017, p. 9).

In rural settings the on-site facilitators are also more likely to have preexisting relationships with students and their families. One on-site facilitator explained, "Because I've been [an on-site facilitator] for four years, I would say I know at least a third to a half of my class that comes in" (Borup & Stimson, 2017, p. 9). de la Varre et al. (2011) interviewed five online advanced placement (AP) English teachers and 58 on-site facilitators located in small rural schools—many of whom were certified teachers. The researchers found that many of the facilitators had preexisting relationships with students who they had known or taught previously. The course instructors found these preexisting facilitator-student relationships to be beneficial and believed that the facilitators' knowledge of the students and their families allowed them to better advocate for the students and facilitate their learning (de la Varre et al., 2011).

Research has found that close facilitator-student relationships can also be formed online through sustained interactions (Borup, Graham, & Velasquez, 2013b; Drysdale et al., 2014; Velasquez et al., 2013). For instance, Drysdale et al. (2014) qualitatively examined a facilitator program at an online charter school that assigned 20 students to each teacher who then worked to facilitate their learning across all of their courses. Facilitators were asked to regularly contact their students and engage in "non-course-specific or social interactions" (p. 18). It was hoped that these types of interactions would provide students with an "anchor adult" whom students could trust and would feel comfortable asking questions or soliciting advice. The researchers' analysis of focus groups and interviews found that the facilitators felt largely successful at developing strong relationships with their students. However, Drysdale et al. (2013) found that facilitators became frustrated when students did not respond to their inquiries. Although on-site facilitators may also have some non-responsive students, Borup et al. (2014) explained that students can more easily ignore teachers and facilitators when they are physically separated.

The technology that online facilitators use to communicate with students can also impact their ability to develop relationships. Velasquez et al.'s (2013b) case study research at an online charter school found that communication tools that allow for quick responses are best for relationship building. Teachers also found video communication tools to be especially helpful because they could see students' non-verbal communication cues. However, students tended to prefer text-based communication such as text-chat tools because they were somewhat uncomfortable talking with teachers on the phone or using video. However, the research indicated that students were more open to video communication once a relationship had been established.

Fostering Communication with and Between Others

In addition to communicating regularly with students, facilitators are charged with fostering communication with and between stakeholders. Facilitators can assist students who lack the skills or are hesitant to communicate with their online teachers (de la Varre et al., 2011; Hendrix & Degner, 2016). Hendrex and Degner's (2016) analysis of 42 on-site facilitators' survey responses identified a belief that interactions between online teachers and students could be improved and that at times facilitators were required to help "struggling but scared" (p. 137) students request assistance from the online teacher.

Facilitators can also help students to interpret communications and feedback that they receive from online teachers (Borup & Stimson, 2017). As a result, Drysdale et al. (2014) explained that it was important for facilitators to act as a "communication link" (p. 21) between students and their online teachers. For instance, one student contacted her facilitator and said, "I am failing a math class. I don't know what to do." The facilitator then arranged for a meeting for the three of them to "work out a plan to help [the student] be more successful" (p. 21). This may help to explain why teachers in DiPietro, Ferdig, Black, and Preston's (2008) research identified teacher-facilitator relationships as an important contributor to student success.

Facilitators can also communicate with parents in ways that both encourage and inform parents' support efforts. Borup and Stimson (2017) interviewed successful on-site facilitators (n = 12) and online teachers (n = 12) at a large virtual school. Online teachers explained that brick-and-mortar schools frequently did not provide them with parents' contact information. As a result, teachers were especially dependent on on-site facilitators to communicate with parents on their behalf. On-site facilitators in part accomplished this by emailing regular progress reports home. On-site facilitators' efforts were especially high near the end of the semester to ensure each student was successful in their coursework. One on-site facilitator stated that she was "communicating with parents every day" (p. 12).

Monitoring and Motivating

Facilitators are required to monitor student course activity and to motivate students when student engagement is low (Borup et al, 2014). In an evaluation report of an online program that utilized on-site facilitators, Roblyer, Freeman, Stabler, and Scheidmiler (2007) stated:

> Student ability to handle distance education courses appears to depend more on motivation, self-direction, or the ability to take responsibility for individual learning. Because of these determinants of success, facilitators that are directly working with students day by day are key to the success of the program. (p. 11)

On-site facilitators' physical proximity allows them to easily monitor students' learning behavior and help to motivate students when needed—especially when students are required to regularly learn in the presence of a facilitator. de la Varre et al. (2011) found that when students worked in the same room as other students, the on-site facilitators were required to maintain classroom discipline and ensure that students remained on task, supporting Harms et al.'s (2006) claim that unmonitored online students could spend their learning time on off-task behavior. Borup and Stimson (2017) identified 12 on-site facilitators with well above average student pass rates and found that 11 of them required students to attend a daily lab. This regular face-to-face contact time with students allowed facilitators to closely monitor student behavior and intervene as needed. In some cases, facilitators assigned academic detention when students failed to respond to their encouragement. de la Varre et al. (2011) added that facilitators' physical presence itself motivated students to engage in learning activities and found that some students could become unmotivated to learn because they wanted more personable and timely communication from their online teachers. As a result, their on-site facilitators used their physical presence to motivate students to engage in learning activities (de la Varre et al., 2011).

On-site facilitators are also commonly tasked with proctoring student exams, but this can be difficult for facilitators who work with large numbers of students across several courses. One facilitator commented, "The exam process is a bit cumbersome. [It was] hard for me to know to proctor exams at one time for five students. [It was] hard to know when to unlock the exam and when to lock it" (Hendrix & Degner, 2016, p. 137). These challenges may help to explain why online teachers have reported that exams are not always properly proctored on site (Borup & Stimson, 2017).

Although online facilitators do not share the same physical space as their students, they can still easily monitor students more demonstrative online behavior such as submitting assignments and online communications. However, not all types of student engagement are as easily observable by online facilitators. Online facilitators can obtain a better understanding of students' level of engagement by communicating with students directly, but Zhang and Almeroth (2010) explained that this can be time consuming and inaccurate because students have difficulty recalling what they have done or exaggerate their activity. Murphy and Rodriguez-Manzanares (2009) conducted and analyzed interviews with 42 online high school teachers and found student-tracking programs proved helpful "to monitor presence or pages visited, or verify what students are doing, if they are struggling in a certain area" (p. 10). Borup et al. (2014) also found that all 12 interviewed teachers at an online charter school found students' activity reports helpful in monitoring students' engagement in learning activities. One teacher stated that although she was physically separated from her students, this data allowed her to "track [students'] little footprints through everything they do" (Borup et al., 2014, p. 801). However, the educational community—unlike the business sector—has been slow to make advances in these types of tools (Davis & Roblyer, 2005) and little is known about how or if facilitators use this data to make decisions.

Instructing

Facilitators are not typically content experts and are not expected to teach the content to students. However, Barbour and Mulcahy (2004) qualitatively examined on-site facilitator behavior and found that in many cases the on-site facilitator regularly went beyond their contractual responsibilities by engaging in instructional activities. This was especially true when the facilitators had experience teaching the course content area. Taylor et al. (2016) asked 36 on-site facilitators in a summer algebra credit-recovery program to maintain daily logs of how much time they spent answering math related questions and the time they spent on administrative and classroom management issues. They found that 15 on-site facilitators (41.6%) spent at least 20% of their class time with students answering their math-related questions.

Similarly, de la Varre et al.'s (2011) examination of on-site facilitators for AP English courses found that facilitators engaged in direct instructional activities, especially when they were certified English teachers. Some facilitators also engaged in instructional activities even when they were not certified teachers in the content area. O'Dwyer et al. (2007) surveyed 231 High School algebra students regarding their interactions with on-site facilitators who were not certified to teach math and found that over 76% of the students asked the on-site facilitator about the course content at least once a week with 33.3% doing so every lesson. Similarly, Barbour and Hill's (2011) research examining rural students who were supplementing their face-to-face learning with an online course found that when challenges arose, students were more likely to ask their on-site peers and facilitators than their online instructor, even when their on-site facilitator was not a content expert. Borup and Stimson (2017) found that the 12 on-site facilitators they interviewed would respond to simple content-related questions. When they perceived that students' questions required more than what they were able to provide, they directed students to contact the online teacher or a face-to-face teacher in the building—especially when the student needed assistance with math. While online teachers generally reacted positively to students receiving instructional support from teachers in their building, they preferred it when facilitators refereed students to the online teacher because it made them "aware of student confusion and possible weaknesses in the course" (p. 11).

de la Varre et al. (2011) found that facilitators commonly provided instruction when they perceived weaknesses in the course curriculum or the pedagogical strategies employed by the online teacher and that teachers were somewhat unaware of the extent that facilitators engaged in direct instructional activities. Some teachers seemed to welcome these instructional activities, and others believed that their role as the course teacher was being undermined. In some cases, facilitators went beyond direct instructional activities and actually modified the course design or timetables. These types of facilitator interventions appeared to especially undermine teachers' authority. One teacher described his relationship with a facilitator as *adversarial* because the facilitator was openly critical toward the instructor and the course design. As a result, de la Varre et al. (2011) explained that teachers and facilitators would be more likely to coordinate their efforts if they engaged in an "in-depth instructor-facilitator conversation at the outset of the course regarding communication preferences, the extent of content support by the facilitator, and local school factors that potentially conflict with the course timetable" (para. 26). Wicks (2010) added that while the "crucial assessment decisions remain the professional teacher's to make," regular teacher-facilitator communication would allow the facilitator to provide the teacher with important information that would help them in their decision making. However, Hendrix and Degner (2016) believed that facilitators would continue to provide students with direct instruction regardless of the professional development that they receive particularly in rural settings where facilitators have developed close relationships with students over many years.

Impact of Facilitators

Although the use of facilitators is commonly cited as a means for increasing learning outcomes, little research has actually examined their ability to do so, and the research that does exist largely relies on self-report data, which limits our ability to generalize the findings. However, there are some encouraging research findings that have indicated the use of facilitators to be effective at improving affective and academic course outcomes. For instance, Roblyer et al. (2008) found that providing online students with a monitored class period to work is especially important for K-12 students. In fact, their analysis of survey responses from 2,880 virtual school students found that students who had an assigned class period to work were nearly twice as likely to pass their course than those who did not have an assigned class period.

Drysdale and his colleagues' (Drysdale, 2013; Drysdale et al., 2014) analysis of facilitator focus groups and interviews with students and facilitators similarly indicated that online facilitators could have a motivational and stimulating effect on students. Frid's (2001) case study examining 28 online students who ranged from 7 to 12 years of age, also found that on-site facilitators who actively organized and monitored student work were "crucial to the degree to which [students] maintained engagement in activities" (p. 18).

Some have suggested that facilitators can have an especially large impact on at-risk students (Archambault et al., 2010). For instance, in their site coordinator handbook, Colorado Online Learning (2012) recognized that at-risk students "will need a much higher degree of on-site support" (p. 4). Pettyjohn's (2012) dissertation research provided some insights as to why at-risk students are especially susceptible to a facilitator's support. More specifically, the at-risk students who participated in Pettyjohn's research were prone to distractions and were unmotivated to engage in learning activities. This lack of motivation possibly stemmed from students' "limited perspective and future outlook" (p. 167) as well as low parental support—some parents were deceased, incarcerated, or deployed overseas. Pettyjohn summarized, "A relationship with a trusted staff member was a key component of at-risk students' success in supplemental online learning for credit recovery. There is an affective part of supporting at-risk students that cannot be minimized or ignored" (p. 174). Ferdig's (2010) mixed method case study also examined a credit recovery program at the Michigan Virtual School. Students in the program were provided with the flexibility in where they worked but were required to visit a center and work with an on-site mentor twice a week. All of the students reported that they "felt accepted by their face-to-face mentor" (p. 18) and appreciated the support they provided. Although the at-risk student completion rate was lower than the general student population, all of the at-risk students successfully completed at least one online course despite being at the "point of expulsion or dropping out of traditional school" (p. 16). Wicks (2010) also described an online program instituted by the Cook County (Illinois) Sheriff's Department that provided facilitators to 17-21 year-old inmates who were enrolled in online high school courses. The program also established off-site classrooms where students in their Day Reporting Program could receive support from facilitators. This model of instruction "show[s] promise as a very effective solution to serving this group of students" (p. 21).

The impact that facilitators have also appears to be somewhat dependent on the training that they receive. Hannum et al. (2008) used a cluster-randomized control trial to examine the impact of job training on facilitators' effectiveness. Students in the treatment group worked with a trained on-site facilitator, and students in the control group worked with an untrained on-site facilitator. Researchers found that students in the treatment group completed the course at a significantly higher rate. Similarly, Staker (2011) reported that Florida Virtual School's courses with on-site facilitators who were trained regarding course navigation, technological assistance, and improving student motivation experienced greater success than those courses with students who study from home.

Specific types of support may also have a larger impact than others. Taylor et al. (2016) used facilitator logs in an algebra credit recover program to classify facilitators as either "instructionally supportive" (those who reported spending at least 20% of their time tutoring students) or "less-instructionally supportive" (those who spent less than 20% of their time tutoring students) and found that instructionally supportive facilitators had higher credit recovery rates (77%) than those with less-instructionally supportive facilitators (60%). However, these findings should be interpreted cautiously because students in both groups performed similarly on the post-test. Furthermore, students with less-instructionally supportive facilitators had higher suspension rates the previous year (43%) than those with instructionally supportive facilitators (34%) which may have indicated a difference in students' willingness to accept facilitators support and direction. This research also examined credit-recovery math students and researchers examining different types of students and/or content areas may discover different findings.

In summary, empirical research examining facilitator models is limited but emerging. The majority of the existing research has focused on on-site facilitators and research examining online facilitators is especially limited. The existing research has primarily identified and described three functions of online and on-site facilitators: fostering relationships, monitoring, and instructing. The majority of research is also descriptive in nature. Few researchers have actually examined facilitators' ability to impact learning outcomes and the research that does exist tends to rely on self-report data—limiting our ability to make generalizations. However, the emerging research has found that facilitators can have a positive impact on learning outcomes. This is especially true of at-risk students and when facilitators have been formally trained on their responsibilities.

Implications for Policy and Practice

Policy makers need to better recognize the important role of the facilitator and work to ensure that students receive the facilitating support they require. The lack of engaged facilitators in many programs may stem in part from school administrators' lack of understanding. Lewis (2011) explained that many face-to-face administrators view online learning as a cost saving measure, and a report by the U.S. Department of Education (2008) found that some administrators were resistant to provide on-site facilitators due to their cost. Lewis (2011) added that some school administrators ask school personnel and teachers to act as on-site facilitators without providing them with time or compensation for fulfilling their roles. As a result, many on-site facilitators lack the time and incentive to be an effective support to students and many facilitator systems rely heavily on "volunteerism and the good will of overworked teachers" (Barbour & Mulcahy, 2009, p. 782). Legislature that mandates students receive facilitator support such as Section 21f of Michigan Public Act No. 60 (2013) can help to ensure students receive the support that they need. However, vague mandates that require students to be assigned to a facilitator does not guarantee that the facilitator will actually fulfill their important responsibilities outlined in this chapter. Facilitators are most likely to impact student learning when they are provided with the:

1. clearly defined responsibilities
2. time to fulfill their responsibilities,
3. space to work with students if they are on-site, and
4. professional development that helps them to learn their responsibilities and develop the skills required to fulfill them.

Providing Time and Space

As stated earlier, Roblyer et al. (2008) found that when facilitators and students were provided with a dedicated space to work, students were nearly twice as likely to pass their course than those who did not have an assigned class period. This may help to explain why of the 12 on-site facilitators who Borup and Stimson (2017) sampled because of their high student pass rates, 11 held daily lab sessions with students and one met with students weekly. Not surprisingly, research has found that teachers who are asked to facilitate online students' learning and teach a face-to-face class during the same class period find it frustrating and difficult to balance both responsibilities (Hendrix & Degner, 2016). Similarly, online teachers who were asked to serve as facilitators for a portion of their students found that their facilitating responsibilities required "consistent effort" and placed demands on their already busy teaching schedule (Drysdale et al., 2014, p. 24).

The level of structure in when and where they work provided to students by facilitators should be determined by student needs. Freidhoff, Borup, Stimson, and Debruler (2015) interviewed 14 on-site facilitators and found that the level of support and structure that students were provided varied across and within schools. They reported that facilitators' contact with students "ranged from daily to weekly, and/or on an as needed basis, from multiple times in a class period to once or twice a semester" (p. 115). While some of these decisions were based on student need, facilitators' level of support was also determined by their "non-mentoring responsibilities" (p. 114). As a result, students were commonly not provided with the level of support they required because their facilitators were not provided with the time to fulfill their responsibilities fully.

Providing Professional Development

At a minimum, facilitators should be provided with the time and space to fulfill their responsibilities. However, even when facilitators are provided with the time and space to fulfill their responsibilities they are unlikely to fulfill them if they do not understand what they are or have the skills to accomplish them. Davis et al. (2007) explained that facilitators would be more effective if they were formally trained regarding their responsibilities and Hendrix and Degner (2016) added that discrepancies across facilitators' practices are in part a reflection of the varied levels of professional development that facilitators receive. Roblyer (2006) accurately stated that "facilitators are made, not born" (p. 34). This sentiment is supported by research that has found trained facilitators to be more effective than facilitators that received little or no training (Hannum et al., 2008; Staker, 2011).

While this is not an exhaustive list, researchers have recommended facilitators receive additional training in the following areas:

- effective communication strategies that provide students with social and emotional support (de la Varre et al., 2011),
- technology use (Lewis, 2011),
- classroom management (Roblyer et al., 2007),
- preventing late or dishonest work (Roblyer et al., 2007),
- skills and strategies to meet the needs of at-risk students (Archambault et al., 2010),
- facilitating students with disabilities (Repetto, Cavanaugh, Wayer, & Liu, 2010).

Little is known about effective strategies for training facilitators, yet policy makers can observe how other institutions have been proactive in this area. Cavanaugh (2009) explained that some school districts rely on the course providers to provide their on-site facilitators with the training they need. For instance, Roblyer (2006) explained that one virtual high school had ambassadors who traveled to meet with on-site facilitators and administrators to discuss student needs. Hendrix and Degner (2016) also recommended that programs "offer some sort of credentialing program as a type of ongoing professional development" (p. 141). However, Lewis' (2011) dissertation research found that "most facilitators received little or no training for their role and had little contact with the online instructors or other facilitators" (p. 110). Montana has attempted to provide their online students with qualified on-site facilitators by requiring them to be licensed and endorsed teachers (Watson, Murin, Vashaw, Germin, & Rapp, 2011). However, it is unknown if this type of policy will be effective. In general, teacher preparation programs have not addressed the unique skills and knowledge that teachers need for the online environment (Kennedy & Archambault, 2012; Repetto et al., 2010). Similarly, it is likely that certified teachers lack the unique skills to be on-site or online facilitators. As a result, policies that require facilitators to be licensed teachers ignore the unique role of the facilitator and can make providing facilitators more expensive without the confidence that the facilitators will adequately understand and fulfill their roles. As a result, Michigan, like Montana, originally required on-site facilitators to be certified teachers but later changed the mandate so that any school employee could serve as a facilitator (Freidhoff et al., 2015). The Chicago Public Schools (CPS) district has taken a different approach. CPS partnered with community organizations to provide students with on-site facilitators. Facilitators received 10 hours of training prior to beginning and 20 additional hours over the course of the academic year (Staker, 2011). Facilitators also needed to be at least 21 years old, hold at least an associate's degree, and pass a background check. Two facilitators worked in a classroom and were paid $15.00 per hour. Approaches like this may provide students with the support they need while still keeping costs low.

Similar to recommendations that new online teachers receive mentoring from a more experienced teacher, new facilitators may benefit from being mentored by more experienced facilitators (Hendrix & Degner, 2016; Smith, Clark, & Blomeyer, 2005). One on-site facilitator commented "experience is very important. New mentors might need mentors!" (Hendrix & Degner, 2016, p. 136). Lewis (2011) similarly recommended that course developers consider providing facilitators with avenues to contact other facilitators. These types of relationships could have several benefits. For instance, Keane, de la Varre, Irvine, and Hannum (2008) described one program where on-site facilitators at 112 rural high schools across the United States were provided with scenario-based training materials and encouraged to participate in discussions with other facilitators in the program. Although participation in these discussions began high and slowly tapered off as the year progressed, facilitators were able to share advice and strategies and it appeared that they were able to establish a sense of community among the facilitators and prevent feelings of isolation. Initial findings also suggested that students who had facilitators who were trained in this manner were more likely to persist and complete the course. O'Dwyer et al. (2007)

also examined one model where on-site facilitators in math courses received close mentoring from the online teacher. This model provided unique professional development opportunities to the on-site facilitators, most of whom were certified teachers in other subject areas or were in the process of earning their math teaching certificate.

In addition to the need for policy makers to increase the quality and quantity of facilitator training, research also suggests that facilitators and policy makers should recognize that students have a variety of needs. Although all students likely need some support from facilitators, Roblyer et al. (2008) explained that not all students' needs are the same. This sentiment was also expressed by online facilitators who felt that some students needed the facilitator's support more than others (Drysdale et al., 2014). As a result, Roblyer et al. (2008) suggested that school resources would be better utilized if schools identified at-risk students for "special tracking and support" (p. 106). Kim, Kim, and Karimi (2012) reasoned that students who were unsuccessful in traditional environments are unlikely to succeed online unless they are provided with a high level of support and encouragement whereas other students may be better apt to self-maintain a higher level of motivation. However, policy makers and facilitators alike need to recognize that students in advanced placement courses may not be fully aware of the rigors and also need a high level of facilitator support (de la Varre et al., 2011; Offir, Barth, Lev, & Shteinbok, 2003).

Implications for Research

While research on facilitators in online schooling is growing, Hendrix and Degner (2016) noted that "research has only begun to explore their role in online learning" (p. 134). This section contains nine recommendations that would help the research community to address important gaps in the literature.

1. Much of the current research focuses on the roles and experiences of on-site facilitators in supplemental programs, with little research examining online facilitators in fully-online programs. Ferdig (2010) called for "more research to help practitioners understand the role of . . . online mentoring" (p. 20). This gap is significant in light of the raising demand for fully-online K-12 schools (Evergreen Educational Group, 2017) and the challenges associated with building relationships online rather than face-to-face (Harms et al., 2006; Hawkins et al., 2012; Hendrix & Degner, 2016; Murphy & Rodriguez-Manzanares, 2009). There is evidence that online programs are relying on online facilitators (for an example see GWUOHS, 2016), and researchers should engage with these programs in mutually-beneficial research efforts.
2. Additional research is needed that examines the impact of facilitators' efforts on attrition rates. Scholars have commonly pointed to facilitators as a means of reducing the persistently high online attrition rates, however, little research substantiates this relationship (Keane et al., 2008; Taylor et al., 2016). Additionally, it would be interesting to learn which facilitator roles are most influential when students are deciding whether to drop-out or complete their courses. For instance, Taylor et al.'s (2016) research indicated that on-site facilitators' direct instruction may be especially important in math credit-recovery courses. Understanding these types of relationships would enable teacher education programs, online schools, and facilitators to focus their efforts on the areas that will most significantly reduce student dropout.
3. Researchers should seek to use a greater variety of methodologies. Most of the research on facilitators in K-12 online learning has been exploratory in nature, often in the form of case studies. This is consistent with what Moore (2004) and Graham, Henrie, and Gibbons (2014) said about developing areas of research. While additional exploratory case studies are needed, scholars should also seek more generalizable studies that will explain relationships between variables in a variety of settings.
4. Existing research that focuses on teacher experiences needs to be balanced with an understanding of how students perceive their experiences with their facilitators. Such an understanding would provide direction for teacher education programs and facilitators as they seek to understand the most effective and meaningful ways to support their students. Obtaining student participation can be challenging especially in supplemental and/or independent study programs (Oviatt, Graham, & Borup, 2016). However, researchers should not be discouraged from pursuing these efforts.
5. Grounding studies in theoretical frameworks could provide helpful insights and form a foundation for a more coordinated research effort. Four frameworks may be especially helpful and have already been used in facilitator research: (1) Garrison et al.'s (2000) Community of Inquiry framework (used by de la Varre et al., 2011), (2) Rovai's (2002) Sense of Community framework (used by Drysdale et al., 2016), (3) Nodding's (1984; 1992) Ethic of Care (used by Borup et al., 2013b and Velasquez et al., 2013), and (4) Borup et al.'s (2014) Adolescent

Community of Engagement framework (used by Borup & Stevens, 2017; Borup & Stevens, 2016; Borup & Stimson, 2016; Oviatt et al., 2016).

6. Researchers should seek to explain the advantages and disadvantages of various models for on-site and online facilitation. Exposure to an analysis of a variety of models would help practitioners as they seek to identify what would work best for their program. For example, one dimension worth exploring would be how to determine if full-time programs should have their online teachers take on the role of facilitator in addition to their other responsibilities (Drysdale et al., 2014), or if they should have a separate person who acts exclusively as a facilitator (Ludwig-Hardman & Dunlap, 2003).

7. Researchers should examine how facilitators adapt their efforts when working with specific types of students such as English language learners and students with disabilities. For instance, Serianni and Coy (2014) explained that facilitators who are working with students with disabilities should work closely with online teachers and ensure that they fully understand students' needs and individualized education plans including any accommodations that students require. Facilitators also need to work closely with special education teachers to learn how to best support students "without enabling dependent behaviors" (p. 108). While students with disabilities are increasingly enrolling in online courses (Beck, Egalite, & Maranto, 2014), research examining how facilitators effectively support these students is lacking.

8. Consideration should be given to how on-site or online facilitators can fit into a variety of blended learning models. A number of blended learning models are being developed that require varying levels of facilitator support (Staker & Horn, 2012). As students have their learning experiences divided between face-to-face and computer mediated instruction, there will be opportunities for facilitators to vary their online or face-to-face interactions with students. Perhaps blended programs will be able to optimize the effectiveness of facilitators as they have the ability to customize the type of interaction (online or in person) facilitators have with their students according to student needs and preferences. We see significant opportunity for research in this area.

9. Researchers should broaden their focus to examine how facilitators' efforts impact and/or support other support systems that are either program provided or student curated. Oviatt et al. (2016) examined a supplemental independent study program and found that students intended on curating their own support system by leveraging those in their proximate community of engagement (e.g. parents, peers, and teachers or counselors at their local school). Borup and Stimson (2016) also found that facilitators helped students to foster a broader proximate support system by encouraging them to approach local teachers for assistance. Additional research would provide further insights into how to best blend formal and informal support.

Conclusion

K-12 online enrollments are growing dramatically despite the higher attrition rates than those found in face-to-face environments. Many programs have attempted to lower attrition rates by providing students with facilitators. Although facilitators are typically not content experts, they can provide important affective and academic support. For instance, facilitators can focus on building relationships with students, monitoring student engagement levels, and helping to build students' capacity to be successful online. There are three primary facilitator models: (1) on-site facilitators, (2) online facilitators, and (3) parent facilitators. This chapter reviewed the research concerning onsite and online facilitators. Although emerging, research is limited. The majority of research has been exploratory in nature, attempting to describe facilitators' actions and how they are received by students. Some researchers have also examined the impact of facilitators on learning outcomes, but this research has relied primarily on self-report data. Research is especially lacking concerning online facilitators. Researchers and policy makers should work together to identify effective on-site and online facilitator practice and preparation strategies.

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The Role of the School Psychologist in K-12 Online & Blended Learning

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ABSTRACT

With the appropriate preparation and training, school psychologists are uniquely suited to provide support within the K-12 online learning environment for students, teachers, administrators, and families. The preparation and training needs at the level of graduate training and professional development are highlighted. Specific emphasis is placed on the adaptation of the school psychologist's functions in the areas of consultation, intervention, assessment, and counseling to the online environment. Additionally, the development of better credentialing models for interstate service delivery and the need for empirical research related to school safety are discussed.[1]

Key Words: school psychology, K-12 online learning, mental health needs, school psychology training, school psychology roles, crisis intervention

Introduction

In the United States, there are currently over 32,300 individuals practicing in the field of school psychology (Jimerson, Stewart, Skokut, Cardenas, & Malone, 2009). School psychologists generally work in school-based settings offering services to preschool through high school-aged students, families, teachers, and administrators. The primary goal of the school psychologist is to help youth succeed academically, socially, emotionally, and behaviorally. Their functions include problem-solving consultation with teachers, parents, or administrators to intervene with struggling students in the aforementioned domains. School psychologists also conduct both formal and informal assessment to evaluate student functioning and/or determine eligibility for special services. In their mental health role, they often serve as therapists or counselors for individual students or groups of students struggling with similar issues. When necessary, school psychologists also provide crisis intervention services at the individual, group, or school-levels. Additionally, school psychologists frequently engage in efforts to design and implement programs (often through a Response-to-Intervention [RtI] framework) for the prevention of academic and behavioral problems common to school-age youth. Thus, school psychologists are specially-trained professionals who apply psychological knowledge and principles to those in or around the school setting.

Before embarking on practice, the school psychologist must undergo extensive training to be credentialed. Beyond the typical four-year undergraduate degree, a school psychology candidate must apply to and be accepted in a graduate-level training program for school psychologists. Although school psychologists are commonly trained at both the doctoral and non-doctoral level in the United States, the entry level degree is that of the Education Specialist (the name of the degree may vary in some states). This degree or its equivalent is typically conferred after the candidate has completed a minimum of 60 graduate credit hours and a 1200-hour internship.

As with most education professionals, the roles and functions of the school psychologist traditionally have been tied to the brick-and-mortar school. However, as noted by Tysinger, Tysinger, Diamanduros, and Kennedy (2013), the K-12 online learning environment is replete with opportunities for the practice of school psychology that will enhance the functioning of the students, faculty, and families affiliated with this burgeoning educational medium. Additionally, research supports

1. This chapter is an updated chapter. It was previously published in the first edition of the Handbook of Research on K-12 Online and Blended Learning.

that many students seeking online enrollment would be considered at-risk, including students with disabilities, students who have been removed from traditional schools due to behavioral challenges, students who have been bullied, and students who are adjudicated in detention centers or house arrest (Ahn, 2011; Beck, Egalite, & Maranto, 2015; Dickson, 2005; Huertal, Gonzalez, & d'Entremont, 2006). Furthermore, dropout rates are higher among students in online learning programs than their peers in traditional schools (Cyrs, 1997; Lynch, 2001; Tuck, 2013). Experts in this area have suggested that at-risk students in the online environment may need additional supports (Roblyer, Davis, Mills, Marshall, & Pape, 2008). Thus, the school psychologists could be seen as critical assets in addressing the academic, social, and emotional issues that may underlie the high attrition rates that are found in online learning environments.

Tysinger, et. al, (2013) and Kennedy, Tysinger, LaFrance, and Bailey (2012) have addressed the need for graduate education programs to prepare school psychologists for practice within and addressing the unique needs of K-12 online learning environments. In relation to personal characteristics and previous experiences, it may be necessary for the school psychologist who practices in an online learning environment to disregard his/her notions about limitations of K-12 online learning to embrace the strengths of the medium, as is recommended in teacher preparation literature (Teclehaimanot & You, 2013). Therefore, when new or experienced school psychologists attain the necessary competency for practice within K-12 online learning environments, the medium offers opportunity for delivering the services of the school psychologist in innovative ways to improve the functioning of students and faculty in the virtual school. School psychologists' skills in consultation, intervention design, assessment, and counseling are particularly amenable and critical within K-12 online learning (Tysinger et al., 2013). Although school psychology services such as academic intervention, behavior intervention and drop-out prevention could certainly support those participating in blended learning programs, those students may also be able to access support through their participation in more traditional learning formats. However, the opportunities for all roles and functions of the school psychologist could be amenable to the fully online learning programs.

Consultation is a primary function of the school psychologist (Curtis & Zins, 1981; Fagan & Wise, 2007) and one that is both necessary within and adaptable to the online learning environment (Tysinger et al., 2013). This practice involves the collaboration of a school psychologist with a teacher, administrator, or parent to apply psychological knowledge and principles to an academic, behavioral, social, or emotional challenge being experienced by a student. The goal of the consultation is two-fold: the school psychology consultant helps the consultee apply new skills to the current issue, but they also desire for the consultee to increase their own skill set in a way that they can apply the new knowledge in similar situations in the future (Brown, Pryzwansky, & Schulte, 2006). School psychologists often refer to this aspect of consultation as "giving psychology away."

The literature within the field of school psychology is well-developed in the area of consultation and supports the practice as effective for promoting positive change as an indirect service of the school psychologist. The service is considered indirect because the school psychologist is working through a third party (teacher, administrator, or parent) to provide intervention support for the student. By utilizing the indirect approach of consultation, the school psychologist can potentially impact a much greater number of students with his/her skills (Fagan & Wise, 2007).

There are numerous models for consultation that have garnered empirical support including mental health consultation and behavioral consultation. For a full explanation of consultation models see Brown et al. (2006) or Erchul and Martens (2012). In order to facilitate consultation within the K-12 online learning environment and adhere as closely as possible to the models of consultation, the school psychologist would need to use the available technology that most closely resembles face-to-face interaction such as Skype, Vyew, Google Hangouts, or ooVoo web-conferencing tools. While other technologically-facilitated means (e.g. instant messaging or email) might be used for consultation purposes, these are less ideal in that the school psychologist will not have access to the consultee's body language or intonation as sources of data for gaining insight into the more psychological elements of the case (Tysinger et al., 2013).

Most approaches of school psychological consultation involve the progression of the process through four phases: problem identification, problem analysis, intervention design, and evaluation. The emotional investment, level of frustration, and commitment to change of the consultee are particularly important variables for the school psychologist to take into consideration in the problem identification and problem analysis phases. Thus, the need for the use of web-conferencing tools within those phases increases since the school psychologist and consultee are working together to arrive at a specific, measurable, operational definition of the issue of concern for the student, taking into account all variables that may be contributing to the issue, and developing a hypothesis from which to approach the problem-solving process (Erchul & Martens, 2012). Tysinger et al. (2013) have suggested that the school psychologist's knowledge and expertise may be particularly helpful in consultation with teachers to target concerns with student assignment completion and motivation within the K-12 online learning environment.

As the school psychologist and consultee move into phases three and four of consultation (intervention design and evaluation), the pair are actually merging into the interventionist function of the school psychologist. Prior to intervention design for any academic, behavior, social, or emotional student concern, the school psychologist works with the teacher to design a plan to collect data on the issue of concern. In traditional schools, this typically involves one or both parties using a systematic observation process to collect baseline data. This baseline data is subsequently compared to that of a typically functioning student to determine if the targeted issue is outside the norm for that age/grade student and the extent of severity of the issue. Additionally, these data are used to determine whether the issue of concern represents a skill deficit or a performance deficit for the student. A skill deficit means that the student has not learned the requisite skill for success; a performance deficit is when a student has the requisite skills for success but is choosing not to use the skill. Therefore, the data typically collected through observation is critical to the development and success of the problem-solving process.

In the case of blended learning programs, the school psychologist could conceivably have the opportunity to directly observe a target student during any face-to-face content delivery. Despite the importance of observational data, direct observation of the student is unlikely in the fully online K-12 learning environment. However, Tysinger et al. (2013) have recommended strategies for utilizing the strengths of the online environment and its associated technologies for the collection of data. The systematic observation techniques of event recording, latency recording, and duration recording could easily translate into the online environment, and the techniques of partial interval recording and time sampling could be utilized during any synchronous online activity. Additionally, the authors have noted that submitted assignments and archived discussions are rich sources of information. The school psychologist should analyze those written products for consistency and inconsistency in the student's demonstration of the targeted issue/response. The school psychologist could also utilize content analysis techniques from the field of instructional technology in these data sources (Yang, Richardson, French, & Lehman, 2011). During any synchronous lesson or activity, the school psychologist could "observe" the student's behavior. Finally, Tysinger et al. (2013) indicate that technologically-facilitated interviews with the student, teacher, and parent can provide further sources of data on which to base problem-solving efforts.

When the resulting data have been compiled and analyzed, the school psychologist and consultee work collaboratively to design the intervention to address the issue of concern. Whether practicing in a traditional or technologically-enhanced format, the intervention is designed to either build a targeted behavioral response or increase probability of the performance of a targeted behavioral response, dependent on the previous determination of its etiology as a skill or performance deficit. The school psychologist and consultee mutually determine acceptable and feasible methods for intervention, progress monitoring, and finally evaluation of intervention success. The interventions are designed to utilize empirically-validated techniques, training, modeling, and positive reinforcement for demonstration of replacement behaviors to the issue of concern. Throughout the process, the school psychologist and consultee continue to track the sources of data for monitoring impact and effectiveness of the intervention.

Similar to consultation and intervention design, another role of the school psychologist reliant on data-based decision-making is that of assessment. File reviews, interviews, and observations are key components in the assessment process that can be adapted to the K-12 online learning environment as described above. The component of assessment that may be more difficult for the school psychologist to deliver is that of testing for eligibility for special services. In a traditional school, this testing takes place in a face-to-face session between the school psychologist and referred student. In fact, many school psychologists who are currently serving K-12 online students continue to utilize this model by meeting at a mutually agreed upon location in order for formal assessment to take place, and many blended online learning programs offer the opportunity for face-to-face assessment methods as well. However, Tysinger et al., (2013) challenged school psychologists to investigate and take advantage of sources of assessment information unique to the online learning environment. Recent technological advancements have been developed for psychological testing which utilize remote onscreen administration of psychological tests such as Pearson's Q-Global. Through this web-based administration system, the school psychologist can arrange for the student's parent to receive an email with a secure link enabling the student to complete the test on a personal computer or device. Once the web-based administration of the test is completed by the examinee, the school psychologist will have access to the testing results. Additionally, common assessment decisions including classroom accommodations, assignment modifications, and need for adaptive technology can be made for the compilation and analysis of multiple sources of data. Tysinger et al. (2013) also noted that work habit information as measured by student log-in data (time spent online, time of day of assignment completion, etc.) and comment patterns can be useful to the assessment and decision-making process.

At the intersection of the school psychologists' functions within assessment and intervention is their role within the RtI process. Brown-Chidsey and Steege (2005) defined RtI as "…an assessment-intervention model that allows schools to deliver sound instructional methods to students….who might fall through the cracks" (p. 2). In the RtI model, the school psychologist utilizes his/her aforementioned consultation, assessment, and intervention skills to assist school personnel with moving students through tiered levels of support to enhance their academic or behavioral performance. Again, the school psychologist is uniquely trained and suited to aid the implementation of RtI in the K-12 online learning environment.

Another direct service role of the school psychologist with potential for enhancing student functioning within K-12 online learning environments is that of counseling. Although data are presently unavailable for children and adolescents in virtual school settings, studies of adult learners show that over 22% of those engaged in online learning environments have self-identified as having mental health diagnoses (Leonhard, 2010). Additionally, it has been noted that nearly 20% of children in the population at large has a diagnosable mental disorder (Huang, Stroul, Friedman, Mrazel, Friesen, Pires, & Mayberg, 2005). However, it is estimated that only one-third of those students will receive the necessary mental health treatment (Whelly, Cash, & Bryson, 2003). Thus, Tysinger et al. (2013) charged that school psychologists affiliated with K-12 online learning environments must be prepared to provide mental health supports necessary for students to succeed, as they do within traditional school environments.

The role of counseling for the school psychologist often includes individual, group, and/or crisis counseling (Fagan & Wise, 2007). Depending on the nature of the issue being targeted, the school psychologist may choose to intervene with a psychoeducational, counseling, or therapeutic focus. Psychoeducational interventions are those that target typically-developing students and may address social skill building, information provision, and performance issues. Counseling interventions target students who are facing issues with development or adjustment, while therapeutic interventions are those more intensive supports for psychologically-oriented challenges (Schectman, 2002). The empirical research on technologically-facilitated counseling is growing rapidly and will be critical to the practice of school psychology within K-12 online and blended learning.

Research Synthesis

Although some scholars have published works promoting the training for and practice of school psychology in the online learning environment (Kennedy, Tysinger, LaFrance, & Bailey, 2012; Tysinger, Tysinger, Diamanduros, & Kennedy, 2013), to date, there are no empirical studies that examine the practice of school psychology in K-12 online learning and blended environments in any regard. However, existing research can be applied to the roles and functions of the school psychologist providing service delivery in online learning environments as previously described. Of particular relevance to the school psychologist would be empirical studies of student engagement data in online learning formats and the burgeoning research on the effective delivery of counseling services through online means.

With regard to student engagement, research suggests that measuring student engagement through the use of learning analytics could be a correlate to or predictor of academic success. As such, the school psychologist may focus academic interventions on increasing student engagement through lessons, activities, or assignments when appropriate. Dickson (2005) indicated that the quantity of data on student performance in online settings actually surpasses that of students in traditional settings since every mouse click, key stroke, and comment is potentially accessible for analysis within the learning management system. Student engagement as measured by clicks is correlated with academic success (Dickson, 2005; Hamane, 2014).

In relation to counseling, a recent meta-analysis suggested the promise associated with counseling conducted through online chat despite the small number of empirical studies to date (Dowling & Rickwood, 2013). The literature on technologically-facilitated counseling indicates that there are many challenges in this form of service-delivery, including ethical considerations related to confidentiality (Mallen, Vogel, & Rochlen, 2005) and counseling process issues. Some of those issues include lack of nonverbal cues (Williams, Bambling, King, & Abbott, 2009), time management concerns, and session progress (Bambling, King, Reid, & Wegner, 2008; Chardon, Bagraith, & King, 2011). Despite these concerns, the empirical studies of online counseling sessions also offer techniques for the counselor for overcoming the limitations of the technology, including the use of overt thought and feeling statements from both the counselor and client and the targeted use of emoticons (Mallen et al., 2005; Trepal, Haberstroh, Duffey, & Evans, 2007).

While research from related fields offers direction for the school psychologist practicing in an online medium, the dearth of research from the field itself is alarming and must be addressed to ensure high-quality, professional, competent, and ethical practice across all the roles and functions of school psychological practice. The uniqueness of K-12 fully online and blended learning environments require extensive empirical study to move toward best practice models for service delivery.

Implications for Policy and Practice

At present, K-12 online learning represents a new medium of practice for the school psychologist with far-reaching implications for service delivery. Both policy and practice will be impacted by the necessary changes in graduate education, professional development, and credentialing to ensure high quality school psychological services are provided for students, teachers, families, and administrators affiliated with K-12 fully online and blended learning environments. Although Fagan and Wise (2007) were not referring specifically to work within K-12 online learning spaces, they may have foreshadowed school psychology's continued evolution with their contention that,

School psychology is expanding outward from center, away from its past of traditional roles, functions, and settings. Almost every conceivable type of school psychologist will exist in the coming decades. Roles and functions may be defined more by setting than in the past. (p. 391)

With regard to school psychology preparation for working within the K-12 online learning environment, very few training opportunities (i.e., curriculum content, assignments, experiential learning) exist at the graduate education or professional development levels (Kennedy, et. al, 2012). Yet, the National Association of School Psychologists (NASP) has emphasized that technology use and impact (like that inherent in online education) is a critical domain for school psychological practice (NASP, 2006), and NASP has started an interest group called School Psychology in Virtual Schools for the purpose of providing a space for those interested in this area. Additionally, the NASP's *Principles for Professional Ethics* (NASP, 2010a) requires that school psychologists engage only in practices for which they are trained and that they seek supervision and/or consultation with other professionals when the need arises to expand their skill sets. Thus, the demand for high-quality preparation is clear to positively influence both policy and practice, and Kennedy et. al (2012) have issued a call-to-action in this regard.

In the context of graduate education, NASP determines the national-level standards for the training of school psychologists as outlined in the *Standards for Graduate Preparation of School Psychologists* (NASP, 2010b). Specifically, the ten domains of education and practice are as follows:

1. Data-Based Decision Making and Accountability,
2. Consultation and Collaboration,
3. Interventions and Instructional Support to Develop Academic Skills,
4. Interventions and Mental Health Services to Develop Social and Life Skills,
5. School-Wide Practices to Promote Learning,
6. Preventive and Responsive Services,

7. Family-School Collaboration Services,
8. Diversity in Development and Learning,
9. Research and Program Evaluation, and Legal, Ethical, and Professional Practice (NASP, 2010b).

The NASP conducts a thorough review of every training program seeking national approval to ensure that the aforementioned domains are addressed extensively across the program's curriculum, assessed directly by its faculty, and attained by its graduate candidates. Although the NASP has yet to address the training needs specific to online school psychological practice, the aforementioned training domains could all apply to the practice in this area, and certainly, current graduate training programs will need to supplement their programs of study with more online instructional design and pedagogy for school psychologists to work effectively within K-12 online learning environments.

Undergraduate and graduate training for education professionals to work within K-12 online learning remains in its infancy; the most progress seems to be in teacher preparation programs where approximately two percent of programs nationwide are offering coursework and/or field experiences specific to teaching within an online environment (Kennedy & Archambault, 2012). Despite the limited presence of content for online learning environments within higher education, Tysinger et al. (2013) recommended that the preparation of school psychologists to work within this relatively new educational medium should follow the models set forth by the teacher education programs that have embraced K-12 online learning within their coursework and field experiences. As such, Tysinger et al. (2013) recommended that, "…school psychology training programs should incorporate knowledge-based content within the course sequence to address each role and function of the school psychologist and his or her adaptation to the online learning environment." They further suggested that those in training to become school psychologists should experience online learning from the student perspective. Taking a graduate-level class that is offered fully online would help the school psychology candidates conceptualize the uniqueness of that learning environment and its associated challenges and opportunities for learners. In fact, a number of research studies has found that the perceptions of online learning from both pre-service and in-service teachers may change after participating in courses that utilize online learning (Barbour & Harrison, 2016; Cook, Dickerson, Annetta, & Minogue, 2011). Finally, supervised field experiences in the form of course projects or practica within K-12 online learning environments (commensurate with those found in teacher education programs) are essential from a pragmatic and ethical perspective (Tysinger et al., 2013). In fact, Standard IV (Responsibility to Schools, Families, Communities, The Profession, and Society) of the NASP *Principles for Professional Ethics* (2010a) includes provision IV.1.1 which details that:

> To provide effective services and systems consultation, school psychologists are knowledgeable about the organization, philosophy, goals, objectives, culture, and methodologies of the settings in which they provide services. In addition, school psychologists develop partnerships and networks with community service providers and agencies to provide seamless services to children and families. (p. 12)

In addition to the needs for training within the school psychology graduate education programs, practitioners who are already working within the field may exhibit knowledge and/or skill deficits with regard to the application of their practice to K-12 online learning environments. According to Kennedy et al. (2012), the school psychologists who are currently working within K-12 online learning environments are assigned to the role as a part of district-level online learning initiatives or are private practitioners who have contracted with online schools for the provision of school psychological services.

In order to gain the necessary competencies for practice in this unique environment, Tysinger et al. (2013) recommended supervised experiences with another professional. This is consistent with Standard II.1.1 of the *Principles for Professional Ethics* (NASP, 2010a) which states the following:

> School psychologists recognize the strengths and limitations of their training and experience, engaging only in practices for which they are qualified. They enlist the assistance of other specialists in supervisory, consultative, or referral roles as appropriate in providing effective services. (p. 6)

Given that few school psychologists have received any formal training or professional development for practice in K-12 online learning environments, school psychologists desiring to work there may need to rely on the expertise from practitioners in closely-related fields with better established training protocols for service delivery in online environments like counseling or social work (Kennedy et al., 2012). Fortunately, utilizing the online medium for supervisory purposes may serve the dual-role of increasing the practitioner's facility with online communication and allow for feedback from experts who are not limited by geographic distance. This supervision could take the form of online review of the school psychologist's interactions within the learning platform and/or supervision sessions that are facilitated through the use of technological tools (Tysinger et al., 2013).

A second and equally complex issue of policy and practice for school psychological service delivery in K-12 online learning environments is that of credentialing and/or licensure. For school-based practice, school psychologists are typically credentialed by their state's Department of Education. At the doctoral-level, school psychologists may also be licensed by their state's Board of Examiners in Psychology for work in private practice settings within that state (Fagan & Wise, 2007). For K-12 online learning programs that are district- or state-based initiatives, these credentials should be sufficient for the practice of school psychology within that medium (Tysinger et al., 2013).

However, many current K-12 online learning opportunities for students actually cross the borders of states or even nations. In these cases, the issue of appropriate credentialing becomes more difficult. School psychologists are bound by NASP's *Principles for Professional Ethics* (2010a) to hold the appropriate practice credential for the state within which they work. When the enrollment of an online learning environment crosses borders, a school psychologist would need to hold practice credentials for each of the states/nations of the student body in order to legally and ethically offer his/her services.

NASP offers the Nationally Certified School Psychologist (NCSP) credential for school psychologists who demonstrate training and knowledge/practice consistent with the criteria set out by that organization for attainment of the credential. One of the benefits of holding the NCSP credential is that 31 states offer credentialing reciprocity for those practitioners with the NCSP. While this could potentially ease some issues of practice across state borders, it would continue to be exceedingly cumbersome and expensive for the school psychologist to acquire and maintain practice credentials for multiple states. Additionally, an ever-changing student body would create an ongoing issue for the school psychologist engaging in K-12 online practice across state borders. Other potential solutions to the issue of interstate practice include the Interjurisdictional Practice Certificate from the Association of State and Provincial Psychology Boards and guest licensure provisions offered by some states. However, both of these practice allowances are temporary and would likely be unavailable to non-doctoral school psychologists at this time (DeAngelis, 2012).

In July 2013, the American Psychological Association (APA) formed the APA Task Force on the Development of Telepsychology Guidelines and adopted the work from that group (APA, 2013). Telepsychology is defined as "…the provision of psychological services using telecommunication technologies. Telecommunication technologies include but are not limited to telephone, mobile devices, interactive videoconferencing, email, chat, text, and Internet (e.g., self-help websites, blogs, and social media)" (APA, 2013). These telepsychology guidelines recommend that

> …because of the rapid growth in the utilization of telecommunication technologies, psychologists strive to keep abreast of developments and changes in the licensure and other interjurisdictional practice requirements that may be pertinent to their delivery of telepsychology services across jurisdictional boundaries. (p. 3)

Further, the guidelines note the probability of a credential for interjurisdictional practice in the future, like that operating in the field of nursing.

Tysinger et al. (2013) contend that the laws designed to ensure appropriate service delivery in traditional models are quickly becoming outdated with the rapid changes in technology and education like that of K-12 online learning environments. In fact, those laws may now be creating barriers by limiting access to services that could otherwise be delivered electronically. Since credentialing for psychological services is based at the state level, the process of updating and change is likely to be slow and laborious.

Implications for Research

Currently, the most pressing need for research with regard to school psychological service in online learning environments is in relation to school safety issues. Addressing school safety issues in K-12 online and blended learning environments is a critical need in the literature base for both theoretical and practical implications (Tysinger et al., 2013). Research by Adamson and Peacock (2007) indicated that 93% of their respondents in traditional schools "had experienced and responded to serious crises" (p. 756). Corresponding data are unavailable for K-12 online learning and blended environments; however, it is unlikely that the technologically-based schools would be immune to a problem that is reported so extensively in traditional educational environments. Crises involving student-to-student or student-to-faculty harm are likely eliminated as a concern in the fully online learning environment due to the lack of physical proximity. However, across their online communications with students, teachers may suspect suicidal ideation, homicidal ideation, and/or child abuse/neglect which are not unlike the conditions in traditional learning environments. Also similar to the brick-and-mortar school, the fully online school community could be impacted by death of a student, death of a teacher, natural disasters, or acts of terrorism (Tysinger et al., 2013). The challenges of geographic distance in fully online learning make the typical school-based crisis intervention models inefficient or impossible to carry out due to their reliance on physical proximity and local response agencies. While many crisis intervention techniques could be applied in a face-to-face format for students in a blended learning program, a model for crisis response that is tailored to the various virtual learning environments would fill a significant gap in education research and practice.

Through their research, Forthun and McCombie (2011) demonstrated that when educators are trained to respond in crisis situations, it decreases negative emotional reactions overall and increases their willingness to help students in times of crisis. As such, it is critical that faculty members receive training for addressing crises in the online learning environment. However, as the previous paragraphs have highlighted, there is currently no empirically-based model on which to base training and crisis response for this growing educational medium. From the literature in traditional schooling models, crisis response proceeds through the evaluation of the individual's threat perception related to the crisis, his/her emotional and physical proximity to the crisis, his/her internal and external vulnerability factors, and his/her reaction to the crisis (Brock, 2011).

There is consensus from experts in the field of school crisis for traditional learning environments that lack of planning for crises contributes to greater harm to students and the environment when crises do occur (Aspiranti, Pelchar, McCleary, Bain, & Foster, 2011; Cornell & Sheras, 1998; Forthun & McCombie, 2011; Low, 2010; Morrison, Russo, & Ilg, 2006). Failure to plan and train for crises can lead to greater threats to physical safety and mental health, including anxiety, depression, and post-traumatic stress disorder (Brock, Nickerson, Reeves, and Jimerson, 2008). Consequently, the physical and mental health concerns impact learning outcomes including attention, memory, retention, and retrieval of academic content (Brock et al., 2008; Eaves, 2001). Although school safety is featured prominently in professional and popular media as a critical need, at present, there are few resources that address school safety issues outside the brick-and-mortar, traditional school.

Beyond the research needs related to crisis prevention and intervention, another need for research in the area of online school safety relates to the issue of cyberbullying. The most common definition for cyberbullying comes from the work of Hinduja and Patchin (2010) who defined it as the "willful and repeated harm inflicted through the use of computers, cell phones, and other electronic media" (p. 1). While cyberbullying has garnered significant attention in the popular media and has a steadily growing research base, to date, no studies have addressed this issue in the context of K-12 online learning. The need for the research within K-12 fully online and blended learning environments is clear and significant given that cyberbullying has been associated with many negative outcomes for students including sadness, anger, frustration (Hinduja & Patchin, 2007), and even suicide (Hinduja & Patchin, 2009). Future areas of research should include cyberbullying policies within virtual school environments, prevalence rates, online intervention effectiveness, and the mental health and social outcomes associated with cyberbullying.

Conclusions

K–12 fully online and blended learning is proliferating in the United States. The wide range of students attracted to and enrolling in these educational environments matriculate with diverse needs with regard to academic, behavioral, and social-emotional constructs. School psychologists are uniquely suited for applying psychological principles to the educational environment. In fact, many school psychologists have already transitioned their services into online practice. However, as with many rapidly developing initiatives, the practice has outpaced the training, research, and literature in the field.

Tysinger et al. (2013) have published the most thorough information to date on the training needs for school psychologists to work within K-12 online and blended learning environments. They have highlighted technologically-facilitated opportunities for the functions of the practicing school psychologist along with some of the ethical considerations of practice within this domain. However, it is hoped that as training programs and professional development opportunities incorporate the specific needs of school psychologists in K-12 online and blended learning environments, the research will flourish to develop empirically-based best practice models for service-delivery in these unique environments, particularly with regard to school safety issues like crisis prevention, crisis intervention, and cyberbullying. Finally, it is critical that credentialing agencies address the new realities of interstate practice to allow greater access and equity for all K-12 students to needed school psychological services.

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K-12 Online and Blended Learning, School Libraries, and School Librarians

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Abstract

Despite the proliferation of K-12 online learning options and the strides school libraries have made toward virtualization of resources and online information fluency instruction, there is not a significant body of research specific to libraries in K-12 online environments. The stage is set, however, for this research to occur. The shifting library landscape, evidence of the connection of school libraries to student achievement, the expanded instructional technology and curation roles of librarians, and the foundational instructional design concepts aligned to the incorporation of libraries in digital learning environments all support the necessity for research in this area. This chapter is updated from the previous published in 2014 and includes new information related to expanding school librarian roles, open education resources, and Future Ready Schools. Research discussed in this chapter includes studies exploring the need for and formats of embedded library services, as well as expanding roles for librarians in blended and online environments. This relatively small but emerging body of literature suggests multiple paths for new research in this field.

Key words: libraries, embedded librarian, information literacy, online libraries, Open Education Resources (OER), Future Ready Libraries, curation

Introduction

School libraries, while a common and essential expectation in brick-and-mortar institutions, are not yet commonplace within K-12 online schools. A review of the literature reveals there does not exist a significant body of research specifically related to K-12 blended and online school libraries. A 2009 review of literature describing research and practice for K-12 online learning by Cavanaugh, Barbour, and Clark contained no discussion of library services. What does exist, however, is a small but growing body of research that informs the growth and development of library services embedded in blended and online learning environments. This research is indexed in academic databases under terms such as virtual libraries, digital curation, embedded librarian, online and blended learning information fluency instruction, collaboration, virtual learning commons, Open Education Resources (OER), and digital resources. Before exploring these converging concepts, we offer a current snapshot of libraries in K-12 online learning, including instructional design foundations, libraries and achievement, and the shifting school library landscape.

Beck (2015) noted that while there is an increase of online schooling at the K-12 level, "the role and responsibilities of the school librarian, particularly as concerns the development of information literacy skills of K-12 online students, continues to be undefined in this setting" (p. 79). Increasingly, blended and online learning paired with increased educational technology adoption are pointed to as catalysts for shifting librarian roles (Green & Kennedy, 2016). These shifting roles include offering technical advice to colleagues (Brzozowski, 2015), increased digital curation and collaborative course design (Ray, 2014), co-teaching (Will, 2016), and relevance and student engagement (Boyer, 2016).

There are two main paths to K-12 online learning: the commercial markets and growth emerging from the brick-and-mortar world. According to the annual Keeping Pace Report "single and multi-district blended and online learning are the fastest-growing segment of online and blended learning" (Evergreen Education Group, 2013, p.17). In order to remain a relevant part of K-12 learning, librarians are incorporating their shifting roles, resources, and instruction into these new environments. In 2012, Rob Darrow, a former teacher librarian and retired principal of the Clovis Online School wrote, "Today, I am not aware of one teacher librarian employed full or part time in any K-12 online school in the U.S. in the job of teacher librarian" and went on to proclaim, "…there really is not a need for a 'traditional' school librarian in an online school" (p. 15). Darrow's point was that the role of librarians in the digital realm requires an expanded set of competences that go beyond those needed in the traditional brick and mortar settings and involve a blending of "the craft of librarianship and teaching" (p. 16). While Darrow predicted that unlike online universities, K-12 online schools would not be employing librarians the services he outlined for college systems nonetheless proved reasonable expectations as potential needs of K-12 learners. These services included instructional materials such as pathfinders and tutorials, research assistance, information literacy modules, and leadership for design of library support. These types of services are no less needed by K-12 students, and, to varying degrees, are slowly beginning to emerge in blended forms in this market.

Online learning platforms and pedagogies are now common enough that the 2016 K-12 edition of the Horizon Report lists it as an important educational technology development with a one-year or less adoption time. In pace with the growth of online learning, there are also two components to school libraries online: highly curated library portals and library information fluency instruction. In addition, the U.S. Department of Education's Go Open movement supporting the use and integration of Open Education Resources as well as the Future Ready Schools initiative are pushing school librarians to respond to shifting needs of their learners in new ways. Increasingly, librarians are growing their practices to meet responsibilities for digital curation and development of online resource collections as well as offering online courses in information fluency and research skills (Boyer, 2015b; Buerkett, 2014; Lincoln, 2012). With growing numbers of schools adopting 1:1 devices (e.g. iPads, Macbooks, ChromeBooks, etc.) or promoting BYOD (bring your own device) programs, school libraries are responding with increased virtualization of libraries, increasing the numbers of e-books, subscription online databases, digital curations, and online library instruction available 24/7 for independent learning. Librarians are providing a growing array of services to meet the needs of learners, whether onsite, blended, or fully online.

Instructional design foundations

Libraries have always been centers of learning how to learn. Constructivist tenets of online learning match those of inquiry and problem-based learning associated with information fluency and library instruction. In the quest for nurturing agile, lifelong learners with skills that will transfer to their wider world, schools of all types are looking to incorporate heutagogical, or "learning how to learn" competencies as described by Blaschke (2012). Standards from the American Association of School Librarians (AASL, 2007), International Society for Technology in Education (ISTE, 2007), and Common Core State Standards (National Governors Association for Best Practices, Council of Chief State School Officers, 2010) all promote competencies supporting lifelong learning. Models for inquiry learning and research such as Big6 (Eisenberg & Berkowitz, 1990), Guided Inquiry (Kuhlthau, Caspari & Maniotes, 2007) and the Stripling Inquiry Model (Stripling, 2003) have been widely utilized by librarians for instruction corresponding to these standards. Effective school library programs are also explicitly named under Every Student Succeeds Act (ESSA) of 2015. As the shift to online learning continues to grow in the K-12 market, librarians will need to build upon and leverage the collaboration and instructional capital they have developed in brick-and-mortar settings. Increasingly, librarians are tasked to be co-teachers and co-designers of instruction targeting developing information literacy and research skills with a focus on college-readiness (Boyer, 2015; Jacobson & O'Keeffe, 2014). These standards and instructional models provide the strong foundation necessary for the development of successful online library instruction.

Shifting library landscape

The necessity for the virtualization of school libraries has grown organically along with the digital shift. While a multitude of digitized collections, resources, and learning object repositories exist, their full integration with information fluency skill instruction and embeddedness into online schools is just developing. The School Library Journal 2017 Technology Survey revealed several points that underscore the library's role with technology and the digital shift in schools (Barack, 2017). Median technology spending in school libraries doubled in 2016-17. Librarians are increasingly involved with their school's computer science offerings (33%) and are enjoying high levels of support from their technology coordinators (41%). Among technology-related tasks, working with learning management systems and using free web-based tools ranked highest for high school librarians at 84% and 83%, respectively. The School Library Journal 2016 Spending Survey (Barack, 2016) pinpointed the growth of digital reference and ebook purchases among school libraries. Roberts (2012) described the shift for libraries as moving "from content to facilitation" of individual learning, calling for libraries to move to "integrated services, one stop shop information points" (p. 156). Stemming from the Loertscher, Koechlin, and Rosenfeld (2011) conceptualization of the library as a learning commons, the virtual learning commons has now emerged (Loertscher & Koechlin, 2012). As a "digital learning community in which the whole school participates," the virtual learning commons model conceptually bridges the traditional physical library spaces to blended and online environments (p.20). Boulden (2015) shared that,

> School librarians in the twenty-first century are tasked with collaborating with classroom teachers to meet school-improvement goals; creating both a physical and virtual learning space that provides 24/7 access to library resources; meeting individual students' reading, informational, and instructional interests and needs; and serving as leaders for their schools' instructional and technology programs, as well as for policy development. (p.55)

In addition to ensuring that the library has a virtual presence, school librarians must also plan for the shift of their own instruction to online environments. Shifting roles of librarians and the subsequent necessity of updating pre-service librarian education has also been present in the literature, with deGroot and Branch (2011) stating that in order to meet AASL information fluency requirements, librarian education programs need to "emphasize the teaching, technology, and leadership skills" (p. 289), and specifically need to provide "more opportunities… to explore and discuss the issues arising from the proliferation of new technologies" (p. 294). As school librarians provide learning resources and strategies, they continue to be "at the forefront of digital integration in schools" (School Libraries, 2016, p. 9). As such, school librarians are well positioned to play an active role in blended and online learning.

The Future Ready Librarian Framework provides librarians, teachers, and administrators with a clear vision of how libraries can and should meet the needs of 21st Century learners (Ray & Trettin, 2016). Future Ready Librarians (FRL) is an expansion of the Future Ready Schools Initiative led by the Alliance of Excellent Education in partnership with the U.S. Department of Education. Currently, more than 3,100 district superintendents have signed the Future Ready Pledge committing to "plan and implement personalized, research-based digital learning strategies" (Ray & Trettin, 2016, p.8).

School libraries and achievement

A body of research exists connecting the presence of strong K-12 school library programs to achievement. This research has been succinctly summarized by Deb Kachel and the graduate students at Mansfield University (Kachel, 2011). Thirty-four individual studies were reviewed, providing overwhelming evidence of the critical need for school libraries and librarians in relation to student achievement. It is logical this correlation is likely to extend to online K-12 settings. The challenge is how best to ensure that the gains made in brick-and-mortar environments can also occur in online school settings. In addition, various school impact studies have shown "a strong relationship between the presence of a credentialed librarian and a higher graduation rate" (School libraries, 2016, p. 11). In addition to these K-12 achievement studies, Smalley (2004) found that "students whose high schools include librarians and library instruction bring more understanding… to their college experiences" (p. 197), and "achievement is substantially higher" for these students (p. 193). This body of research can inform decision-makers as to why school librarians are essential to the success of blended and online learning.

Despite the lack of formal literature, a look at the current usage of one tool for library virtualization, Springshare's LibGuides, demonstrates that school librarians are building online portals to serve students. With over 500,000 published guides (i.e. online library resource portals), LibGuides is the chosen tool for virtualization for 138,196 librarians in 4,763 institutions in 73 countries. K-12 comprises 743 of these guides. This number represents the degree to which librarians in K-12 schools are developing online virtual libraries for their learners, regardless of school format. In addition to Libguides, there are countless Web 2.0 tools that K-12 librarians are leveraging as means to virtualize their libraries, share resources, and provide instruction beyond the physical library space.

The shifting library landscape and growth of online school libraries paired with strong evidence of the correlation of school libraries to student achievement collectively point toward the value and necessity of librarians and library resources to play a role in blended and online K-12 environments. At this time, however, research specific to K-12 online and blended school libraries remains limited. The following section provides a synthesis of this research grouped into these main themes: the need for school libraries and librarians to be embedded in online learning systems, how services and instruction can be embedded, and the design of online information fluency instruction.

Synthesis of Research

Although still somewhat limited, extant research into school libraries for K-12 online settings provides foundational research to inform future study. Literature presented here includes discussions of the need for curated school library resources, instruction and services to be embedded like their academic counterparts; how embedded library services can be designed; and, how library information fluency instruction can be presented with a blended approach.

Why school libraries and librarians need to be embedded

Beck (2015) noted that despite an increase of K-12 online schooling, "the role and responsibilities of the school librarian, particularly as concerns the development of information literacy skills… continues to be undefined in this setting" (p. 79). In a discussion of why school libraries are essential to online learning and how to make the transformation from physical to virtual, Darrow (2009) pointed to Tapscott's eight norms of the Net Generation as a "guide to transforming library services into what is needed for the 21st century learner" (p. 80). Tapscott's norms include: freedom, customization and personalization, scrutiny, integrity and openness, entertainment and play, collaboration, need for speed, and innovation (2009). Vesey (2004) stressed that digital libraries must surpass the "web links only" style and instead reflect foundational library strengths by offering students "quality, edited, age-appropriate, verifiable information representing a variety of viewpoints… and formats" (p. 28). To meet learner needs, virtual libraries need to include instruction, collaborative activities, and highly specialized curated content, all of which needs to be openly accessed online and at a variety of entry points within the learning management system. The ultimate goal of virtual libraries is personal knowledge construction that extends beyond the demands and constraints of the online classroom, facilitating both formal and informal learning, and supporting "free agent learners" identified by the 2003 Speak Up Research Project (Smith & Evans, 2010). These libraries can be places of connected learning as described by the Young Adult Library Service Association (YALSA, 2014):

> Connected learning is realized when a young person is able to pursue a personal interest or passion with the support of friends and caring adults, and is in turn able to link this learning and interest to academic, career success or civic engagement. (p. 9)

To these ends, virtual libraries can support formal and informal learning (YALSA, 2014) and become a key to personalization through differentiation of materials to meet the variety of learning needs and interests of students with both just-in-time and just-enough learning (Gunn, 2002). An advantage of these highly-curated spaces, according to Gunn (2002), is that they reduce the overwhelming flow of information to just those materials that carefully match learner needs.

Advantages of inclusion of librarians from the early development stage of online learning systems have been delineated as helping smooth the technological transition for colleagues (Huwe, 2010; Ray, 2014; Rohland-Heinrich & Jensen, 2007), assisting with instructional design issues (Boyer, 2015b; Lincoln, 2009), targeting key services for inclusion in the system (Kelly & Boyer, 2012; Ray, 2014), and providing interactive instruction and support (Kachel, Henry & Keller, 2005; Lincoln, 2009; Rohland-Heinrich & Jensen, 2007). Shumaker (2012) stated, "The goal of embedded librarianship is more than service. It is partnership" (p. 18). Huwe (2010) pointed out that for those online schools stemming from existing brick-and-mortar institutions, librarians already have built strong collaborative relationships with faculty and are recognized as helping teachers learn new technologies, making them "instrumental in extending 'buy-in' among this important group of stakeholders" (p. 28), potentially helping to "create and advance new online community services that really work" (p. 29). Rohland-Heinrich and Jensen (2007) asserted, "serving as mentors, media specialists ensure that teachers possess the technological and research skills necessary to effectively deliver dynamic and relevant online courses" (para. 20), by providing "essential pedagogical and technological foundations… in the areas of curriculum development, online instruction enhancement, and student-learning support in the virtual environment" (para. 7). In addition, librarians are cognizant of the necessity for this instruction to be interactive and offer authentic research opportunities (Kachel, Henry & Keller, 2005; Lincoln, 2009). Lincoln (2009) asserted that young learners gain technology skills through their everyday use of computing devices, but need online learning experiences that "will require them to complete assignments, meet deadlines, learn appropriate online behavior, and effectively collaborate with others in an instructional setting" (p. 4). In this way, the implementation of online information fluency courses or modules embedded within content area courses helps prepare learners for the level of independent online research they will conduct at university and in everyday adult life.

Embedding library services and instruction

Farmer (2012) reported that the School Library Journal 2010-11 Spending Survey revealed the top three tasks performed by library media specialists to include teaching classes (89%), tech troubleshooting (60%), and faculty development (52%). Reviewing the 2009 Speak Up research results, Smith and Evans (2010) found librarians to be the educators most likely to be engaged in social networks, use social media, write blogs and create videos. The tasks identified by these two significant national studies all align well with professional learning, collaborating, and teaching in the online environment.

The 2014 OCLC membership report, *At a Tipping Point: Education, Learning, and Libraries,* noted that "once discovered, the library website is used by 83% of online learners" and that a "vast majority found all of the items they used from the library website to be useful" (p. 75).

More than half of college-level online learners said "it is important for the library to provide access to and instructions on how to use the library's materials and resources. Access to freely available information on the web, as well as tools, consultation, and instructions on how to conduct research" were their top needs (OCLC, 2014, p. 77). While the librarian role as collaborative course designer appears frequently in academic literature (Shepley, 2009), descriptions of collaboratively-designed secondary online information literacy courses are just emerging. These courses usually target college readiness (Boyer, 2015a; Boyer & Kocis-Westgate, 2014) or dual credit with college (Davis & Watson, 2017).

Lists of key services and design elements for supporting online learning like those delineated by OCLC (2014) and Farmer (2012) have frequently appeared in trade publications and include common elements such as the inclusion of pathfinders of curated high quality resources, integration of open source media, instructional materials and tutorials, professional resources and support for instructors, points of contact for assistance and support from librarians, integrated social media, places for collaborative activities, and places to showcase student work (Buerkett, 2014; Johnson, 2013; Lamb & Callison, 2005; Loertscher & Koechlin, 2013; Smith & Evans, 2010). One common form of embedding librarians is to have them become active participants in the online course discussions to provide direct interventions as needed (Darrow, 2009). Zmuda (2009) pointed out that librarians working to expand or shift services and instruction to meet the needs of online learners must first discover what are students trying to learn and how they prefer to learn it, ensuring that instruction offered is both relevant and in accessible and appropriate modes. While achievement has been linked to the presence of librarians available to instruct and assist learners (Kachel, 2013; Smalley, 2004), research by Anderson and May (2010) further demonstrated that the method of instruction (whether face-to-face, blended, or online) did not affect levels of retention of information literacy skills (p. 498). Kachel, Henry and Keller (2005) presciently looked to the growth of blended learning as a means to achieve greater personalization and motivation for secondary learners, stating,

> Good education, whether face-to-face or online, should be meeting the needs of the individual learners; connecting them with content, resources, and the ideas of others," and that "the best scenarios for high school students would be hybrid online courses that combine face-to-face class time with online learning components. (p. 17)

Descriptions of blended approaches bridging the physical classroom with the online library and librarian roles (Boyer, 2015; Brzozowski, 2015; Stubeck, 2015) are on the rise. Black (2008), pointing to earlier literature that confirmed "the integration of library resources into the learning management system has the potential to significantly enrich the educational experience of students" (p. 496), stressed that the question had moved to how to best accomplish this task and recommended a "toolkit" approach, including embedded resources, single authentication for student ease of use of resources, and additional resource pages.

Where and how to embed resources and services

Shank and Dewald (2003) described library/librarian embeddedness as occurring at the macro and micro levels. Micro integration occurs at the course level, and could be as granular as integration into specific activities. Micro integration relies on collaboration between librarian and instructor, each having administration/authorization rights within the course (Black, 2008). Librarians need to be able to embed both resources and themselves (e.g. in discussions, as research assistance, etc.) into courses (Kelly & Boyer, 2012). Macro integration occurs at the LMS level, with one main entry point into the library portal. In 2013, Murphy and Black investigated the efficacy of LibGuides as the key tool to accomplish these tasks. Their findings confirmed that the students using Libguides embedded within their management system found the guides helpful, confirming anecdotal evidence from case studies such as Verbit and Kline (201l).

Literature of the past few years reflects the growing desire for libraries to be more than repositories of information. Online libraries must be flexible and comprehensive enough to serve learners whether onsite, blended, or online. How-to guides for the design and development of online school library environments (Boyer, 2016; Buerkett, 2014) are beginning to appear in the literature. Developing such a highly adaptable environment requires librarians to become fully aware of stakeholders' existing perceptions of the library as well as what they would like it to be. It demands, too that the librarian has comprehensive knowledge of the curriculum. Additionally, librarians must be prepared to design and develop the space. This requirement means that they have curated free web resources to accompany digital subscription resources and are prepared to embed resource how-tos and information literacy skills in the space (Boyer, 2016). In this manner, online libraries become what OCLC (2014) identified as "support ecosystems" that not only provide information but are also environments that provide the tools and communities of support (p. 90). As Green and Kennedy (2016) noted, however, the design of online library environments is just the first step, and we "are not collaborating with teachers and students to support connected learning," nor "advocating for the crucial and active role we play in this learning" (para. 4).

K-12 librarians, curation and online instructional roles

Careful, skilled curation of resources for inclusion into online courses and networks is essential.

Curation of resources for online content is a continuation of the librarian's traditional role in gathering and vetting resources. Librarians serve their learning communities through sense-making as they gather materials with varied perspectives and "scaffold information for our students, matching resources to curriculum objectives" (Kirkland, 2013, p. 20). Reviewing shifts among annual Project Tomorrow studies, American Libraries (2016) highlighted that while in 2010 only 35% of school librarians indicated they were acquiring digital content, by 2015, that number had increased to 69% (p. 10). Valenza, Boyer and Curtis (2014) presented examples of how digital curation efforts of school librarians "supports learning, serves as a learning activity for students, and contributes to the larger community" (p. 27). McIlvain (2010) specifically pointed to librarians' contribution to "capacity building proficiencies" through their "vital role in leveraging, filtering, and imparting to teachers information about effective use of digitally based information, communications, and content resources, and in identifying needs that remain unmet" (p. 59).

Perhaps the largest shift in both roles may come from the rapidly growing trend to adopt OER in K-12 settings. The Office of Educational Technology of the U.S. Department of Education promotes the use and sharing of open educational resources as a way to reduce costs while sharing best practices (2017). Welz (2017) posited that school librarians are well positioned to support OER initiatives as experienced evaluators and curators of content with "extensive experience in teaching both students and teachers how to identify credible and authoritative online sources" (p. 64).

The School Library Journal 2016 Annual School Library Spending Survey noted that 75% of reporting librarians are either already using OER (30%), or "have them on their radar" (45%) (Barack, 2016, p. 46). This indicates that helping teachers to find, evaluate and use OER is becoming a new responsibility. The 25% of school librarians who were unaware of these options are most often at elementary schools, while 42% of high school librarians are adopting OER and using them with their students (p. 47). These findings represent a shift from a traditional assumption of curation being "collection development" to one of "connection development" (Loertscher & Koechlin, 2016). Defined in this light, the term curation infers the notion of collaborative discovery of resources.

The number of resources linked or embedded into a course is not, however, as important to the learning environment as it is "the quality and relevance of resources used that really leads to enhancements of student learning" (Callison, 2007, p. 16). Additionally, access to libraries in the online environment alone does not lead to student motivation to use quality online resources. A librarian is needed to guide this work as an instructional partner, information specialist, teacher, and program administrator (Hibbard & Franklin, 2015, pp. 89-90). By its nature, information fluency instruction supports the success of online learners and is tailored to the needs of a citizenry engaged in everyday learning activities online. Understanding how to access and effectively judge what is trustworthy information and knowing how to ethically use this information are core competencies required for online learners. A fully embedded librarian in an online course can add "library resources and librarian guidance to assignment pages and within course modules," and become "a member of the course, with full access to assignments, course materials, discussion forums, and other resources provided" (Burke & Tumbleson, 2016, para. 4). This level of embeddedness signals that librarians are full collaborative, co-teaching partners with their teacher colleagues. It also makes librarians available for just-in-time learning assistance while they actively promote information and digital literacy when and where it is most relevant. Further, Burke and Tumbleson (2016) asserted, this level of embeddedness provides librarians with new metrics for measuring their impact.

Research is beginning to evidence the success of information fluency instruction embedded into online learning systems (Boyer & Kocis-Westgate, 2014; Tang & Tseng, 2013; Williams, 2010). Particularly, Tang and Tseng (2013) found that college-age online learners who had greater self-efficacy of information fluency also had higher self-efficacy for online learning while Valentine and Bernhisel (2008) posited that secondary students transfer their technological capabilities to their academic experiences. These findings are significant in that they underscore the need for K-12 online learners to have instruction in information fluency long before moving on to university.

Green and Jones (2014) acknowledged that while librarians are well-versed in implementing national AASL Standards in physical libraries, their roles in the online learning environments are just beginning to emerge (p. E11). These authors asserted that school librarians have made headway by establishing virtual libraries as compliments to physical spaces and by engaging learners in flipped instructional experiences. Flipped instruction, a blended learning experience, calls upon students to interact with content so that face-to-face time with the librarian can be directed to advancing the students' research and inquiry experiences (Valenza, 2012b). Blended learning is also paving the way for integration of technology tools as a means of preparing high schoolers for college (Barack, 2016). Flipped instruction is also being utilized to provide library lessons or tutorials (Bayliss, 2013). Engaging in this type of library service prepares librarians to make the leap to the fully online environment where they can best affect learning by partnering with teachers in collaborative instructional designs, underscoring the necessity of online learning to be a part of the school library landscape (Green & Jones, 2014; Jones & Green, 2012).

As overall instructional demands are increasing, information evaluation in light of digital media literacies is pushing librarians to grow their onsite instructional role (Will, 2016). For librarians, the instructional role includes collaborative co-teaching and extends to providing professional development for colleagues (Kompar, 2016; Will, 2016). In this role, librarians are called upon for help finding and using apps and free and open resources, authoring in learning management systems, and instructing information literacy. Librarians can be "instructional leaders in supporting teachers and students through formal workshops, informal one-on-one tutorials, online mini-module resources, and embedded professional learning" (Kompar, 2016, p. 61). Jones and Green (2012) illustrated how "virtual collaboration… addresses many of the difficulties inherent in traditional, face-to-face collaborative efforts," such as time constraints (p. 27). A benefit of a heightened level of collaboration was identified by Abilock, Harada and Fontichiaro (2013) who, using case studies, noted that instructional conversations and decisions are facilitated when librarians transcend their role of resource provider and lead instead with instructional expertise. This level of deep reflection, conversation and planning demonstrates the grit and dedication of instructors involved in student learning and enriches the instructional capital of the collaborative team (Boyer & Kocis-Westgate, 2014). Likewise, built-in instruction and assessment in online environments provides the type of output measures described by Abilock, Harada and Fontichiaro (2013) that evidence learning. Although they may recognize the need to move into online teaching, many K-12 librarians are not prepared for this challenge. Jones and Green (2014) published results of a survey targeting librarians attitudes toward online learning and teaching. While 80% of librarians had experienced online environments as learners, they did not have instructional experience and "69 percent of the respondents said they had no formal preparation to do so" (p. E14). The necessity for pre-service training of librarians (and K-12 teachers) for teaching online is an issue yet to be fully addressed by institutions preparing new educators. Undoubtedly, the Future Ready Schools and Go Open initiatives will become drivers for new school librarians' pre-service coursework.

Implications for Policy & Practice

Keeping pace with the influx of technology in the K-12 landscape, the field of school librarianship has concentrated on developing and fine tuning the best ways to prepare students for an information-rich world. National and state level school library organizations have built standards of practice around the outcome of developing effective members of the global community. To this end, school librarians must provide environments that nurture "life-long learning, informed decision-making, a love of reading, and the use of information technologies" (AASL, 2003, para 7). This goal is over-reaching and governs the work of all school librarians regardless of setting. Taking a holistic approach to teaching library skills with the understanding that these skills are necessary in any learning environment allows school library organizations to create frameworks for instruction that librarians can modify, adapt and utilize to meet the needs of their students. Because library organizations have not yet designed specific frameworks for the online environment, the focus of school librarians has been to educate all students, building instruction based on individual needs. Organizational research and advocacy for school librarians is just beginning to focus on blended and online environments.

Going forward, a three-pronged approach must be employed where school librarians, organizations representing school librarians and pre-service institutions that prepare school librarians each take a role. First, practicing school librarians must be agile and extend their services beyond the brick and mortar environment to meet the needs of students online. The second prong involves school library organizations such as the American Association of School Librarians (AASL) partnering with Association of College and Research Libraries (ACRL) and organizations like the International Association for k12 Online Learning (iNACOL) that promote best practices in K12 online learning. These partnerships would ensure that the crucial role librarians play in student learning can be translated into the online environment. The third prong concentrates on the instructional programs for pre-service librarians. These programs must be infused with coursework incorporating the skills necessary to build online library environments and teach the skills required to meet the needs of online learners. This pre-service work would need to include "hands-on" experiences in the online learning environment to help the students remain committed to engaging in the course content while completing their degrees – helping students interact with one another around meaning-making with course content (Moreillon, 2015, p 46). Green and Kennedy (2016) noted online and blended learning in public school districts is outpacing that of virtual schools. This fact illuminates the fact that pre-service education must be immersive, integrating online and blended environments in teacher prep. Green and Kennedy called librarians to action to become "informed and active voice(s) in critical conversations that shape the role of school librarianship in all learning spaces" (para.7).

School librarians currently in the field need to champion their essential role in the online environment if the field is to flourish as the educational landscape changes, with blended and online learning taking center stage. Some librarians have taken the lead in this area creating online, curated resources that specifically address K-12 curriculum. Additionally, they offer virtual services where they connect with students and faculty through electronic means such as social media and direct messaging to offer research guidance. Future Ready initiatives may ensure that addressing the needs of blended and online learners will become the norm in the K-12 setting.

Advancing the library and librarians' roles in online environments also requires that organizations that serve the library field investigate the practices of online learning providers to uncover why these roles have been overlooked in their programs. Only then can library organizations explore potential opportunities for integrating essential library services where needed in K-12 blended and online environments. To do this, complete programs of study as well as contents of individual online courses should be evaluated for potential use of all resources, including a librarian. As content from websites, organizations and institutions changes constantly in the virtual environment, critical services such as keeping materials up to date and checking and vetting new resources are glaring needs not fully addressed by many current online providers. Additionally, as students are performing authentic research they require the guidance of a skilled information specialist, in real time, who can provide that instruction.

Librarians are uniquely qualified to provide all of these services and currently do so in the brick and mortar setting. This type of widespread provision of library resources and instruction is not as evident in strictly online enterprises and represents an area where such organizations pale in comparison with their brick-and-mortar counterparts whose programs are very successful (Kachel, 2013). By partnering with organizations that govern and promote best practices in online and blended learning, like iNACOL, the Clayton Christensen Institute, Future Ready Schools, and the Hewlett Foundation for OER, school library organizations can begin to establish protocols and procedures for library instruction to be embedded in the online environment, and offer online content providers a road map for developing their courses and program, enabling it to find the same success.

Preparing librarians to meet the needs of all learners should drive the curriculum of pre-service programs. This training must include instruction on meeting the needs of online learners. In addition to traditional collection development, cataloging, genre studies and researching skills, pre-service librarians must be taught how to navigate the online environment, curate information to meet the demands of rigorous K-12 curriculum and how to provide researching guidance for inquiry based, online instruction. It is essential that school librarians entering the field are prepared to offer services in the online and blended teaching environments if this field is to continue to grow.

Considering that online continues to steadily grow at the post-secondary level (Evergreen Education Group, 2016), it becomes essential that students develop an understanding of what is needed in order to effectively learn in virtual environments before leaving the K-12 setting. Several states now stipulate that students take an online class as part of their high school graduation requirements citing the importance of preparing students for college and career pursuits beyond graduation (Evergreen Education Group, 2013). This fact is a call to action for librarians and their professional organizations. As online learning gains prominence in K-12 learning, library programs must ensure their services extend beyond those already evident in the brick and mortar setting.

There are several steps that should be taken in order to make libraries and librarians essential components of the online environment.

For libraries:

- Create virtual libraries, where curated resources are available to learners regardless of class format.
- Brand libraries – establish a presence in social media and areas where students and faculty look to find information and a "support ecosystem" (OCLC, 2014, p. 90).
- Create a virtual presence where information assistance can be offered through tutorials, pathfinders, and other communication tools, as well as personal assistance available in real-time.

For librarians:

- Connect with other professionals around the world to collaborate on building materials, creating consortiums and other OER-related spaces, and extending programs.
- Promote the library program and advocate for it with administration by becoming a Future Ready Librarian.
- Engage in the online environment to meet students where they are
- Build a professional learning network to provide teachers and students extended access to specialists in all fields.

For library organizations:

- Engage in conversations with other organizations that specifically work on building blended and online models for education.
- Advocate the importance of library and librarian presence in all learning environments, including online, and push for legislation that supports that need.
- Build standards for library practice that specifically address the needs of the online learner.

For pre-service programs:

- Infuse program with resources and experiences that prepare pre-service librarians to meet the needs of online

learners including experience with social media, online databases, curation tools, Web 2.0 tools and OER resources.
- Instruct students in methods of communicating both face-to-face and in the online environment in order to offer reading and researching guidance.
- Build pre-service librarians' Professional Learning Networks to include experts in the field who promote best practices in meeting the needs of students in the online and blended environment.

Implications for Research

Since little research specific to K-12 online school libraries exists, there are multiple opportunities and avenues of potential investigation that could inform the field going forward. Challenges faced by school libraries making the shift to online instruction and services, the use of digital learning objects and automated scaffolding agents, branding of online school libraries, and assessments of existing models for developing these virtual spaces are areas warranting study.

Challenges inherent in making the shift to online

Online learners prefer to have resources embedded and collaboratively used and shared within the LMS (Li, Fu, Zhao, & Leh, 2009). Brooks-Kirkland (2009) noted that a critical point regarding content and resources included in virtual libraries is that they follow the research workflow. In other words, the layout, design, and access points for online content must be logical according to how a student researcher approaches (or should approach) a research inquiry. When designing virtual library pages containing a variety of content and research tools, readability and organization according to learner workflow ensures that the resources are not only present, but in an efficient, usable order. Embedded database widgets need to be placed strategically to promote a logical search path that is enhanced by the proper tools along the way. For example, search widgets appear next to documentation, note-taking and graphic visualization tools and job aides (documents, checklists, etc.) along with highly relevant, high quality websites, media resources, and the tools for mobility. In addition, learners need to have a menu of curation tools at their disposal in order to extend their learning further, gather other resources they deem relevant, and begin to establish their own niche authority (Valenza, 2012a). Scaffolding resources like tutorials and graphic organizers support the learner's ability to independently learn. When expert assistance is needed, various librarian contact points are strategically placed on the same screens. Contact points range from including phone, email, Twitter, or Google Voice connections to the librarian to scheduled synchronous help sessions via tools like Skype or Google Hangouts. Enabling "maximum flexibility" for individual learning is the goal (Brooks-Kirkland, 2009, p. 44). Research is needed to uncover efficient designs and optimal tools to complement K-12 learner workflows.

Measuring success

Stephens (2013) posited that as school libraries continue to shift to accommodate and promote individualized learning, the metrics used to measure the success of library programs are also shifting away from traditional "return-on-investment measures" to elements that provide a clearer reflection of online student life and research habits (p. 4). These measures could be comprised of online discussion posts, collaborative documents and presentations, and student-generated resources shared out into the wider physical and virtual communities with which the student actively learns. In addition to resources and services, perhaps the greatest challenge is for librarians to ensure that what they are offering is truly what students need. In their discussion of best practices for academic librarians online, Hartsell-Gundy and Tumbleson (2012) stated, "Online embedded librarians are most effective when they are proactive, perseverant, and patient as they collaborate with faculty and students… Time is needed to establish trust between the embedded librarian and faculty and their students" (p. 60). Just as in the success of traditional school librarianship, collaboration is perhaps even more critical for success in the online school environment. Lindsay and Davis (2013) provide an extensive collection of ideas for collaboration within and beyond the local school and include the Loertscher, Koechlin and Rosenfeld (2011) concept of the learning commons as a critical learning space. Callison (2007) offered a rubric to evaluate such places of learning, and included as exemplary those that serve as a "network hub," offer space and time for discussions, debate, authentic research, open and critical evaluation of information, and multiple paths for knowledge construction (p. 17). Ultimately, learning spaces are judged by how well these affordances meet the needs of stakeholders, a critical design goal for any virtual library. How to best build these online places of learning is another area ripe for investigation.

Branding

Ancillary to embedding librarians, resources, and information fluency instruction into the K-12 online learning is the concept of branding. It is critical for online learners to be able to not only readily navigate the learning management system and individual courses, but also easily access resources or make contact with the librarian. Consistent branding of the online library and librarian presence across the platform helps to ensure this access and establishes a relationship between learners and library (Gall, 2012). Branding the virtual K-12 library may in turn inspire and support ongoing collaborations between instructors and librarians in what Perrault (2007) labeled as the larger "information ecology" (p. 49). How the concept of branding may affect the usage and perceived value of virtual K-12 libraries has yet to be explored.

Digital learning object (DLO) collections, automated tutorials and scaffolding systems

Research into process-oriented scaffolding agents (POSAs) is emerging as means for supporting learners in the performance of independent inquiry including developing metacognitive reflective practices (Miao, Engler, Giemza, Weinbrenner & Hoppe, 2012). The purpose of these tools is to deliver just-in time guidance as learners navigate their way through online inquiry processes. These tools must balance providing learners enough support without hampering those who can move more quickly. Some popular DLOs and scaffolding systems include:

TRAILS – Tool for Real-time Assessment of Information Literacy Skills http://www.trails-9.org/

Developed by Kent State University with the vision of providing school librarians with a tool aligned to the standards of the American Association of School Librarians' and the Common Core State Standards initiative, TRAILS offers a snapshot of students' in grades 3, 6, 9 and 12 understanding of literacy skills through a multiple-choice assessment. This tool will provide librarians and classroom teachers the means "to identify strengths and weaknesses in the information-seeking skills of their students" (Kent State University Libraries, 2014). It is a service provided free of charge.

ProQuest Research Companion http://www.proquest.com/libraries/schools/

Designed to support student research, "ProQuest Research Companion is comprised of nine Learning Modules and seven interactive Tools—all designed to automate the basic parts of the research process. The multimedia-based Learning Modules engage students to think more critically and creatively about their research, while powerful, interactive Tools help students navigate through the research process more quickly to spend more time on the research that interests them most" (ProQuest, 2014).

PRIMO (Peer-Reviewed Instructional Materials Online) database maintained by ACRL(Association of College and Research Libraries) containing peer-reviewed learning objects. PRIMO offers peer-reviewed instructional materials developed by academic librarians. While these materials are originally designed for college-level learners, they can serve as inspiration for K-12 librarians designing online instruction.

OER Commons http://www.oercommons.org/search?f.search=information+literacy

Open Educational Resources – international collection of open resources. Gathered since 2007, "Open Educational Resources (OER) are teaching and learning materials that you may freely use and reuse at no cost. Unlike fixed, copyrighted resources, OER have been authored or created by an individual or organization that chooses to retain few, if any, ownership rights" (OER, 2014).

A June 24, 2017 search for "information literacy" yielded 419 results in OER Commons including lessons, tutorials and other learning objects, each item clearly displaying usage permissions.

Research is needed to explore how tools such as automated scaffolding systems, tutorials and learning objects and microcredentialing (i.e. badging) will play a role in online school libraries. First, evaluation studies comparing the relative effectiveness of these items would provide baselines for measurement. It is also unknown how automated process-oriented scaffolding systems such as Research Companion will play a role in online inquiry and research instruction. Evaluation of the efficacy of existing learning object repositories such as OER and PRIMO and how these may be leveraged for better sharing of best practices is also needed. This path of research would uncover best practices for online information fluency instructional design and virtual library design. Revealing and sharing these practices with the wider community of course developers, online school markets and individual teachers/librarians would advance future development, enriching the overall instructional design knowledge base.

Studies assessing current needs and practices

Evaluative studies that assess current models and stakeholder needs are also necessary. Assessment of existing embedded librarianship models at the academic level, the needs of K-12 online schools for library services and personnel, and the quality of established K-12 virtual libraries growing from brick-and-mortar settings would provide practitioners and instructional designers with valuable foundations for future design and development of virtual K-12 libraries. One obvious path of investigation would include testing existing models of embedded librarianship at the academic level to determine if and how these models may be applicable to K-12 environments. Specifically, these existing models should be explored for efficacy of design in terms of the following: student access to library services, personal assistance from library staff, provision of resources and assistance for using them, and means for providing instruction. Studies grounded in the body of web usability/user experience research may inform the design and development of virtual library spaces and strategic organization of resources to reveal the means to compliment the young learner's workflow and provide wider personalization of these spaces.

Another primary path of research would include a comprehensive inventory of existing commercial K-12 schools to determine the level of need and potential value for the placement of comprehensive library portals at the macro (platform) level, and specific library resources to be available at the micro (individual course) level (Shank & Dewald, 2003). Research is needed to uncover the potential ways macro and micro placement of library resources (including access to librarians) could support learners for both course assignments and individual interests. In addition to researching placement of library portals, existing online K-12 schools should also be explored to determine if and how information fluency instruction is currently being offered. This path of investigation should look for fluency elements such as advanced search strategies on the free web and within proprietary databases; evaluation of information; ethical use, copyright and documentation; media literacy; presentation skills; global collaboration skills; and, leveraging social media for curation and research. This line of investigation would provide the necessary needs assessments upon which library services could be developed and tailored for specific communities of learners.

Parallel to this inventory of existing library needs of K-12 online schools, evaluations of established virtual libraries in K-12 brick-and-mortar schools are needed as these are likely models for K-12 online spaces. Studies should explore the efficacy of these existing libraries for supporting learner completion of course assignments and research/ inquiry projects, as well as the quality and effectiveness of available just-in-time instruction (tutorials, graphic organizers and other learning scaffolds). In addition, investigations into how these virtual school libraries meet curricular needs but also provide various avenues to independent learning interests and connected learning as described by YALSA (2014) would greatly inform designers of virtual library spaces by potentially revealing how deeper personalization of library services for online learners could be designed. Assessments of the efficacy of existing K-12 online instruction for addressing AASL standards (2007) would yield further critical information. This research would determine if and how current online instruction is preparing learners to complete course assignments, conduct age-appropriate inquiry, and transfer information fluency skills to their real life information needs. Another essential question is how to best utilize new metrics for measuring the success of library programs as described by Stephens (2013) and how these compare to the body of research on school libraries and achievement (Kachel, 2013).

Other topics for research

Other instruction-related topics that need investigation include best practices for connecting online learners to those in different online and brick-and-mortar schools for digital collaborative learning and authentic research. Studies of how new information management strategies such as social media curation could be used to enrich or further extend learners' abilities for personal knowledge management are also essential. This research would point out how transfer of knowledge and overall learning agility could potentially be improved through the efforts of K-12 online librarians. Obviously, the librarian's role in blended and online K-12 learning also warrants investigation. For example, research is needed into how librarians might extend the role of learning facilitator (Lankes, 2012) in novel ways in online environments, and how they could establish collaborative relationships with fellow faculty in these environments. How pre-service preparation of school librarians might become more responsive to all aspects of the digital shift, especially in terms of emerging literacies, designing virtual library environments and providing online and mobile services and instruction, also demands consideration.

Conclusion

Despite the lack of a significant body of research specific to school libraries embedded in online learning environments, a wide range of literature exists to inform the growth and development of these environments in K-12 settings. By building upon foundational standards and instructional design models, librarians can build both virtual libraries and online information fluency instruction that meets the needs of young learners. Although not directly addressed in the literature, K-12 librarians are making strides toward full embeddedness by offering a wide variety of online instruction, services and digital resources in their schools. Most of the growth toward virtualization is emerging from higher education and K-12 brick-and-mortar library practice. In some cases, librarians are teaching online courses; in others, they are offering online collections for learners to access 24/7, providing personalized assistance as well as providing on demand, just-in-time tutorials. In increasing numbers, school librarians are seen as instructional technology partners and curation guides for colleagues learning to use OER. Regardless of which paths librarians are following, the fact is that libraries must continue to grow and develop into virtual partners to support online instruction, and more importantly, to meet the long-term needs of all learners. The emergence of virtual school libraries has occurred somewhat organically, opening multiple avenues for new research. Progressing library services in online K-12 schools requires systematic research into these varied facets of online education and librarianship as well as new conversations between professional organizations, policy-makers, and stakeholders of all kinds.

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PART VI

Research on Instructional Design

34

Introduction

Amy Garrett Dikkers

Educators around the world and in all contexts know that purposeful instructional design is essential – to match curriculum (content, course objectives, standards) with effective pedagogical strategies and a variety of appropriate assessments that help students demonstrate their learning. In an online or blended learning environment, instructors have additional challenges determining their own roles, choosing carefully from a wide array of technological tools, and doing so while meeting the needs of all learners. In the online space, diversity of learners can also be hidden, adding an additional layer of the need for purposeful design to support learning for students at all levels. Design matters. Building course sites carefully and thoughtfully and reviewing course design regularly to identify what methods are effective and which are not matters.

The growth of K12 instructional design as a field demonstrates recognition of the importance of this balance among curriculum, pedagogy, and assessment to support student mastery of content. Although chapters throughout this handbook address aspects of course design, chapters in this section focus on two specific areas – utilizing the Universal Design for Learners framework in online and blended course design to support all learners and the pedagogical value of social interaction between and among individuals and groups in the online learning space.

Basham, Blackorby, Stahl, and Zhang provide a comprehensive overview of the Universal Design for Learning (UDL) framework, originally focused on the inclusion of students with disabilities in general education face-to-face classrooms. UDL as a framework is widely utilized to provide instructors and designers with a sense of whether and how their online and blended courses meet the needs of a wide variety of students. The authors provide research-based suggestions for the application of the UDL framework to online learning, discussing multiple means of engagement, multiple means of representation, and multiple means of action and expression. These multiplicities support access to the content for more students and deeper learning for all students. As they state, "Most online environments support a nexus of multimedia choices that can be readily available to students for exhibiting knowledge or skill mastery." They argue this nexus is helpful for **all** students and essential for others, like students with disabilities or English Language Learners.

Garrett Dikkers addresses one specific aspect of course design that is debated, the role of social interaction and its connection to student satisfaction, motivation, engagement, and achievement. The importance of social interaction in student learning is centered in social constructivism, which supports deeper understanding of content comes when individuals learn with others. She provides an overview of Moore's Transactional Distance Theory (1993), also discussing three types of interactions identified by Moore (1989): learner-content interaction, learner-instructor interaction, and learner-learner interaction, before shifting focus to social interactions specifically. Research demonstrates variability for the value of social interactions between and among students and with their instructor(s) and Garrett Dikkers summarizes the research to provide clarity and focus for future research. Additionally, she discusses the specific role of social presence, simply defined as the creation of community in a course, and research that addresses the value of social presence for different learners. Garrett Dikkers combines theory and research to make suggestions for instructional design practice that holds social interaction at its core.

Metanalyses from the last ten years have found the need for more research targeted to the K12 online learning environment that focused on design and the impact of design on student learning, motivation, and satisfaction (Cavanaugh, Barbour, & Clark, 2009; Means, Toyama, Murphy, & Baki, 2013; Means, Toyama, Murphy, Baki, & Jones, 2010). This need continues to grow as K12 online learning grows and morphs into a wide variety of different models. Research discussed in these chapters demonstrates that research in the field **is** moving forward. Additionally, both chapters conclude with solid recommendations for research that continues to impact our practice, especially specific to purposeful instructional design.

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Universal Design for Learning

Because Students are (the) Variable

James D. Basham, Jose Blackorby, Skip Stahl, & Ling Zhang

Introduction

Universal Design for Learning (UDL) as articulated by researchers at CAST has been in the lexicon of education for nearly 20 years (Orkwis & McLane,1998; Pisha & Coyne, 2001; Hitchcock, Meyer, Rose, & Jackson, 2002). Originally formulated as an approach for ensuring the effective inclusion of students with disabilities and diverse learning needs in general education classrooms, UDL has steadily gained traction as a framework for addressing the variability inherent in all learners.

UDL promotes educational systems that offer multiple ways of engaging students, representing information, and demonstrations of mastery, and is most recently energized as a fundamental framework for ensuring learning environments responsive to the needs of all students in the Every Students Succeeds Act (ESSA) of 2015. This chapter explores the role of UDL as a framework for inclusive K–12 learning design across all four aspects of the curriculum — its goals, assessments, instructional practice and materials — and how the unique capabilities of online learning can actualize UDL in practice.

In this chapter, we highlight some key issues within the evolving landscape of elementary and secondary education, in general, and the expanding impact of online learning, in particular. Some of the primary issues discussed include:

- The variability of K–12 students engaged in online learning, their abilities/disabilities, their native languages and cultures of origin, and their prior learning experiences is steadily increasing.
- Elementary and secondary students with higher levels of variability enrolled in online learning are demonstrably less successful than their brick and mortar counterparts.
- Online curricula including goals, assessments, methods, and materials designed for a hypothetical "average" student are often insufficient to address the variability of today's learners.
- On a whole, online learning can provide an efficient and effective vehicle for individualizing learning trajectories, based on real-time student progress data, that leads to student-centered decision-making.
- Online learning offers unique affordances for supporting and extending UDL aligned implementation practices.

We detail how these factors present significant opportunities and challenges for educators, students and families, and how addressing these changes by applying UDL-aligned policies, curriculum design, and instructional practices can proactively prepare learning environments for the new reality of K–12 education and online education.

Definitions

Universal Design for Learning (UDL)

As defined in section 103(a)(24) of the 2008 amendment to the Higher Education Act of 1965 (PL 110-315), Universal Design for Learning means"… *a scientifically valid framework for guiding educational practice that-(A) provides flexibility in the ways information is presented, in the ways students respond or demonstrate knowledge and skills, and in the ways students are* *engaged; and (B) reduces barriers in instruction, provides appropriate accommodations, supports, and challenges, and maintains high achievement expectations for all students, including students with disabilities and students who are limited English proficient".*

Learner Variability

Recent neuroscience research (Hinton, Fischer, & Glennon, 2012; Immordino-Yang & Damasio, 2007) acknowledges three general dimensions of systematic variability that exist in every learner at every age: differences in terms of the way they represent information, differences in the way that they engage with media and material, and differences in the way they can act and demonstrate what they know.

Personalized Learning

According to Patrick, Kennedy, and Powell (2013), personalized learning means tailoring learning for each learner's interest, strengths, and needs. This approach encourages flexibility to support mastery and enables learners to influence how, what, when, and where they learn. Personalization is also generally associated with three key operational factors that make customizing instruction at the individual student level both possible and practical: 1) real-time student progress data provided by networked learning management systems which provide and record 2) flexible opportunities for students to acquire and demonstrate 3) competencies or proficiencies.

Blended Learning

As defined by Christensen, Horn, and Staker (2013) blended learning is a formal education practice where students learn, in part, through online learning with some learner control over time, path, pace, or place. At least some of the learning takes place in a school-based, brick-and-mortar setting.

Supplemental Online Courses

Enrollment in an online learning environment to supplement another primary learning environment. For instance, when students are in enrolled in a French class online because their local school only offers Spanish.

Competency/Proficiency-Based Learning

Within in this curricular structure, students progress based on mastery of successive goals. Students are often grouped by age and/or proficiencies rather than by grade level, and movement through a course of study is based on demonstrated skill or knowledge achievement, not seat time (Patrick et al., 2013).

Digital Delivery Systems

Content management or learning management systems (CMS/LMS) provide access to digital curriculum materials and learning interactions for student use. Most of these systems require an individual student login via username/password or unique student identification number, and record and display real-time student usage and achievement data.

Digital Learning

Use of digital technology to support learning. This term is context free to specific digital technology, environment, pedagogy, instructional design, and learner interaction with the material or environment.

Research Synthesis Who's Online? The Increased Diversity of Online Learning

Recent enrollment data (Gemin, Pape, Vashaw, & Watson, 2015) estimates that 2.2 million students take supplemental online courses, nearly 300,000 are enrolled in full-time virtual charter schools, and that nearly all of the roughly 13,500 public school districts serving the nation's 55 million elementary and secondary students offer some form of online learning. The majority of these opportunities enroll secondary students, with 47% of students in grades 9-12 reporting some level of online learning involvement.

In the 2016 publication, The Growing Diversity in Today's Classroom, Digital Promise reports that given the historical trajectories from 1973 to 2014 (based on US Census Bureau), today's classrooms have undergone a dramatic transformational increase in diversity and the number of students who present learning challenges. While not all the nation's elementary and secondary students are yet engaged in online learning, most are, and while many of these students are underrepresented in blended and full-time virtual settings, their numbers are steadily increasing. A 2015 report from the State Charter Schools Commission of Georgia noted that white students made up nearly 75% of the current online learning enrollees with black and Hispanic students at 10% and 11% respectively. When combined with other reports (e.g., Heiney, Dianne, & Anderson, 2012; Sludden & Westmaas, 2014) the authors noted an expected increase in traditionally marginalized populations within online settings.

Generally, demographic profiles of students in full-time virtual schools highlight some marked distinctions between those enrollees and their counterparts in brick and mortar settings (Huerta, Shafer, Barbour, Miron, & Gulosino, 2015; Woodworth et al., 2015). Similar to the State Charter Schools Commission of Georgia findings, both the Huerta and Woodworth studies note that nearly 70% of students in virtual schools were white, less than 25% Hispanic, approximately 13% Black, 2% or less Asian and approximately 1% Native American. They also found that students with disabilities comprised 7.2% of enrollees in the Huerta study, and 11% in the Woodworth analysis with English Language Learners (ELLs) representing 1% or less in both studies. Interestingly, both studies reported that students at or below the poverty level comprised 45% to 48% respectively of all enrollments, compared to 35% in brick and mortar settings. Similarly, while national data shows the participation of other student subgroups in online learning to be trailing that of their counterparts in brick and mortar settings, some more targeted state-level data (Colorado, Georgia, Pennsylvania, Minnesota) shows a steady increase in these populations as well.

Overall, the field of online learning is seeing an increase in diversity and variability of learners in K-12 online learning spaces. Unfortunately, not all online learning spaces have been designed for these diverse learners. As will be discussed later, UDL provides a research-based framework for designing online learning environments.

How Are They Doing?

The impact of full-time virtual schooling has been found to be more negative for students in poverty, ELLs, and students with disabilities than the achievement of comparable students in brick and mortar schools or the achievement of students not in these demographic groups (Huerta et al., 2015; Woodworth et al., 2015). The Woodworth study documented that the overall academic achievement of two-thirds of students in online charter schools was weaker than that of their peers in brick and mortar settings. In fact, other research confirmed that on-time graduation for all secondary students enrolled in virtual and blended settings was substantially lower (40.6% and 37.4% respectively) than the 81% national average for public high schools (Miron & Gulosino, 2016).

The Woodworth study referenced the predominance of text-based media in online settings as a challenge:

"As with students in poverty, students who are English language learners tend to progress academically more slowly than students whose primary language is English. This is potentially even more of an issue in an online setting where students typically rely more heavily on reading as the primary method of curriculum delivery" (p.29).

Several research summaries have cited the often inaccessible rigidity of online learning materials and practices as presenting insurmountable barriers to students with disabilities, cultural impoverishment, and ELLs (Harrison, 2016; Hashey & Stahl, 2014; Tindle, East, & Mellard, 2016), and limiting the option available for any learner. In many instances, the design and delivery of elementary and secondary online learning has emphasized efficiency over efficacy by creating learning environments based on norms developed for a hypothetical "average" learner — one that emerging neuroscience and education research is increasingly identifying as a statistical phantom (Barbour, 2009; Gargiulo & Metcalf, 2017; Quinn, 2016). Clearly the practice of K-12 education, in general, and the growing presence of online learning need to become more effective in supporting the strengths and addressing the weaknesses of the students for whom they are responsible. Online learning, specifically, with its transformative and flexible digital tools, materials, and affordances, and its capacity to collect and display real-time student progress data needs to be built upon an assumption of learner variability.

Enter Universal Design for Learning

Within federal law UDL is defined as "a scientifically valid conceptual framework for guiding educational practice that provides flexibility in the ways information is presented, in the ways students respond or demonstrate knowledge and skills, and in the ways students are engaged" (20 U.S.C. § 1003(24)). Its three core principles – multiple means of engagement, multiple means of action and expression, and multiple means of representing information (see UDL Guidelines, 2.0) – are meant to proactively address the academic, social, and cultural distinctions that exist in today's schools. As a framework, UDL is focused on harnessing technology and instructional practices to remove barriers in curricula and across digital as well as physical learning environments. This is done to create proactive and iterative educational settings that support personalized learning. Rather than explaining deficits as intrinsic to the individual student, UDL conceptualizes differences as following often predictable patterns of systematic variability, with variability being the norm rather than the exception. Accordingly, flexible learning environments are planned and designed from the beginning to anticipate learner variability by providing alternative routes or paths to success.

Evidence for UDL in the learning sciences research literature is strong (Rose & Gravel, 2010) as is the growing community of researchers examining the application of UDL in a variety of contexts and classrooms (e.g., Courey, Tappe, Siker, & LePage, 2013; Coyne, Pisha, Dalton, Zeph, & Smith, 2010; Kennedy, Thomas, Meyer, Alves, & Lloyd, 2014; Marino et al., 2014). UDL has also begun to appear more prominently in federal education policy and statute including the U.S. Department of Education's National Education Technology Plans 2010 and 2016, Ed Tech Developer's Guide (2015), the Higher Education Opportunity Act of 2008, and the Every Student Succeeds Act of 2015. UDL is entering its third decade influencing education policy, research, and practice. As a flexible approach to addressing learner variability, UDL is organized around three principles: 1) multiple means of representation, 2) multiple means of expression and action, and 3) multiple means of engagement (Rose & Meyer, 2002). Nine guidelines more specifically articulate these principles to actively support design and implementation (www.udlcenter.org/aboutudl/udlguidelines).

In recent years, there has been a dramatic increase in the visibility and impact of UDL. As a field, UDL has grown to include a wide range of ages from early childhood to postsecondary education and workforce development, a wide diversity in content areas (e.g., literacy, mathematics, STEM), curriculum materials, online learning, and assessment, and a wide range of implementation models and settings. Once very closely associated with CAST, now growing numbers of organizations, educators, researchers, advocates, and policymakers are using and implementing the framework consistent with their own goals and missions.

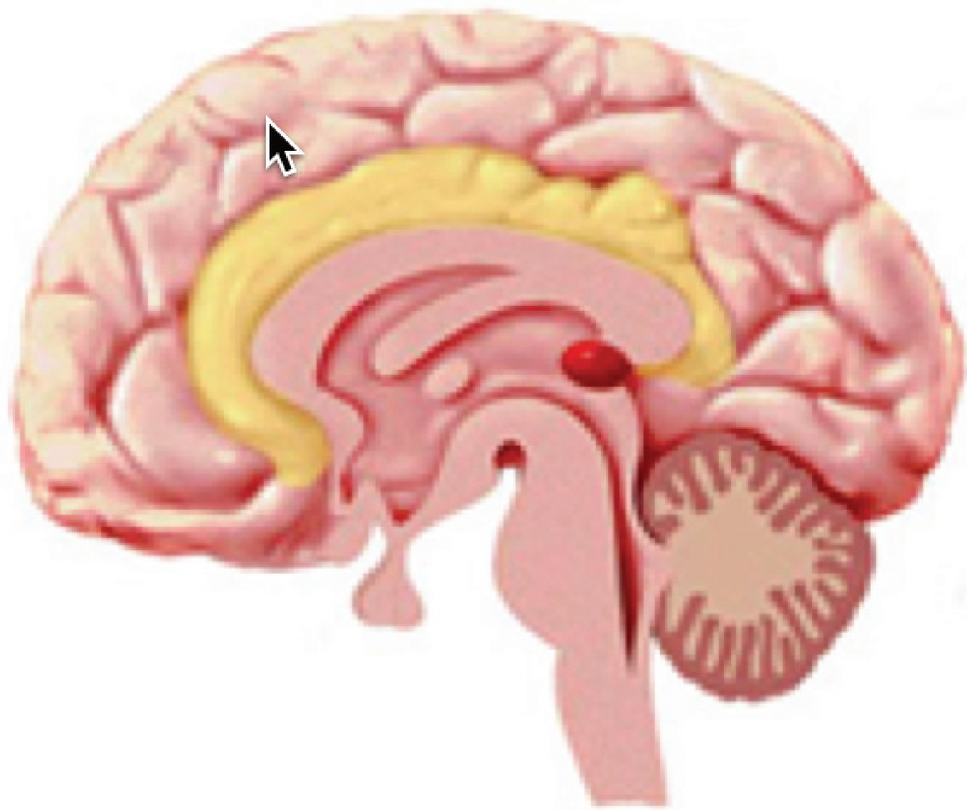
UDL and all other educational interventions and programs increasingly need to provide empirical evidence of effectiveness in improving outcomes. In the last 15 years, tools to evaluate programs for quality and effectiveness have emerged such as the What Works Clearinghouse, and the I3 Evidence Standards as well as methods for synthesizing research. In this context, the status of the UDL research base is robust in some areas and in emerging stages in others. Certain aspects of UDL itself make it especially difficult to investigate, synthesize, validate, and aggregate with established research tools, designs, and tools. A sizeable number of researchers are wrestling with the challenge of how to rigorously evaluate the implementation and impact of UDL in ways that don't substantially interfere or obscure the paradigmatic changes it advocates and requires. What, for example, is fidelity of implementation when diversity of implementation is expected and valued?

There is much to do. Below we briefly summarize the research basis for the general principles of UDL, some unique challenges of UDL research, research identifying the specific practices critical to meeting the challenge of individual differences, research on specific applications of UDL, some meta-analyses, and a research database.

Research Base for the Foundation & Principles of UDL

The foundational research in cognitive neuroscience, cognitive science, affective science, and other learning sciences is critical in articulating the range of what learning is, and the range of individual differences in learning. To provide a broad enough basis for approaching teaching and learning, the basic principles of UDL reflect three broad kinds of learning distributed across networks within the brain:

- affective systems in the medial nervous system



- pattern recognition systems in posterior cortex

- motor and executive systems in anterior cortex

While even this division is an over-simplification, it is an articulation that is common and draws historically on Luria's (1973) classic work and has been elaborated and modified by many others (see Barsalou, Breazeal, & Smith, 2007; Bassett et al., 2011; Berridge & Kringelbach, 2013; Breedlove, Watson, & Rosenzweig, 2010; Chan, Shum, Toulopoulou, & Chen, 2008; Cytowic, 1996; Eisenberg, Spinrad, & Eggum, 2010; Goldberg et al., 2013; Immordino-Yang & Faeth, 2010; Shenhav, Botvinick, & Cohen, 2013; Stuss, 2011; Vidyasagar & Pammer, 2010). A significant body of research on learning and individual differences supports the three core principles of UDL:

1. **Multiple means of engagement** in the ways to support the affective state and motivational connection to learning (e.g., Coch, Fischer, & Dawson, 2010; Crone & Dahl, 2012; Damasio, 1994; Davidson, Scherer, & Goldsmith, 2009; Efklides, 2011; Emery & Easton, 2005; Komarraju & Nadler, 2013; Lane & Nadel, 2002; Rolls, 2000; Lévesque et al., 2004; Lewis & Stieben, 2004; McRae et al., 2012; Pekrun & Linnenbrink-Garcia, 2014; Zimmerman & Schunk, 2016).
2. **Multiple means of representation** in the ways that we sense and perceive information through "recognition" networks that occupy the posterior regions of the brain (e.g., Banich, 2004; D'Esposito & Postle, 2015; Farah, 2000; Friederici, 2012; Martin, Cabeza, & Kingstone, 2001; Meyer, Salimpoor, Wu, Geary, & Menon, 2010; Mountcastle, 1998; Price & Devlin, 2011; Pulvermüller & Fadiga, 2010; Raschle, Zuk, & Gaab, 2012).
3. **Multiple means of expression and action** in the ways that we organize and execute strategies and actions through executive and motor cortices that occupy the frontal lobes (e.g., Cartwright, 2012; Dawson & Guare,

2010; Diamond & Lee, 2011; Diamond, 2013; Goldberg, 2002; Ibañez & Manes, 2012; Jeannerod, 1997; Meltzer, 2007; Meltzer & Krishnan, 2007; Rothi & Heilman, 1997; Stuss & Knight, 2002).

Research Base for UDL Guidelines

The UDL framework offers both three core principles and nine associated guidelines to help in making informed decisions about what practices are optimal. The purpose of the framework is to ensure comprehensiveness; that the instructional designs will address the full range of learning variabilities in a learning environment.

Within each of the three UDL Principles, the nine UDL Guidelines articulate the general framework with specific practices that have been shown to be effective for one or specific types of learning or learners. The representation below is of the Guidelines version 2.0 where the principle of "Engagement" replaced "Representation" as the initial focus of the learning process.

Below, we present a representative sampling of research associated with each of the nine UDL Guidelines as background for organizing actual practices. Given the scope of the research citations, we have not attempted a detailed synthesis. Instead, we have catalogued studies that support each of the guidelines as a foundation for further inquiry.

Evidence for Providing Multiple Means of Engagement

1. **Providing options for recruiting interest and engagement** (e.g., Choices in content, focus or topic of interest, choices in rewards for success, choices in context for performance, choices in background distractors, reduces threats and distractions) (Arnone, Small, Chauncey, & McKenna, 2011; Bandura, 1993; Choi & Ma, 2015; Cordova & Lepper, 1996; Habgood & Ainsworth, 2011; Luiselli, Putnam, & Sunderland, 2002; Patall, Cooper, & Robinson, 2008; Patall, 2013; Patall, Sylvester, & Han, 2014; Song, Wong, & Looi, 2012; Stipek, 1996; Walkington, 2013).
2. **Providing options for sustaining effort and persistence** (e.g., Options in level of challenge and support, options in scaffolds for self-regulation, goal-setting, and progress monitoring) (Donohoe, Topping, & Hannah, 2012; Doll, Brehm, & Zucker, 2014; Elliott, & Dweck, 1988; Holifield, Goodman, Hazelkorn, & Heflin, 2010; Klassen, 2010; Labuhn, Zimmerman, & Hasselhorn, 2010; Locke & Latham, 2002; Moeller, Theiler, & Wu, 2011; Schunk, 2003; Wehmeyer & Palmer, 2003; Wehmeyer et al., 2012; Zimmerman, 2011; Zimmerman, Bandura, & Martinez-Pons, 1992).
3. **Providing options for building intrinsic motivation and self-regulation** (e.g., Options in external rewards or reinforcement, options in the social and emotional contexts for learning, options in scaffolds for self-regulation) (Agran, King-Sears, Wehmeyer, & Copeland, 2003; Bachevalier & Loveland, 2006; Bai, Pan, Hirumi, & Kebritchi, 2012; Bierman et al., 2010; Cerasoli, Nicklin, & Ford, 2014; Chen & Law, 2016; Deci & Ryan, 1985; Deci & Ryan, 1992; Delen, Liew, & Willson, 2014; Lee et al., 2011; Meyer, Abrami, Wade, Aslan, & Deault, 2010; Molenaar, Roda, van Boxtel, & Sleegers, 2012; Schunk & Zimmerman, 2007; Zimmerman, 2008).

Evidence for Presenting Information in Multiple Representations

1. **Providing sensory and perceptual options** (e.g., Captions for speech, audio for text, descriptions for images) (Aldera & Mohsen, 2013; Chang, Tseng, & Tseng, 2011; Cheng & Ye, 2010; Huang, Liu, Shadiev, Shen, & Hwang, 2014; Schmidt-Weigand & Scheiter, 2011; Shamir & Shlafer, 2011; Strangman & Hall, 2003; Yoon & Kim, 2011).
2. **Providing linguistic options in the way information is represented** (e.g., Embedded definitions for vocabulary, alternative syntactic constructions, text to speech, translations) (Billings & Mathison, 2011; Boone & Higgins, 1993; Dalton, Pisha, Eagleton, Coyne, & Deysher, 2002; Dalton, Proctor, Uccelli, Mo, & Snow, 2011; Dawson, Venn & Gunter, 2000; Elbro, Rasmussen, & Spelling,1996; Fradd, Lee, Surman, & Saxton, 2001; Lynch, Fawcett, & Nicolson, 2000; Pierce, Stacey, Wander, & Ball, 2011; Plass, Chun, Mayer, & Leutner, 1998; Przybylski et al., 2013; Tanimoto, Thompson, Berninger, Nagy, & Abbott, 2015; Weiser & Mathes, 2011).
3. **Providing conceptual and cognitive options in the way information is represented** (e.g., Concept maps

for information in text, providing links to background knowledge, highlighting critical features, providing scaffolds for memory and attention) (Arroyo et al., 2014; Bui, Myerson, & Hale, 2013; Bujak et al., 2013; Hwang, Yang, & Wang, 2013; Karpicke & Blunt, 2011; Knight, Spooner, Browder, Smith, & Wood, 2013; Montelongo & Herter, 2010; Sam & Rajan, 2013; Scheiter & Eitel, 2015; Strangman, Hall, & Meyer, 2003; Strangman, Hall, & Meyer, 2004; Van den Broek, 2010; Whitaker, Bell, Houskamp, & O'Callaghan, 2013).

Evidence for Providing Multiple Means for Expression

1. **Providing motor and physical options for action and expression.** (e.g., Alternatives for navigation, response, and production) (Cook, Adams, Volden, Harbottle, & Harbottle, 2010; Choi & Chan, 2013; Fridin, 2014; Fitzgerald, 2005; Garrett et al., 2011; Kumar, Reddy, Tewari, Agrawal, & Kam, 2012; Lancioni et al., 2010; Lorah et al., 2013; Morphy & Graham, 2011).
2. **Providing options in the media and communication tools available for action and expression** (e.g., Providing options in the media or tools for communication, providing opportunities for graduated scaffolds) (Berninger, Nagy, Tanimoto, Thompson, & Abbott, 2015; Bouck, Satsangi, Doughty, & Courtney, 2013; Evmenova, Graff, Jerome, & Behrmann, 2010; Fernández-López, Rodríguez-Fórtiz, Rodríguez-Almendros, & Martínez-Segura, 2013; Kent-Walsh, Murza, Malani, & Binger, 2015; Kim & Hannafin, 2011; Leng, 2011; Raes, Schellens, De Wever, & Vanderhoven, 2012; Silió & Barbetta, 2010; Wainer & Ingersoll, 2011; Wu & Pedersen, 2011).
3. **Providing options in the executive and strategic supports for planning and organizing action and expression** (e.g., Graphic organizers, checklists and templates for planning and organizing, cues and prompts) (Asaro-Saddler, & Saddler, 2010; Belson, Hartmann, & Sherman, 2013; Berkeley, Marshak, Mastropieri, & Scruggs, 2010; Bernacki, Byrnes, & Cromley, 2012; Ciullo, Falcomata, & Vaughn, 2014; Conderman & Hedin, 2010; Crabtree, Alber-Morgan, & Konrad, 2010; Devolder, van Braak, & Tondeur, 2012; Douglas, Ayres, Langone, & Bramlett, 2011; Falkenberg & Barbetta, 2013; Kiuhara, O'Neill, Hawken, & Graham, 2012; Legge, DeBar, & Alber-Morgan, 2010; Mason, 2013; Mason, Harris, & Graham, 2011; Menzies & Lane, 2011; Montague, Enders, & Dietz, 2011; Morisano, Hirsh, Peterson, Pihl, & Shore, 2010; Negari, 2011; Peters, 2009; Schmitz & Perels, 2011).

Applied Quantitative and Experimental Studies of UDL

The body of applied research and experimental evidence related to UDL as an integrated design package is also growing. Studies have examined the efficacy of UDL interventions in applied educational settings with generally positive findings with a few null findings as well (Rao, Ok, & Bryant, 2014). For example, research on UDL supported reading environments have shown improved literacy outcomes across students in diverse populations (e.g., Coyne, Robinson, & Murray, 2008; Coyne et al., 2010; Dalton & Coyne, 2002; Dalton et al., 2002; Dalton et al., 2011; Proctor et al., 2009; Proctor, Dalton, & Grisham, 2007; Proctor, Uccelli, Dalton, & Snow, 2009; Rose & Dalton, 2002; Strangman & Dalton, 2005). A UDL approach has also been established as effective in promoting positive, engaging learning experiences in informal science settings (Rappolt-Schlichtmann & Daley, 2013; Reich, Price, Rubin, & Steiner, 2010), and has been shown to improve motivation for science using a technology-based science notebook platform (Rappolt-Schlichtmann et al., 2013).

Additionally, a recent randomized control study (RCT) that meets i3 and WWC standards by Rappolt-Schlichtmann et al. (2013) showed a statistically significant impact of UDL on science content learning (Cohen's $d = .46$, $p < .01$). In another study, a UDL-based online science curriculum for middle-school students showed evidence of helping students to identify goals in their learning and change behaviors to meet those science-related goals (Daley, Hillaire, & Sutherland, 2014). In yet another experimental study, Kennedy et al. (2014) found significant positive effects on vocabulary learning using the UDL-based intervention Content Acquisition Podcasts (CAPs) in secondary world history classes for students with disabilities ($d = 1.24$ to 1.84) and general education students ($d = .61$ to 1.04). Table 1 shows a selection of findings from empirical studies with a range of populations, content areas, interventions, and study designs.

Table 1. Selected Quasi-Experimental and Experimental Studies Involving UDL

Study	Participants	Results
Engaging the Text (Dalton et al., 2002)	102 middle school students who were struggling readers.	Quasi-experimental reading research study. Results indicated that students in the UDL condition demonstrated significantly greater gains on the Gates MacGinitie Reading Achievement Test than did their peers, which was statistically significant for those readers below the 25th percentile prior to intervention.
Literacy By Design (LBD) (Coyne et al., 2010)	33 students with significant intellectual disabilities in grades K-2.	Quasi-experimental study of a UDL reading intervention resulted in significantly greater gains ($p < .05$) on the Woodcock Johnson Test of Achievement III Passage Comprehension subtest for the UDL group. LBD also had a moderate effect on students' word attack skills and a small effect on listening comprehension.
Strategy Tutor (Coyne et al., 2008)	162 middle school students, including struggling readers.	Quasi-experimental study of an online UDL reading comprehension and search inquiry environment. Based on researcher-designed measures, the study yielded promising results for internet search skills and improvement on reading comprehension skills.
Monitoring Students' Progress Toward Standards in Reading (Hall, Cohen, Vue & Ganley, 2015)	238 6-8th graders, 55 students with high-incidence disabilities.	Experimental study of a technology-based UDL and Curriculum Based Measurement (CBM) intervention to improve reading comprehension for all students. Students in the online progress monitoring condition had a greater slope of improvement (4.89% change, $p<.011$) than their peers in the offline progress monitoring condition (4.31% change, $p<.01$). The students with disabilities in the online condition showed a significantly greater increase in performance (10.40%, $p <.025$) than students with disabilities in the offline condition (6.58% change, $p <.2$).
An Exploratory Study of Universal Design for Teaching Chemistry to Students With and Without Disabilities (Kings-Sears et al, 2014)	141 10th graders, 39 students with LD.	10th grade students in four co-taught high school chemistry classes were randomly assigned to a Universal Design for Learning (UDL) treatment or a comparison condition. Each co-teaching team taught one comparison and treatment class. UDL principles were operationalized for treatment: (a) a self-management strategy (using a mnemonic, IDEAS) for the multi-step mole conversion process; (b) multi-media lessons with narration, visuals, and animations; (c) procedural facilitators with IDEAS for conversion support; and (d) student workbooks mirroring video content and containing scaffolded practice problems. There were no significant differences between conditions; however, there was an interaction effect between students with and without disabilities for post-tests.
Using Evidence-Based Multimedia to Improve Vocabulary Performance of Adolescents With LD: A UDL Approach (Kennedy et al, 2014)	141 10th graders, 39 students with LD.	A multimedia-based instructional tool called content acquisition podcasts (CAPs). CAPs delivered vocabulary instruction during two concurrent social studies units to 32 SWD and 109 students without disabilities. Results revealed that students with and without disabilities made significant growth on CBMs and scored significantly higher on the posttests when taught using CAPs

UDL in the Middle School Science Classroom: Can Video Games and Alternative Text Heighten Engagement and Learning for Students With Learning Disabilities? (Marino et al, 2014)	57 middle school students with LD.	57 students with learning disabilities (LD) were followed over the course of a school year in their inclusive science classrooms as they alternated between the use of traditional curricular materials for some units of study and materials that were supplemented with video games and alternative print-based texts to more closely align with Universal Design for Learning (UDL) guidelines during other units. Findings indicate that video games and supplemental text were effective at providing students with multiple means of representation and expression. The UDL-aligned units led to heightened levels of student engagement. There were no significant differences on posttest scores when students with LD were compared with peers without LD. Students' performance did not indicate significant differences between UDL-aligned units and those taught using traditional curricular materials.
Thinking Reader for English Language Learners (TRELL) (Proctor et al., 2007; Dalton & Proctor, 2007)	59 4th-grade students, including 24 students who were ELLs.	Pilot study of a supported literacy environment especially designed for students who are English Language Learners (ELLs). Among the many positive findings, TRELL students made greater gains in vocabulary than did their control group peers based on pre-post performance on the Gates MacGinitie Reading Achievement Test. TRELL learning supports were positively correlated with gains in standardized reading achievement performance. ELL students actively used the TRELL supports for vocabulary and strategies more than their English-only counterparts. Furthermore, students who made the greatest gains were those students who used the supports most frequently.
ICON (TRELL) (Proctor et al., 2009)	240 45h-grade students, including 49% students who were ELLs.	A 16-week quasi-experimental study of ICON was conducted where students read eight multimedia texts with embedded instruction on 40 words and reading strategy support. Students could access all texts and activities in Spanish and English. In comparison to a control group, there were significant intervention effects on a standardized measure of vocabulary knowledge, but effects were non-significant for comprehension. Similarly, significant effects on researcher-developed measures of vocabulary depth were detected, but not for a researcher-developed measure of breadth.
Universally Designed Science Notebook (Rappolt-Schlichtmann et al., 2013)	84 4th-grade students, including 8 students who were IEPS.	Random assignment study in 8 schools and 28 classrooms. Study covered 8 weeks of content in electricity and magnetism and showed significant effects (Cohen's d = .46) for science content and motivation for science.

Selected Quasi-Experimental and Experimental Studies Involving UDL

Applied Qualitative and Mixed-Method Research in UDL

Various qualitative and mixed methods studies have also taken place with a focus on UDL (e.g., Izzo, Murray, & Novak, 2008; Kortering, McClannon, & Braziel, 2008; McGuire-Schwartz & Arndt, 2007; Rao & Tanners, 2011). Each of these studies have added to the growing literature base demonstrating how UDL might be successfully applied across various design solutions and learning environments. For instance, McGuire-Schwartz and Arndt (2007) used action research to investigate how the application of UDL supported bettered lesson planning for early childhood teacher candidates. McGuire-Schwartz and Arndt (2007) found that participants of the study identified the importance of their own contributions, as educators to the design and implementation of the learning environment. Specifically the participants, had a greater ownership in the outcomes of the learning environment. In another study, Basham, Lowrey, and deNoyelles (2010) used a mixed method approach to investigate the outcomes of two UDL based online teacher education class experiences. Basham et al., (2010) found that UDL based class experiences associated with greater flexibility, overall design, as well as improved class perception and meaningfulness to the students. In another mixed method study of a college teaching experience, Kumar and Wideman (2014) conducted a case study on a undergraduate health science course. Their case study found increased social presence, reduced stress, and increased ownership of learning across students in the class experience. Importantly, Kumar and Wideman (2014) also found a reduced need for students with disabilities to rely on campus disability support. Finally, Basham, Meyer, and Perry (2010) conducted a qualitatively driven design-based research (DBR) study to investigate how UDL might support the design and implementation of what they called a Digital Backpack for supporting learning outcomes in a museum setting. Their findings indicate that UDL provided a successful framework for supporting targeted learning outcomes in the design of this solution.

Summaries and Meta-Analyses of UDL Research

Several researchers have taken on the task of summarizing UDL research and application through various methodologies. These include published efforts of Al-Azawei, Serenelli & Lundqvist (2016); Crevecoeur, Sorenson, Mayorga, & Gonzalez (2014); Edyburn (2010); Mangiatordi & Serenelli (2013), and Rao et al. (2014). Cynthia Okolo of Michigan State also has an extensive literature review effort underway. These reviews generally strike the same conclusions: there are still too few studies dispersed across diverse content areas, some findings are promising, some are null, and the field is still early in its development. In addition, the UDL-Implementation Research Network (UDL-IRN) has created a database of recent UDL articles to facilitate further research and synthesis (http://udl-irn.org/udl-research/).

Unique Challenges to Research in UDL

- **Defining UDL.** Defining the 'it' in UDL is an ongoing challenge. UDL calls for flexibility and options in curricula, instruction, and assessment based on scientific design principles. This means implementation is focused on in situ design variables and often demonstrates some level of variability across settings and studies. Thus, the variation may not imply lack of fidelity, but potentially sound implementation. This is a challenge for designers, researchers, and evaluators alike.
- **Does Research Need to Cite or State UDL?** There is a growing literature in which researchers and authors specifically cite all or part of the UDL framework as part of their program or intervention. Most, but not all, of these would logically fall into the broad category of UDL evidence. However, there is a much larger literature base, which is related to UDL but does not specifically mention it. Examples of this include multiple representations in mathematics, executive functioning, and growth mindset. While obviously related, it is questioned whether these various efforts should be included in the evidence conversation surrounding UDL.
- **Does Research Need to Address All or Just Some of the Guidelines?** Part of the idea of UDL is that all three principles are important for addressing learner variability. So the question arises: if a UDL program addresses a subset of the principles, does it 'count' as an example of UDL? This is the 'how much UDL is enough' question, something with which the field continues to wrestle..
- **Can UDL research be aggregated?** The evidence question is sometimes couched as "does UDL work?" There are examples of UDL across age ranges, content areas, settings, and populations. The field is wrestling with

whether aggregation makes sense and, if so, how. For example, does the result of UDL science notebook experiment in fourth grade mean anything for a UDL secondary literacy effort? We do not yet have clear answers.

- **Measuring UDL.** We are in the early stages of developing measurement tools that will allow for evaluating whether a program is indeed a UDL aligned program and whether it represents adequate or inadequate implementation. Some feel that traditional measurement methods like checklists and observation rubrics are too rigid to do UDL justice. One of the goals of UDL, for example, is often to increase the variance among students, more paths to success rather than to narrow their differences, and this causes difficulty in observation.

Implications for Policy and Practice: UDL and Online Learning

The UDL framework promotes the use of flexible materials whenever possible, to be supportive of and accessible to all students. It embraces the concept that core curriculum materials themselves should contain tiered, embedded learning supports and scaffolds. This obviates the need for a separate curriculum for some students, and shifts the often-unrealistic burden of personalizing instruction for every student from the teacher to the materials themselves. Further, the means of instruction are often too narrow and rigid to reach all students. This is particularly common for students "in the margins" because the curriculum is largely intended to be centrist, focused on the illusory "average" student (Rose, 2016).

Although the emerging research targeting the integration of the UDL framework, principles and guidelines as a foundational element of online learning is still limited, the volume of studies related to UDL in all aspects and structure of education is steadily increasing, and it can be assumed that efficacy and impact investigations of UDL and online learning will also increase. Finding increased research in UDL, Mangiatordi and Serenelli (2013) conducted a meta-analysis of the ERIC database and found that citations of UDL in abstracts with research results between 2000-2005 were 0.66 per year, while from 2006 to 2011 they grew to 2.66 per year. Within online settings only, Al-Azawei et al. (2016) reviewed six studies conducted in blended learning environments and two in full-time virtual settings. These findings indicated that in fully online education, the application of the UDL framework enhanced both learner perceptions of their own efforts and increased persistence in large-scale online course completion. In both blended and full-time virtual settings, the authors surmised that the inherent flexibility offered by UDL-aligned instructional practices improved both learner satisfaction and learning outcomes.

Online learning designs, especially those based on proficiency or competency-based progressions, are, in most instances, emerging as the environments most actively aligning with UDL principles (Basham, Hall, Carter & Stahl, 2016; Basham & Stahl, 2015; Bray & McClaskey, 2013; Din, 2015). Either referenced as "personalized" or "student centered", these educational approaches can be facilitated within full-time virtual, blended, or supplemental online learning settings since both the characteristics of proficiency-based education and the affordances of networked digital learning systems can combine to optimize a UDL approach. The three core principles of UDL provide a framework for concretizing this synergy.

Multiple Means of Engagement

Blended learning environments are often uniformly predicated on giving individual students control over the time, place, path, and/or pace of learning (Christensen et al., 2013) and many full-time virtual schools incorporate this approach as well (Gemin et al., 2015). This emphasis on agency — guiding and supporting students to increasingly assume more responsibility for their own learning — is a hallmark of personalized learning. Online systems that generate real-time student progress data aligned to specific and unambiguous learning goals function as an educational GPS: they identify where a student is at any given time, where they are going, and the best optional routes for a successful journey. In the most successful of these settings, student academic efforts are augmented by explicit instruction in self-regulation strategies: goal-setting, progress benchmarking, time management, etc. These are all designed to support student persistence and engagement.

Another core feature of many blended settings is an emphasis on collaboration over competition (Basham et al., 2016; Basham & Stahl, 2015). Although still not a common practice, transparency related to student progress can be pivotal in assisting students to view one another as learning resources (Basham et al., 2016). In some settings, the academic skill achievement and progress trajectories of each student in each subject area are publicly available, and students are encouraged to seek out one another for help, or to join others at the same level in cooperative learning groups (Basham et al., 2016). This approach, when combined with proficiency rankings rather than letter grades, demythologizes the process of learning and encourages collaborative efforts often unavailable in traditional classrooms. Learner variability becomes apparent to all involved, and therefore, more students are actively engaged (Posner, 2011).

Multiple Means of Representation

Beyond the research reviewed earlier, harnessing the capacity of digital media to represent information in multiple ways has been an active area of exploration for many years as technology has become more pervasive in schools (Clark & Mayer, 2016; Hannafin & Land, 1997; Hannafin, Hill, Land, & Lee, 2013; Spector, Merrill, Elen, & Bishop, 2013; Mayer, 2003; Merrill, 2002). Most student-centered learning gives students access to a variety of learning resources – text, graphics, video, audio, tactiles, etc. — as a means of facilitating student agency and preferences. Key resources related to core topics may be differentiated (e.g., different books, movies, or websites focused on the same learning goal) or equivalents (e.g., text transcripts of podcasts, audio versions of texts, or captioned videos.) The former provides multiple perspectives that can elicit student fact-finding or perspective taking, while the latter presents the same information in multiple ways. Such multiple representations are essential for some learners with sensory, physical, or learning challenges, or simply preferential for those without.

While providing multiple representations of information and learning resources can be accomplished in the absence of technology and digital media, doing so is far more challenging and time-consuming. Several publications have gone so far as to equate UDL only with digital media and technology use, and this is not especially accurate. Technology simply offers heightened efficiency for UDL implementation.

Multiple Means of Action and Expression

Most student-centered and proficiency-based systems prescribe student demonstrations of knowledge or skill mastery in multiple ways via exhibitions, progress monitoring, traditional quizzes or tests, reports, presentations, or other examples of cross-modal understanding or competence (Darling-Hammond, Friedlaender & Snyder, 2014; Johnson, 2013; Teele, 1996).

This practice is designed to ensure that a student's skill or knowledge is solid and able to be transferred from one context to another, but it also directly addresses learner variability by allowing students to document their achievement in one or more mediums of their choice; thereby, activating areas of strength to support in areas of relative weakness.

In addition, encouraging students to exhibit skills and understanding in multiple ways requires them to develop time and resource management strategies, and can help students to differentiate a goal — the competency — from the means of acquiring or demonstrating it. Most online environments support a nexus of multimedia choices that can be readily available to students for exhibiting knowledge or skill mastery: for some, these are optional and based on preference; for others, like students with disabilities or English Language Learners, these alternatives are essential.

Implications for Research

The adoption of UDL in policy and practice has progressed more rapidly than the accumulation of research to support specific instantiations of the model. There is a need for continued research. But it seems likely that, congruent with its disruptive effects on traditional educational beliefs and practices, the full adoption of UDL will also be disruptive on both the goals of education and how the achievement of those goals can be measured. In similar fashion, the power and usefulness of jet engines cannot be adequately assessed by measuring how long it takes them to reach the end of the runway. And it is much more difficult to measure the power and expertise of a jazz musician than a beginning clarinetist.

Efforts at rigorous evaluation of UDL are likely to require longer timescales, more flexible and diversified instruments, and much richer and revealing analytics than are possible with results from single standardized tests. There is a great need to think both scientifically and creatively about how to accelerate the research evaluation process so that it contributes more actionable information sooner to the wide range of stakeholders who are asking for it. Revisiting the unique challenges of UDL research can help jumpstart that process.

- Defining UDL. UDL in action is context specific – it may look different depending upon the goal of instruction and the in situ variables at play. Revisiting the concept of the "systematic variability" inherent in all learners and its three components (represented by the UDL principles) is where most existing research begins, and the UDL Guidelines help instantiate that focus. Even though the three principles and their underpinnings in neuroscience are often presented separately (authors included), all three are core, essential components of UDL, and subsequent research should address that totality.
- Does Research Need to Cite UDL? UDL can be conceptualized as an amalgamated construct; a combined framework made up of empirically documented and effective components that can be used to operationalize learning environments to maximize the potential of each learner. To date, as this paper attests, it has been easier to research the parts of UDL rather than its whole, and reference research as UDL-aligned whether or not UDL is even mentioned. Ultimately, continuing this disaggregated approach seems counter-productive and not useful. It is clear by now that each of the UDL principles and guidelines has an evidence basis; what's needed is research on the aggregate: impact and efficacy studies focused on learning environments that deliberately incorporate, in some fashion, all three UDL principles.
- Does Research Need to Address All or Just Some of the Guidelines? As referenced above, research on the separate components of UDL is solid and extensive; what is needed now are studies that investigate learning outcomes in environments where the entire framework of UDL is addressed. Within this research, a means to identify and define UDL must clearly be apparent. It is thought this may be limited to a subset of the nine UDL Guidelines, but include all three of the UDL principles.
- Can UDL research be aggregated? The question here is the extent to which positive outcomes from UDL-aligned education in one instance actually transfer to another, unrelated or partially-related set of circumstances? The answer to this query seems anchored in which variables are targeted and controlled for, much as with any other avenue of research. Perhaps the question could be reframed as "Can UDL research be contextualized?" and that might lead to the creation of more definable categories (i.e., UDL versus not UDL), and some research currently underway is taking this approach.
- Measuring UDL. A key question most often raised early on in any discussion of UDL research relates to fidelity of implementation. If UDL is highly contextualized, perceived to be more than the sum of its component parts, and is sufficiently variable to address learner variability, how will we know it when we see it, and how do we know that it is being implemented accurately? A recent approach to assessing the fidelity of implementation across sites may suggest an alternative approach (Bryk, Gomez, Grunow, & LeMahieu, 2015). "Adaptive Integration" is a concept introduced by Bryk and colleagues as a method for addressing the existence of strong contextual variables. Built from implementation science, the authors convincingly argue that "fidelity of implementation" might better be replaced with "Implementation with Integrity" as a way of adhering to shared and consistent principles while allowing for ongoing and necessary modifications. This seems the right premise for measuring the impact of UDL.

Throughout these unique challenges is the need to develop partnerships that are working toward continued improvement and research for informing implementation. Current work in this area has drawn from Implementation Science (Fixsen, Blase, Duda, Naoom, & Van Dyke, 2010) and, more recently, Improvement Science (Bryk et al., 2015). These efforts involve partnerships among education leaders, educators, and researchers to collaborate in phasing in adoption, collecting implementation and outcome data, and both evaluating progress and informing future directions. This type of research partnership will be critical in the coming years.

Conclusion

What is clear is that online learning continues on an accelerating and pervasive trajectory throughout all aspects of elementary and secondary education (Barbour, 2017). Commercial investments in digital content and delivery systems is expanding, and data structures optimized for interoperability are becoming more commonplace. In addition, the spectrum of opportunities for learners, from one-off supplemental courses to blended learning to full-time virtual schools are steadily increasing. The online population of the few, the white, and the empowered of ten years ago has become the population of the many and the diverse today. The current online population is becoming more representative of elementary and secondary schooling at large. In general, the current impact of online learning experiences for students with disabilities, ELLs, or students in poverty is more negative than the experiences of these students in brick and mortar settings or that of their age-mates not in these traditionally marginalized categories. Despite the promise of flexibility, customized one-off learning solutions, and anywhere/anytime educational opportunity often associated with online education, the reality is that for many of these learners their learning experience has been at best underwhelming, and at worst detrimental (Woodworth et al, 2015).

On the positive side, some online learning content developers, delivery system designers, education professionals, parents, and even students themselves have become more knowledgeable of the importance of addressing the diversity in today's digital environments. Unsurprisingly, the spreading adoption of personalized and student-centered learning with its associated use of real-time student progress data generated by online learning systems has spotlighted the variability inherent in all learners. As K-12 online education comes into an age where outcomes are important for all learners and where learning is truly personalized, UDL provides a foundational framework for supporting the design and implementation of these new environments. While not without its own challenges, both foundational and emerging implementation research support a framework that adheres to the unique needs of all learners, supporting system designers and teachers alike in meeting demands of our steadily diverse and ever progressing society.

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Social Interaction in K-12 Online Learning

Amy Garrett Dikkers

Situating Social Interaction in the Context of Online Learning

The idea of the importance of social interaction in learning is rooted in constructivism. Individuals create their own understanding by engaging in learning as an active, constructive process. This construction of knowledge is social, with individuals who learn from reflecting on their own thoughts and experiences and sharing them with others (Vygotsky, 1978, 1986). Vygotsky's Social Development Theory (1978) also supports the idea of students learning best when they work within their zone of proximal development (ZPD), with a range of potential knowledge to gain in any given learning opportunity, from what the student can complete individually and what s/he can accomplish with the support of peers and instructors to deepen her/his understanding. The ZPD reinforces how knowledge and learning increase through interaction and collaboration.

Within online and blended learning environments, especially those with significant asynchronous components, interactions in learning take on different forms than the traditional face-to-face learning environment. Although early efforts in distance education were focused more on the ability to deliver content to students separated from their instructor, truly *at a distance*, the last 15 to 20 years has seen a focus on pedagogy and interaction in the distance learning space. Moore's (1993) foundational Transactional Distance Theory proposed the idea that distance was connected more with pedagogical decisions instructors made than the actual physical distance between instructors and their students: decisions in structure, dialogue, and learner autonomy. Moore (1989) also posited three types of interactions that should be the focus of development of distance education development: learner-content interaction, learner-instructor interaction, and learner-learner interaction. These three types of interactions have been the focus of research and development in online learning and extended to consider the purpose of the interaction. Recent efforts to enhance the quality of online education have included a focus on building purposeful interactions between and among learners, instructors, and content, including an awareness of the value of social presence in online learning environments to aid student achievement and contribute to student satisfaction.

The concept of social presence, variably defined, is considered by many to be foundational to learning online (Benbunan-Fich, Hiltz, & Harasim, 2005; Garrison, Anderson, & Archer, 2000, 2010; Whiteside, 2007, 2017; Whiteside & Garrett Dikkers, 2015; Whiteside, Garrett Dikkers, & Swan, 2017). Originally, social presence was defined as the ability to convey self and perceive others as real in computer-mediated communication (Garrison et al., 2000; Gunawardena, 1995; Gunawardena & Zittle, 1997). Although researchers utilize a wide variety of definitions and approaches to studying social presence (Garrett Dikkers, Whiteside, & Tap, 2017; Whiteside, Garrett Dikkers, & Swan, 2017), what remains central is the idea of social interactions within online learning environments as key to learning. Incorporating methods, tools, and pedagogical approaches helps students make sense of their own and their peers' meaning-making processes becomes the role of the student, the instructor, and the class community in the online learning space. These connections stand on Vygotsky's ideas of social development.

As social learning theorist Etienne Wenger (1998) argues, "We are social beings…this fact is a central aspect of learning" (pp. 4–5). Learning is intrinsically bound with interaction (Bornstein & Bruner, 1989; Conrad & Donaldson, 2004, 2011; Lave & Wenger, 1991). If we start with the assumptions that learning is social, learning is interactive, and learning is active, when we remove the traditional face-to-face classroom and the immediacy of synchronous connections between and among students and instructors and move toward asynchronous online learning, does that mean we remove the social interaction, the social presence, and the connections that deepen learning? Perhaps this is removed in online learning focused on transmission of content *at a distance*. However, if the focus is learning and engagement with content and peers, we do not need to lose the social interaction and connections in asynchronous online spaces. What research shows is that we need to be purposeful in the design and organization of online learning environments to create interaction that leads to Vygotsky's deeper learning. Conrad and Donaldson (2011) explain, "Vygotsky believed that social interaction helped students learn the viewpoints of others in order to build a more complex world view" (p. 18). Rice (2006) supports a focus on social learning, stressing the need to investigate the social and cognitive aspects of distance education and their effect on knowledge construction. These social approaches to learning are definitely transferable to and, in some ways, enhanced by, the online learning environment.

Connecting Moore's (1989, 1993) foundational understandings of interaction, transactional distance, and pedagogy with an awareness of the importance of social learning (Vygotsky, 1978, 1986; Wenger, 1998) and social presence (Whiteside, Garrett Dikkers, & Swan, 2017) brings us to the focus of this chapter – social interaction in online learning. Although some may see social interaction as being separated from content interaction, for the purposes of this chapter, social interaction may truly be social in nature or interaction with peers or instructors that is content-connected. For the author, *social* equals the social in social presence, that of community, connection, awareness of self and others.

Context and Overview of the Chapter

As a field, it has been clear there is a need for more focused research specific to K-12 online learning. Cavanaugh, Barbour, and Clark (2009) reviewed literature from 1997 to 2008, determining that the majority was descriptive or focused on personal experiences in online learning. Studies that were part of the body of work were primarily regarding the role of teachers. They identified four areas of need: effectiveness of specific instructional practices; identification of characteristics leading to or hampering student success; focus on interaction between online and in-school classmates in virtual and brick-and-mortar schools; and the overall quality of the student learning experience, especially for lower-performing students.

Means, Toyama, Murphy, Baki, and Jones (2010) conclude their meta-analysis of empirical studies within K-12 online learning with the recognition of a continued lack of research to support K-12 online course and program development. They state, "Educators making decisions about online learning need rigorous research examining the effectiveness of online learning for different types of students and subject matter as well as studies of the relative effectiveness of different online learning practices" (p. 54).

Specific to interaction in K-12 online learning, Corry and Stella's (2012) Framework for Research in K-12 Distance Education specifically identified interaction as a variable. They suggest future research should include study of the value of interaction for different populations of students, social skill development of students, and perceived authenticity of interactions in the online space.

For this research synthesis, searches of academic databases with a variety of search terms (K-12 and online learning, *with* social, social interaction, social presence, interaction) resulted in few recent articles that dealt solely with social interaction in K-12 online learning. Social interaction in K-12 online learning is often not studied separately from larger research questions – instead it is often discussed as a byproduct, finding, result, or one research question of multiple research questions. Often the research study discussed in the literature is focused on quality, student perceptions, or teacher preparation, for example. Additionally, there are reports of research with a specific student population (such as students with disabilities in general, or students with a certain disability), in specific contexts (case studies of a school, general research on online charter schools), or in regards to the use of specific tools (including discussion boards, blogs, social network sites, etc.). This chapter provides an overview of the areas of research where social interaction is discussed, studied, and mentioned, and synthesizes the limited research, providing a discussion of implications for policy and practice. Additionally, areas of future research are identified and outlined, with key questions for researchers and practitioners to consider regarding study of the value of social interaction in online and blended learning, *Student Desire for Interaction*

Although many studies of perceptions of K-12 students regarding their online and blended learning opportunities find students are satisfied overall with their learning experiences (Barbour & Mulcahy, 2008; Barbour, McLaren, & Zhang, 2012; Garrett Dikkers, Whiteside, & Lewis, 2013, 2014, 2017; Oliver, Osborne, & Brady, 2009; Tunison & Noonan, 2001), students often do mention a desire for interaction with their peers and instructors. In fact, Muilenberg and Berge (2005) identified the lack of social interaction as a significant barrier to online learning. In their large-scale survey of 1056 secondary school students, a lack of social interaction was identified as the single most important barrier to students who were learning online. They identified lack of communication with fellow students, the impersonal nature of online learning, fear of isolation, lack of social context clues, lack of student collaboration, and a general preference to learn "in person".

Virtual school students studied by Barbour and Reeves (2009) stated a benefit of online learning was the ability to control their own learning, but they also detailed an appreciation for synchronous contact with their instructor and peers and stated feeling isolated and a sense of the lack of community in completely asynchronous environments. Similarly, students in the North Carolina Virtual Public School, the second largest virtual school in the United States, stated in surveys and interviews the benefit of autonomy that online learning provided, but also discussed the challenge of feeling like they had to be independent and control all aspects of their learning, detailing a desire for more community connection (Garrett Dikkers, Whiteside, & Lewis, 2013; Lewis, Whiteside, & Garrett Dikkers, 2014; Whiteside, Garrett Dikkers, & Lewis, 2016). This sense was echoed by students in a virtual high school who engaged in their online coursework from a lab space in a physical building but did not feel connection with their online peers (Barbour, McLaren, & Zhang, 2012). The students interviewed for this study (n = 7) discussed a lack of connection with their online peers and instructor, and more of a connection with students in their building who were also learning online.

Research on the Value of Interactions

Those varied types of interactions (learner-learner, learner-instructor, learner-content) as first outlined by Moore (1989) and applied to higher education learning environments, have been initially studied and applied to the K-12 online learning landscape as well. Borup, Graham, and Davies (2012) explored perceptions of 82 students in two online courses at an open high school to determine whether learner-instructor, learner-content, and learner-learner interactions were educational and/or motivational, as well as to what extent they impacted course outcomes, perceived learning, and grades. The majority of students identified all interactions as motivational. Learner-instructor and learner-content interactions were of significantly higher educational value than learner-learner interactions. Learner-instructor interactions were more motivational than learner-content or learner-learner interactions.

Borup et al. (2012) further identified three purposes within the types of interactions: Content-specific, procedural, and social. The researchers found that the majority of human interaction in the courses was social (classified as focused on motivation, encouragement, personal interest, humor, service projects, etc.), and the majority of those social interactions were learner-learner. Content-specific interactions (improving understanding of course materials) were more valuable and more motivational for students than the other two purposes. However, social interactions with their instructor (whether face-to-face or via phone, text, and email) were significantly correlated to students' disposition to the content of the course. Social learner-learner interactions were low to moderately correlated to students' dispositions. Additionally, there was a significant correlation between students' grades, the overall time spent on learner-learner interactions, and whether those learner-learner interactions were social.

Borup, et al.'s (2012) findings are additionally illuminating when paired with Hawkins, Barbour, and Graham's (2011) interview study of eight teachers in a virtual high school who identified social or supportive interactions as the least important (behind instructional/intellectual and procedural/organizational interactions). Teachers reported the majority of their interactions with students were instructional (providing feedback or answering questions about content), and these interactions were mostly student-driven. They also reported there was limited opportunity for social interaction (typically limited to about me posts or bios) and felt that a lack of time on the part of the teacher was a barrier to social interaction. Additionally, Hawkins et al. determined teachers simply may not have seen the value in social interaction.

Additional research exploring the value of the three types of interactions in virtual school language learning found similar results to Borup et al. (2012) regarding the value of learner-content and learner-instructor interaction. Lin, Zhang, and Zheng (2017) conducted a large-scale survey of 466 students taking online language classes in a virtual high school to identify whether types and frequency of interaction connected with student satisfaction and perceived progress. Learner-instructor and learner-content interactions had significantly positive effects on perceived satisfaction, with learner-content interaction being the strongest predictor. Additionally, learner-content interaction was the only factor that affected student perceived progress. Learner-learner interaction was not correlated with either perceived satisfaction or progress. However, the authors stress that part of this difference may be connected to the design of the courses, which had limited opportunity for learner-learner interaction. Research demonstrates that learner-learner interaction continues to not be central to online learning course design. Carver and Kosloski (2015) found in their comparison of high school student perceptions of psychosocial learning in online and face-to-face Career and Technical Education classes that students perceived a significantly lower level of student interaction and collaboration in the online courses. Survey (n = 584) responses also detailed face-to-face students had a higher level of enjoyment in their classes. Carver and Kosloski support the importance of learner-instructor interaction for student satisfaction and enjoyment in online learning, as well as the aforementioned variance in desire and expectation for collaborative learning (learner-learner connected with content).

Based on an understanding of the importance of learner-learner interactions in online learning, Borup (2016) further explored virtual high school teacher perceptions of learner-learner interactions in online learning. Teachers were asked to explain learner-learner interactions they saw regularly in their online courses. Fourteen teachers listed and ranked roles students fulfilled in helping their peers. Eleven teachers were interviewed to provide further information. Through a constant comparative method, Borup identified four categories of behaviors students engaged in: befriending, motivating, collaborating, and instructing. Teachers identified and referenced all four behaviors in their students, although they focused more on affective behaviors (befriending and motivating) instead of teaching behaviors (instructing). The majority also mentioned collaborating behaviors. Interestingly, teachers identified less social interaction among their online students than would perhaps be expected, although this was explained as potentially being connected with the fact that some students chose online learning specifically because of negative social interactions at a brick-and-mortar school. This finding connects with research by Lewis, Whiteside, and Garrett Dikkers (2014), which discussed stories of some students who chose online learning specifically to get away from the social nature of traditional high school, which distracted them from their learning. Additionally, teachers in Borup's (2016) study identified potential negative consequences of interactions with peers that could harm learning (such as causing students to feel more isolated or unmotivated if they felt they were bullied or marginalized), although in general they see value in learner-learner interactions for social integration and motivation of students.

Students are seeing value in a variety of types and purposes of interactions; however, some teachers are not as aware of the value in that variety. A clear finding across these studies is that interactions in the online space are important on many levels and in many different variations. Additionally, teachers need to be provided the opportunity to hear the voices of their students through the research in order to gain different perspectives of the value of this variety. This section has provided an overview of the research literature on all three of Moore's (1989) three interaction types: learner-content, learner-instructor, and learner-learner interaction, enumerating the different purposes for the interactions. The following section explores social interactions and learner-instructor interactions through the lens of social presence.

The Role of Social Presence in Learner-Teacher Interactions

One foundational concept to interactions in online learning is social presence, defined in its simplest as the creation of a community. Sensing self and others and feeling connected to others in a learning space can contribute to satisfaction, enjoyment, and greater learning.

For fifteen years, Whiteside and Garrett Dikkers, with Lewis, have been exploring social presence, or the level of connectedness among students and instructors across online and blended learning at K12 and higher education levels. The researchers have studied online education within varying contexts, including virtual public schools, specific programs serving at-risk students, blended learning high schools, graduate programs in education, undergraduate and graduate programs across disciplines. The qualitative and mixed methods research endeavors have centered on exploring students and teachers' experiences, identifying pedagogical practices and instructional activities utilized to build social presence, and understanding benefits, challenges, and necessary supports for students and teachers.

Throughout this period of research, a Social Presence Model emerged and has been refined, one that combines five aspects that together influence and guide individuals' meaning-making processes in online and blended learning (Whiteside, 2015). The five aspects are:

- Affective Association – how students and teachers show emotion online;
- Community Cohesion – seeing the class as a community;
- Instructor Involvement – how the teacher shows involvement in student learning;
- Interaction Intensity – what ways and how often students interact; and
- Knowledge and Experience – ways students share their prior knowledge and experiences with course content (Garrett Dikkers, Whiteside, & Lewis, 2017, p. 160).

The researchers believe the context-driven integration and intersection of these five aspects is a critical literacy for students and teachers in online and blended learning environments (Whiteside, 2017; Whiteside & Garrett Dikkers, 2015). It is interesting to note that across the bulk of the studies utilizing the Social Presence Model, Instructor Involvement in the process of community-building has been seen as very important, more so than any other element. Students and teachers alike see the primary responsibility resting with the teacher to develop the activities and design the online environment in a way that creates purposeful interactions and provides opportunities for students to connect with their peers and their instructors.

Specifically, school administrators, teachers, parents, and students in the Huntley Blended Learning Initiative identified Instructor Involvement as essential (Garrett Dikkers, Whiteside, & Lewis, 2014, 2017). There were a multitude of responses in surveys, interviews, and focus groups where participants discussed the instructor's role in building community and making connections with students in order to make them more comfortable within the blended environment. Stakeholders felt when teachers were able to do so, students were more able to focus on their learning than the online modality within which they were learning. Whiteside and Garrett Dikkers (2015) argue that social presence is an essential literacy for cultivating emotions and relationships that enhance the overall learning experience and have published several studies detailing specific methods instructors use to build and facilitate social presence in online and blended learning (Garrett Dikkers, Whiteside, & Lewis, 2012; Whiteside & Garrett Dikkers, 2012; Whiteside, Garrett Dikkers, & Lewis, 2014, 2017).

Regarding interaction with their teachers, specifically, several studies within the North Carolina Virtual Public School found that the majority of students saw Instructor Involvement in their learning (learner-instructor interaction) as well as Interaction Intensity with their peers (learner-learner interaction) and course content (learner-content interaction) as important or very important to their learning (Garrett Dikkers, Whiteside, & Lewis, 2013; Lewis, Whiteside, & Garrett Dikkers, 2014, 2015). Additionally a large-scale survey of 1648 NCVPS students in the first year of operation by Oliver, Osborne, and Brady (2009) demonstrated students' high expectations for their teachers. Those expectations were: teach, not moderate; supplement course content as necessary; incorporate course content, including projects, that illustrated relevance; incorporate content discussions and content interactions; provide quick and timely responses and feedback on assignments; and provide individualized attention when necessary. These learner-instructor interactions were seen as essential; however, students also mentioned their capability to seek assistance and support from individuals other than their teachers as needed.

Students in the Huntley Blended Learning Initiative found greater connections with their blended teachers than their traditional face-to-face teachers, a sentiment echoed by the teachers and administrators, potentially because they could initiate contact with their teachers outside of designated class time to gain additional support or enrichment (Garrett Dikkers, Whiteside, & Lewis, 2014, 2017; Whiteside, Garrett Dikkers, & Lewis, 2016). This effect is a surprise to some who expect the students to be less connected to their teachers since they do not see them daily (Garrett Dikkers, Whiteside, & Lewis, 2014). As with so many aspects of online and blended learning, the particular contexts of the learning environment, course and program design, and perceived roles of the instructors seem to impact the level of interaction, social or otherwise, for students.

Research above discussed the role students have in motivating each other within the online learning environment; however, virtual school teachers also see significance in their role as motivators for their students. Research demonstrates that the learner-instructor interaction element is complex and contains multiple layers (Borup, Graham, & Drysdale, 2014; Garrett Dikkers, Whiteside, & Lewis, 2013; Murphy & Rodriquez-Manzanares, 2009). Murphy and Rodriquez-Manzanares (2009) conducted hour long interviews with 42 virtual high school teachers in Canada to gain insight into their perspectives on what motivates their students and specifically which methods they use in their online classrooms. Data analysis identified three categories of motivation identified by teachers: Communication, interaction, and social presence; Intrinsic and extrinsic motivators; and Learner-centered design. All three are discussed with specific strategies used by teachers. Examples of those motivating strategies connected with communication interaction, and social presence include the following: using humor, providing opportunities for students to hear the teacher's voice and share content in their own voices, providing prompt and careful feedback that puts comments into perspective, interacting daily, using real-time communication as much as possible, and structuring assignments that discuss controversial issues and/or require students to communicate or collaborate with their peers.

North Carolina Virtual Public School teachers also identified multiple strategies they use to address all aspects of the Social Presence Model to enhance student learning (Garrett Dikkers, Whiteside, & Lewis, 2012, 2013; Whiteside & Garrett Dikkers, 2012). One-on-one contact with students (and their parents) is seen as essential to aid student learning and motivation in NCVPS courses. Teachers use a variety of tools for this synchronous contact (social media such as Twitter and Facebook, Google Voice and Hangouts; email, phone calls, text messages, etc.). Additionally, teachers discuss using the announcements feature in the LMS to praise student work, build community with shout outs to groups or individuals who have successes in the class and outside of the class in extracurricular activities, etc. Purposeful creation of social spaces in the online learning environment and encouraging students to use them is also a useful technique to build community. Learner-content interaction can be connected with learner-instructor interaction when teachers use webcams and screen capture software programs to create video explanations of course content ore review challenging materials.

Teachers in the Open High School of Utah in the United States discussed ways they are engaged in improving student outcomes, resulting in a core concept of teacher engagement (Borup, Graham, & Drysdale, 2014). Teacher engagement encompasses six aspects:

- designing and organizing learning activities;
- facilitating discourse with students, parents, and other teachers;
- providing students with one-on-one instruction;
- nurturing a safe and caring learning environment;
- motivating students to engage in learning activities; and
- closely monitoring student behavior and learning (p. 797).

Facilitating discourse, nurturing students, and motivating them are three aspects of teacher engagement that closely connect with learner-teacher interaction and creating community through social presence. Teachers interviewed by the researchers discussed keeping regular contact with students in their classes, as well as a school shepherding program where each teacher was assigned 20 students to contact weekly and really get to know. Teachers saw teacher-initiated social interactions as a key component in student engagement and satisfaction. Additionally, teachers used many motivating behaviors – showcasing student work on a "Wow Wall" or a "Strut your stuff" wall, offering incentives such as candy bars and drawings for iTunes gift cards for students who completed all their assignments, and generally focusing on using positive praise.

What is valuable for researchers and practitioners is that all of these studies provide specific examples of and recommendations for practice to enable educators to incorporate effective practices in their own online teaching.

Interaction for Students with Disabilities

As noted in the overview of the chapter, exploration of social integration in online learning is often considered as part of larger research studies. Also, as more students from a variety of backgrounds and educational experiences access online learning, there is a greater awareness of the need to address learning needs of specific groups of students with disabilities in online course design and development (Center on Online Learning and Students with Disabilities, 2012; Watson, Pape, Murin, Gemin, & Vashaw, 2014). Given the importance of peer interactions for the generation of new knowledge (Lave & Wenger, 1991) and the fact that students with disabilities may be enrolled in online courses because of difficulties with peer relations or failure to progress in student learning environments in traditional schools (Rice, Stahl, & Basham, 2015), purposeful design of interaction is key for online courses accessed by this population of students. Online learning for students with disabilities is discussed at length elsewhere in this handbook (Black and Thompson; Rice and Dykham), as well as the importance for Universal Design for Learning (discussed by Basham, Blackorby, Stahl, and Zhang in this section). However, it is worth mentioning here a few works that specifically identified social interactions or peer-to-peer learning and the value of those practices for students with disabilities (Burgstahler, 2015; Greer, Rowland, & Smith, 2014; Johnston, Greer, & Smith, 2014).

Johnston, Greer, and Smith (2014) discuss the importance of peer-to-peer learning and the challenges of that practice with some students with disabilities. They stress developing the right balance between meeting the peer-to-peer learning recommendations of curriculum standards and other leading educational practice with recognizing the varying capacities of students to engage with their peers. They recognize that the bulk of this seeking the balance rests with the course designer and/or course instructor, who need to be build environments that afford peer-to-peer learning and implement educational activities designed for collaboration. Key questions in their work are: "Can such environments enable optimal learning for students with disabilities? If so, does optimal learning occur for all or some students? While there have been great strides made in online learning, design of virtual learning environments to support peer-to-peer learning among all students is still an emerging phenomenon" (Johnston, Greer, & Smith, 2014, p. 5-6). Burgstahler (2015) extends the discussion of peer to peer learning to include the importance of online learning as providing opportunities for social inclusion of students with disabilities, rather than continuing to exclude them by not utilizing the key principles of Universal Design. Greer, Rowland, and Smith (2014) provide a blueprint of sorts for teachers and instructional designers to consider when developing or revising courses to meet the varied needs of students with disabilities.

Tools for Social Interaction

Across the research around social interaction, learner-learner interaction, learner-content interaction, and learner-teacher interaction, there are several tools regularly mentioned as those utilized to build those collaborations. Interaction in discussion boards continues to be central to much K-12 online learning practice, along with blogs and wikis. Teachers also can use real-time web-conferencing tools that integrate chat, voice, webcam and whiteboard technologies to engage with there students around the course content, while simultaneously building the course community (Watson & Gemin, 2008, p. 7). Of course, not all students and teachers are able to connect synchronously. If there are synchronous web conferences with some students, teachers can record these for other students to view at a later date. Although perhaps not as ideal as real-time conversations, viewing recordings such as these can still help build course community and allow students to feel part of a larger group.

Additionally, there is an emerging body of research on the use of social networking sites to provide social interaction opportunities for online students, although instructors must recognize that sending students to tools outside of the LMS may cause confusion for some students. There is a recognized value of social networking sites to provide collaborative opportunities for K-12 students beyond the confines of the classroom space (Barbour & Plough, 2012; Howard, 2013). Clearly these connections can be simply social in nature, but social networks as counterparts to K-12 online learning can also encourage social interactions that enhance students' learning experiences. Barbour and Plough (2012) traced the growth in use of a social networking site at Odyssey Charter High School in Nevada, USA, which started with teachers who were frustrated at the lack of social interaction they had with their students. An analysis of the use of the social networking site found curricular, co-curricular, pedagogical, and social interactions. Some pedagogical uses in the space were for students to discuss their learning and coursework with their teachers and peers, to build community and feel more connected to the online school, and as support for at-risk students. Additionally, the social networking site allowed for students to interact socially, creating interest groups (as a replacement for clubs and activities typical in brick-and-mortar high schools), engaging in conversations around current issues (politics, career choice, etc.), and leading student activities (such as committees for prom and talent show, two events that had never occurred at the school). Other social aspects of interaction were around social problems that teens face and discussion of social issues.

The use of social networking sites in traditional and online K-12 education has elements of risk and inherent questions of access. Howard (2013) provides suggestions for districts and teacher education programs to consider regarding ways to mitigate the risk, focusing on suggestions for psychological safety, appropriateness of student-teacher interactions, and protection of privacy. Privacy and safety was also at the core of decisions by the Odyssey Charter High School and Barbour and Plough (2012) conclude with recommendations for schools and districts.

Implications for Policy and Practice

There is much support for purposeful design of online learning environments to incorporate multiple and diverse opportunities for interaction – learner-learner, learner-content, learner-instructor – whether for a truly social purpose, the purpose of course content, or even procedural interactions between learner and instructor. What remains is for the purposeful design to occur and researchers are moving us in this direction by identifying evidence-based approaches for design. Also, it is increasingly clear that teachers are key to successful and effective social interactions in the online space. Training and professional development for online teachers varies greatly depending on the individual teacher, school, district, or organization. Pre-service teacher training in most cases does not incorporate training and preparation to teach in an online learning environment. However, multiple sources cite the importance of targeted training for teachers (Abrami, Bernard, Bures, Borokhovski, & Tamin, 2011; Basham, Smith, Greer, & Marino, 2013; Garrett Dikkers, Lewis, & Whiteside, 2015; Garrett Dikkers, Whiteside, & Lewis, 2013; Lewis & Garrett Dikkers, 2016; Oliver, Kellogg, Townsend, & Brady, 2010; Rice, 2009).

Recommendation: Be purposeful in design.

One place for instructional designers and teachers to start is with the conclusions drawn by Abrami, Bernard, Bures, Borokhovski, and Tamin (2011). Researchers used a thorough meta-analysis of distance and online learning (Bernard, Abrami, Borokhovski, Wade, Tamim, Surkes, & Bethel, 2009) to argue for the next generation of interactive distance education, identifying evidence-based principles of self-regulated learning, multimedia learning, collaborative and cooperative learning, and motivational design. Starting small is perhaps the best approach, choosing one set of these principles as outlined and utilizing them in course design and revision.

Recommendation: Utilize a team approach to design and revision.

Ideally, an instructional design team could include a distance education researcher so as new practices are implemented, we can move toward a comparison of different interactive techniques to determine their impact on student learning, satisfaction, retention, or any number of variables. As Borup et al. (2012) conclude, "if instructors guide learner–learner interaction to focus more on collaborative learning and shared learning activities, stronger relationships between learner–learner interaction and learning outcomes will likely emerge" (p. 162-163). In many cases, teachers may not have instructional design experience or background and will need to be part of a team to help determine activities and their value for students.

Recommendation: Incorporate specific activities for interaction.

If we design collaborative (learner-learner) activities, we need to make sure the interaction is purposeful, meaningful, and explained to students (Abrami, et al., 2011). As more students choose courses online as supplemental to their traditional brick-and-mortar education, we need to realize that choice often has to do with flexibility and availability of courses not otherwise provided for them; that choice may not connect with expectation or desire for collaborative learning. However, research has shown the value of cooperative activities that are purposefully designed and Borokhovski, Tamim, Bernard, Abrami, and Sokolovskoya (2012) provide design recommendations for educators and instructional designers.

These include the use of role-based scenarios; scaffolding collaborative interactions by providing specific directions and guidance; and monitoring and adjusting the collaborative activities by providing feedback (from instructor and peers).

Implications for Research and Questions to Consider

There are an emerging variety of online learning options for K-12 students. As we conduct our research into those spaces, we need to be concise and precise with our discussion of school context, participant profiles, demographics, and other variables of the online learning environments we study. This detail would enable researchers and practitioners to be better able to identify findings that may align with contexts within which they work.

Similarly, we need to define the terms, concepts, and tools we are studying with as much detail as possible. For example, the author of this chapter has chosen to discuss social interaction as that which is social in nature (i.e., disconnected from course content), as well as that which is social in context (related to course content, but involving interaction with peers and instructors). This explanation provides context for the audience. However, having shared definitions could be beneficial for our research, as well. Can we agree on a definition of social interaction that researchers as a whole utilize in our research? If not, then we need to be clear in our research design, analysis, and discussion exactly what concepts we have studied.

The research synthesized in this chapter leads us to a variety of interesting questions:

- Will the movement to personalized learning in online learning environments take us even further from building in social interactions?

There seems to be a tension between meeting individual needs and encouraging collaborative learning (Borup, 2016; Johnston, Greer, & Smith, 2014; Kim, 2012; Lewis, Garrett Dikkers, & Whiteside, 2017; Lewis, Whiteside, & Garrett Dikkers, 2015). As a field we should explore this question further, identifying whether and how collaborative activities can be encouraged in a more personalized learning environment where students may be learning completely at their own pace and separately from their peers.

- Are there certain contexts/disciplines/populations where social interaction is more important and others when it isn't as necessary?

Although Muilenberg and Berge (2005) found that social interaction was strongly related to online learning enjoyment, effectiveness of learning online, and the likelihood of taking another online class, this does not imply causation. Are there times when social interaction is not as essential? Corry and Stella (2012) pose this question and the conflicting findings from Borup et al. (2012) and Lin, Zheng, and Zhang (2017) continue to raise it as an area of focus.

- Should we study social interaction and its connection to satisfaction? Or should we study social interaction and its impact on achievement? Can we separate satisfaction and achievement?

These and other questions demonstrate the movement of K-12 online learning research away from a comparison of online and face-to-face education toward an evaluation and comparison of specific instructional practices.

Conclusion and Continued Call for Future Research

Although there has been more research published specific to K-12 online learning in the years since Cavanaugh, et al. (2009) and Means, et al. (2010), we still haven't caught up as a field to the significant amount of research dedicated to online learning in higher education. The oldest K-12 online schools and programs in the United States are between 15 and 20 years old (Evergreen Education Group, 2016). Enrollments in online courses, programs, and schools continue to grow as students, parents, and schools have more options (Evergreen Education Group, 2016): state virtual schools (more than half a million students); private online schools; online consortia that are statewide, regional, or even national in scope; virtual charter schools (in 25 states in 2014-2015 for an approximate 275,000 students; Evergreen Education Group, 2015); and individual schools and districts moving toward providing their own online courses and supplying them to others, as well. Additionally, a projected 2.2 million students are taking supplemental online courses while attending a physical school and an unknown number are attending hybrid schools with online courses and a face-to-face teacher or mentor (Evergreen Education Group, 2015).

The body of research with specific kinds of students, learning content, and circumstances is expanding as options for online learning expand for K-12 students (Means, Toyama, Murphy, & Baki, 2013). Our job as researchers who see value in social learning is to be strategic in the focus of our work, looking to answer questions about the value of different types of interactions, the methods that are most effective to build purposeful interactions, and the impacts of social interaction on student satisfaction, performance, retention, and overall experience.

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PART VII

Research on Learning Environments

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Introduction

Chin-Hsi Lin

Nearly a decade ago, Cavanaugh, Barbour, and Clark (2009) reviewed the literature on K-12 online learning that had appeared since 1997, and called for researchers to examine students' learning experiences in online educational environments. Unfortunately, no systematic review of the affordances of different environments for online learning has yet appeared. One possible reason is that such environments vary widely in terms of their pedagogical practices, class sizes, levels of individual attention given to students by teachers, and teachers' skills (Blake, 2011), as well as in fundamental structure, e.g., the use of synchronous vs. asynchronous discussion. Given the challenge of comparing learning effectiveness across such diverse online environments and the dangers inherent in generalizing about them, it seems preferable to conduct systematic reviews of each type of environment individually.

Accordingly, this section's four chapters cover research conducted in diverse K-12 online learning environments, including virtual reality (VR), educational games, mobile learning, and open learning. Its first chapter, "Virtual Reality – Augmented Reality" by Enrico Gandolfi, offers a synthesis of research on VR and immersive VR (IVR). Despite recent increases in IVR use in K-12 education, and findings that it improves learning outcomes, cognitive skills, and attitudes towards using such technology among average students as well as students with special needs, research on it remains scant. Mobile VR, on the other hand, is widely accessible by people with mobile devices, and a wide range of empirical evidence supports its use in K-12 online education, where it has been shown to improve learning outcomes, confidence, and engagement. Gandolfi concludes with four issues that need to be considered before implementing VR or IVR in education – costs, teacher preparation, pedagogy and content – and proposes several directions for future research.

The second chapter in this section, "Critical Perspectives on Implementing Serious Educational Games: Providing New Research Paradigms" by Leonard Annetta, Marina Shapiro, and Sunmbal Abbasi, addresses the four major objections to the use of educational games: societal pressures, cognitive attributes of learning, assessment, and learning through failure. Based on empirical research and educational theories, the authors provide counter-arguments to each of these objections, and argue strongly for the integration of such games into K-12 education, with specific examples of how this can be done.

The third chapter, "Mobile Learning" by Cathy Cavanaugh, Dorit Maor, and Aidan McCarthy, offers an up-to-date synthesis of research published since 2010 on the use of mobile devices for learning purposes in K-12 schools. The authors conclude that, at the individual level, mobile learning promotes personalized and cooperative learning; and that, at a national scale, it is a vital means of widening educational access, promoting digital citizenship, facilitating learning, and increasing student engagement. From an education-policy perspective, they note that many countries that perform strongly in international measures of learning have integrated mobile learning into their educational systems, and that the six countries that posted the largest improvements in academic outcomes between 2000 and 2015 all shifted to student-centered learning with mobile learning environments during that period. Lastly, from a professional-development perspective, the authors recommend ongoing professional development and adoption of the 4Cs model (i.e., champions, create, communicate, and celebrate).

The section's fourth and final chapter, "Open Educational Practices in K-12 Online and Blended Learning Environments" by Verena Roberts, Constance Blomgren, Kristina Peters, and Lee Graham, offers a comprehensive review of open-learning pedagogy. The purpose of open education practice (OEP) is to use existing resources to promote knowledge-building and collaborative learning, and to develop lifelong learners. As the authors note, "OEP is not a learning theory, but rather a teaching and learning method in which through teacher facilitation, learners identify and locate learning opportunities for themselves as well as create learning opportunities for others" (p. 000). The three main foci of research on OEP in K-12 learning have been open textbooks, the benefits of OEP, and teachers' perceptions towards OEP. The authors introduce two K-12 OEP innovations from the United States, and summarize research outputs based on them. Implementing OEP is associated with various challenges, but it has immense potential to bridge the gap between informal and formal learning, and to create opportunities for students to make learning meaningful, which will help to prepare them for the knowledge economy.

While all four chapters provide state-of-the-art syntheses of K-12 online and blended-learning environments, it is important that we not focus our attention too narrowly on whether a particular environment or technological tool improves students' learning. Technology itself does not constitute pedagogy (Hughes, 2005). To take full advantage of the affordances that each learning environment provides, multiple stakeholders should be involved in the learning process and be given proper training. As Cavanaugh et al. (2009) noted, students' success in K-12 online and blended learning crucially depends on teachers, course designers, site facilitators, administrators, guidance counselors, technology coordinators, and library media specialists. The authors in this section unanimously highlight the need to provide professional development before deploying a new technological tool or implementing major changes to the learning environment.

Future research on online learning should consider the following topics. First, questions of why and how certain learning environments work better for certain groups of students than for others may be more readily answered if we seek to understand learning processes, rather than continuing to focus chiefly on learning outcomes. Second, practitioners' adoption of new pedagogical approaches will benefit from studies' inclusion of more sample tasks, along with explanations of such tasks' pedagogical designs. Third, methodologically, research on K-12 online and blended-learning environments has not yet made full use of learning analytics or other analytical approaches (e.g., lag sequential analysis) to the examination of learning behaviors. The authors of future studies should consider using combinations of self-reported and behavioral data to gain a more complete understanding of learning processes.

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Open Educational Practices in K-12 Online and Blended Learning Environments

Verena Roberts, Constance Blomgren, Kristina Ishmael, & Lee Graham

Abstract

Open educational practice is becoming a critical focus for K-12 technology-supported programs, both those strictly online at a distance and blended classroom practices extending into online learning environments. This chapter reviews the emerging practices influencing open learning in K-12 online and blended environments by considering the pedagogical foundations of open learning practices. An examination of current literature has led to the authors' call for a new focus on research on thoughtful use of an open pedagogy by K-12 teachers and supportive policies and legislation.

Introduction

There is a substantial and ongoing change occurring in K-12 education. Within the last two decades the teaching and learning context has changed from analog, tethered, isolated, generic, consuming and closed to environments that are digital, mobile, interconnected, personal, creating and open (Wiley & Hilton, 2009a). With this continuing change, all levels of education have necessarily examined their practices and explored how best to respond not only to the variety and costs of educational technology, but also to the fundamental beliefs and attitudes that infuse the daily practices of educators to encourage a focus on building knowledge with and for all learners. Within Higher Education (HE), this change has been labeled as Open Educational Practice (OEP).

The K-12 education system experiences barrages of innovation challenges including calls to develop digital fluency, and to become more personalized, flexible, and adaptable to individual learner's needs. At its inception, the foundation of public education evolved from its local context. This community was first served by the historical one-room schoolhouse. The schoolhouse and the system that spawned this model of education served its public well. Today, however, the nature of community has rapidly shifted from its small, regional roots to become an interconnected, digital world of instant communications within a global context.

The structure of OEP facilitates the rapid information and societal evolutions contained within this context particularly capitalizing on networked connections and interdisciplinary learning opportunities.

Its value lies in its ability to enable educators and students to learn with and from each other through sharing and remixing the content they co-create. Such a teaching practice requires the ability to collaborate, comment together on materials, or interact with them in some way and thereby move to reusing, repurposing, and remixing. These practices are hallmarks of openness within education. What occurs in one node of this connected world is no longer isolated to its local community; today the world wide web and social media amplifies events and communications to a potentially global audience.

Defining Open Educational Practice

A common definition of open education has not been established in part due to the broad interpretation of "open" and "openness". Despite these variations, in Conole's exploration of integrating Open Educational Resources (OER) into the practice of open education (2012) she applies the OEP definition offered by the International Council for Open and Distance Education. This definition describes OEP as the practices which:

> "…support the production, use and reuse of high quality open educational resources (OER) through institutional policies, which promote innovative pedagogical models, and respect and empower learners as co-producers on their lifelong learning path. OEP address the whole OER governance community: policy makers, managers and administrators of organizations, educational professionals and learners" (n.d., p. 112-3).

Although the International Council for Open and Distance Education is describing OEP within higher education, the definition fits equally well within the K-12 context. In-service and pre-service teacher education programs are working with varying success in tandem with the use of educational technologies driving change to address the pedagogical implications of ongoing technological innovations. However, much professional development has placed an emphasis on technology integration and has thus limited the broader acceptance of a pedagogical shift represented by OEP. The institution of K-12 education, with its social purpose and perceived permanence, previously has not had to encounter such a foundational shift in practice which is more than moving to a learner-centred model to that of a technology-enhanced connected learning model. The term OEP is not prominently used in K-12 research although K-12 scholars have described similar impulses and practices to OEP as *networked publics* (Ito, Horst, Finn, Law, Manion, Mitnick, Schlossberg & Yardi, S., 2010; boyd, 2008); *connected learning* (Ito, Gutiérrez, Livingstone, Penuel, Rhodes, Salen, Schor, Sefton-Green & Watkins, 2013); *participatory culture* (Jenkins, Clinton, Purushotma, Robinson, & Weigel, 2008); and, *open learning* (Roberts, 2013b).

This array of description may continue for some time. Despite the lack of a cohesive and commonly accepted definition, the daily *praxis* of teachers within blended and online learning environments continues to evolve as a set of beliefs and applications that are perhaps best encapsulated as an *open educational practice*. This execution of a variety of knowledge, skills and abilities occur in a shared and transparent manner in which teachers and students through digital platforms can Retain, Reuse, Revise, Remix, or Redistribute the evidence and artifacts of learning with others (Wiley, 2014). Taken together these 5Rs and OEP mark a substantial shift in the age of digital teaching and learning encouraging collaboration, connections, networked learning, and interdependence among educators and learners. As the work of Wiley and other scholars suggest, because of this digital and pedagogical shift sustainable open learning ecosystems become possible, in part through promoting trust, sharing, and interdependence (Blomgren, 2017b) among educators, learners, and the broader participants of public education.

Origins of Open Educational Practice

Originally, OEP was known as *opening learning*, a movement based on the belief that learners have barriers imposed them due to a closed learning environment. Although short-lived as a term, the underlying premise of opening learning was to remove or weaken the barriers, thus opening up learning possibilities that previously were not possible. (Butcher & WilsonStrydom, 2008). These concepts continue to permeate the Open movement which now includes open software, open data and open learning. (Couros, 2006; Cronin, 2017; Roberts, 2013; Wiley 2014).

Educational theory that supports opening up learning occurs in a wide variety of educational writings and philosophies. Dewey (1938) espoused the idea of learning for all in democratic spaces and posited that it was the role of educational institutions to support and build learning experiences within these learning environments. The building of such learning environments implies that there would be groups of people *learning from and with each other*. In 1930s Russia, Lev Vygotsky, in a manner similar to John Dewey, also described learning environments as being shaped by sociocultural factors (1978). Although Vygotsky was not widely known in the west until the late 1970s, scholars since have sought connections between Dewey and Vygotsky and their independently derived yet common conclusion of the social aspects of learning (Wong, Pugh, Dewey Ideas Group, & the Dewey Ideas Group at Michigan State University, 2001).

The educational theory of Dewey and Vygotsky's linguistic sensibility have been combined to describe foundational aspects of an open pedagogy and its practice. Additionally, Paquette (2005) reinforces the social aspects of learning in OEP with the learning values of autonomy and interdependence, freedom and accountability, democracy and participation that collectively exemplify the potential of digital and open learning spaces. The Brazilian educator and philosopher Paulo Friere (1972) epitomized similar values in *The Pedagogy of the Oppressed* where he promoted access to learning for all, regardless of a set curriculum or institution, and highlighted the power of informal learning. Like Vygotsky, Friere encouraged individuals to work collaboratively and dialogically to nurture trust and respect that culminates in a mutual meaning shared amongst all participants. The emancipatory potential of OEP and public education shares in the lineage of Friere's critical pedagogy that questioned traditional, instructivist, and privileged educational approaches. Because OEP is part of the broader open movement of open source software, the open access to scientific research and its outputs, and open content with its creative possibilities, OEP can be viewed as a challenge to the educational conventions and practices well established in previous centuries.

Within Canada, open pedagogy began to gain prominence in the 1970s. One of the earliest definitions of open pedagogy, translated from French, describes this pedagogical orientation as the interrelation among three key elements: the physical layout of the classroom, the learning activities and the teacher interventions (Paquette, 1979). Similar to Dewey, Vygotsky and Friere, Paquette questioned the privilege, limited access and freedoms inherent within the status quo of the reigning educational system, and thereby sought liberty, choice and becoming a voice for change. For Paquette (2005), open pedagogy holds the following foundational characteristics: it is based on the respect of individual differences; it emphasizes the individual learner's growth within today's world; it changes the role of the teacher to an indirect influence thus contrasting to an older model that emphasizes the direct role of the teacher; and it is based on the developmentally appropriate learning outcomes for an individual.

Openness also came to the attention of psychologist Carl Rogers who influenced many progressive educators. Rogers viewed education as an opportunity for open learning experiences and in an early reference to openness, Rogers (1969) stated:

> in persons who are moving towards greater openness to their experiencing, there is an organismic commonality of value directions. These common value directions are of such kinds as to enhance the development of the individual himself, of others in his community, and to contribute to the survival and evaluation of the species (p.49).

By the mid-1980s, openness within learning theory had a loose footing in education with these ties to the past and technological changes within K-12 education brought new options to delivery models and teaching practices.

In this new context, "open learning" began to align with the concomitant rise of digital educational technology and the emerging distance education (DE) options (Bates, 2008). Prior to this point DE was limited to print based or videotape enhanced or television delivery with completion proven through snail mail channels. The computer revolution, along with the rise of online learning was now challenged time and geographic barriers. Open learning became a term to describe flexible learning or asynchronous learning. Aspects of open learning formed the basis for distance or online learning (Boot & Hodgson, 1989).

Unintentionally, this refashioned definition has caused confusion (Butcher & Wilson-Strydom, 2008). The appreciation of the potential of OEP to fundamentally shift pedagogical practice slowed. Noting this confusion and in an effort to provide definitional clarity, Butcher and Wilson-Strydom (2008) distinguished distance learning from open learning and identified the following eight principles of open learning: (1) learner-centeredness; (2) lifelong learning; (3) flexibility in learning; (4) removal of barriers to access;(5) recognition of prior learning experiences and current competencies;(6) learner support; (7) expectations of success; (8) and cost-effectiveness. Open learning therefore need not be distance and cannot be inclusive only with distance learning. Despite the usefulness of enumerating these principles, educators within all levels of education continue to conflate DE with open learning and by default onto open educational practice. (Coffey, 1988, Butcher & Wilson-Strydom, 2009).

This brief summary of the origins of open educational practice provides an introduction to its complex beginnings and serves as one description of how OEP has evolved to its current state. Following additional threads to the OEP narrative is expected and will provide further appreciation for the complexity of OEP and what it means for current and future K-12 teaching and learning environments.

Emerging Characteristics of OEP

The movement toward open educational practice is based on a set of beliefs shared by a wide range of academics (Barianiuk, 2007; Nov, Arazy & Anderson, 2011; Westera, 1999). These scholars argue that knowledge should be free and open to use and re-use; collaboration should be easier, not harder; individuals should receive credit for contributing to education and research; and that concepts and ideas are linked in unusual and surprising ways in contrast to the simple and linear presentation of a printed textbook. OEP is not a learning theory, but rather a teaching and learning method in which through teacher facilitation, learners identify and locate learning opportunities for themselves as well as create learning opportunities for others (Coffey, 2006, Butcher & Wilson-Strydom, 2008). OEP has an equity basis premised on the belief that every learner deserves access to learning choices regarding time, place, medium, and content (Lewis, 1994). Open educational practice in K-12 continues to develop its philosophical values and many educators advocate for open pedagogy and the potential to improve the quality and access to learning for all (Cronin, 2017; Havemann, 2016; Hegarty, 2015; Weller, de los Arcos, Farrow, Pitt, & McAndrew, 2015; Conole, 2013; Butcher, & Wilson-Strydom, 2008).

At its core, open learning promotes a way to learn that is still emerging and does not easily fit with current research conventions that have taken decades to evolve and be accepted. With the proliferation of broadband, mobile devices with data capabilities, easy-to-use mobile applications, data storage, and applications that operate in the cloud – in online digital repositories, servers and software – there has been considerable interest regarding learning in the 'open'. This interest has been fed by the rise of social media and attempts to close the gap between the *daily divide* (Wiley & Hilton, 2009a, p. 5) with a set of practices of the closed, resource-limited approaches that have permeated all of education in contrast to the digital, participatory, resource-abundant and resource-multiplicities of many students that occur in the non-school hours engaged in the post-digital world.

A participatory culture is an essential contributor to OEP in K-12 learning environments. Participatory cultural skills (Jenkins, Clinton, Purushotma, Robinson & Weigel, 2008) include: play, performance, simulation, appropriation, multitasking, distributed cognition, collective intelligence, judgment, transmedia navigation, networking and negotiation (p.4). Building on the conceptualization of participatory culture, Hegarty (2015), provides a description of open learning that reconnects to the original open learning ideals from Paquette (2005) and Rogers (1969). Hegarty (2015) applies Thomas and Browns' (2011) "arc-of-life" (p.19) learning and defines it as a "seamless process that occurs throughout life when participants engage in open and collaborative networks, communities, and openly shared repositories of information in a structured way to create their own culture of learning" (p. 3). Additionally, Hegarty's (2015) description of open learning within Higher Education is distinguished by the eight attributes of open pedagogy (OP) that include: participatory technologies; people, openness and trust; innovation and creativity; sharing ideas and resources; reflective practice; a connected community; learner generated content; and peer review. In the *Multiply K-12 OER* media project, Blomgren (2017b) with the assistance of the subject matter expert Verena Roberts, adapted Hegarty's eight principles for a K-12 context. In the videos and podcasts produced, various educators ranging from beginners to experts in OER implicitly discussed these principles. Additionally, they noted the unique K-12 context where students are still growing in maturity and are also minors under the law. OEP adaptation from HE with the freedoms that post-secondary students hold must be considered when discussing OEP for a K-12 context and is an area strongly needing prompt attention by policymakers, researchers, and the K-12 profession.

The K-12 move toward design thinking and its teacher facilitation has been steadily growing. Design thinking and its related approach, project based learning (PBL), both involve the consideration of, "real-world problems, research, analysis, building by hand, and lots of experimentation, documentation, and sharing" (Barseghian, 2015, para 1). Young children and adolescents participate in the design of projects. The process of design itself in an artifact of learning. Designing for participation "position(s) learners as active members of epistemic communities; capitalize(s) learners' funds of knowledge as resources for learning; situate(s) learners in authentic practices; create(s) public learning artifacts for progressive knowledge construction; and encourage(s) technology use for learning about content, creating artifacts, and becoming a member in a participatory learning community" (Kim, Tan & Bielaczyc, 2015, p.552). Although situated within HE, Conole (2013) describes learners' application of digital and social technologies in which they experience and interact through peer critique, user-generated content, collective aggregation, community formation, digital personas, and blurring boundaries.

Baraniuk (2007) asserts that open learning promises to fundamentally change the way authors, instructors, and students interact worldwide. In open learning experiences while the teacher developing the experience might have a purpose and learning outcome in mind, the learner engaging in those experiences may have a different yet equally valuable outcome than the one expected in the initial instructional design. Unlike a closed educational environment, such discrepancies are no longer lost nor nullified but with open practice are valued, expected and capitalized upon.

It is anticipated that through the power of learning networks, OEP will catalyze institutional change and invoke a critical review of conventional pedagogical approaches. Because of its interdisciplinary approach, design thinking includes an extensive variety of methodologies, disciplines and perspectives, and creates authentic situated learning opportunities for K-12 students thus aligning with the philosophies and learning theories that support openness in learning. There are potential research opportunities to critically examine learning design and design thinking as part of OEP.

For this chapter, we have created an image to help describe the interconnections among: open educational practices; open educational resources; network feedback and interactions; designing for open educational practices; and, learner openness levels. These interconnected open learning indicators are influenced by the learners' connection to networks and the feedback they receive through their interactions and relationships with other learning nodes.

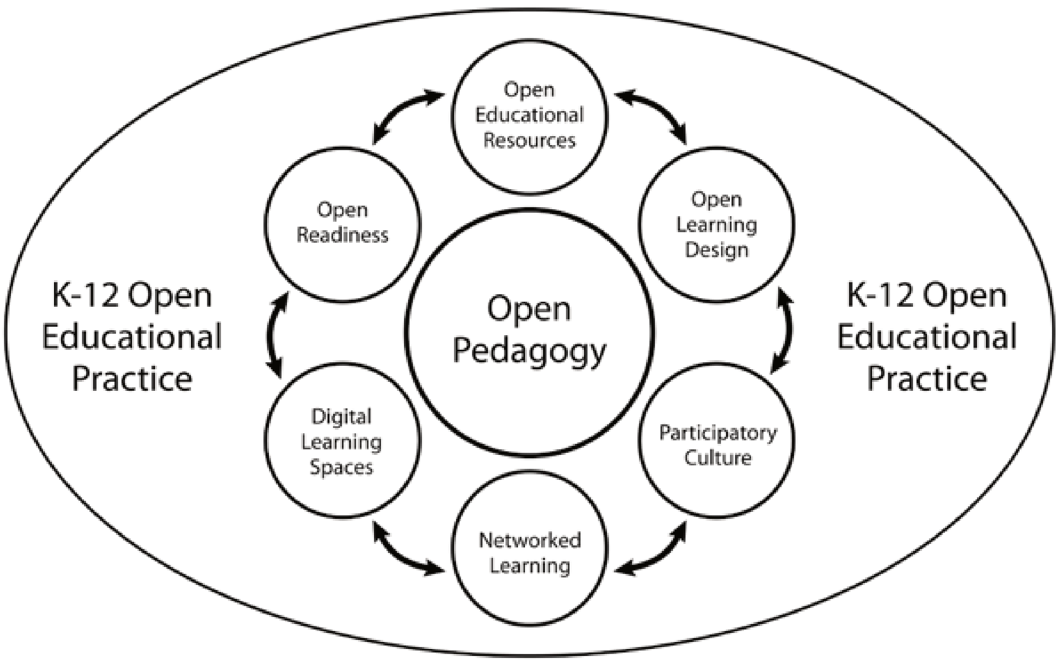

Figure 1: K-12 Open Educational Practice

Current research describes the potential for K-12 open educational resources and designing for OEP and K-12 networked learning; however, there is limited research exploring K-12 teacher and learner openness levels. This void thus requires current Higher Education research to temporarily influence the gap. Examining the relationship between openness and praxis by university educators, Cronin (2017) identifies four OEP use levels that determine the extent and manner of OEP praxis:

Macro – global level (Will I share openly?)

Meso – community/network level (Who will I share with?)

Micro – individual level (Who will I share as?)

Nano – interaction level (Will I share this?) (pp. 25-26)

Cronin's OEP and praxis research encourages future researchers to examine K-12 teachers and learner's attitudes toward the traits of openness as part of OEP. However, because of the age of the learners in K-12, the decisions regarding the manner, degree and strength of sharing would rest with teachers, school based administrators, and district decision makers.

In addition to Cronin's (2017) research, open digital spaces have been recently explored by White & White (2017) using a third space theoretical basis from a Higher Education perspective. This research points to another gap, one that describes the safe spaces that are considered proximal zones of development in which young students can learn in the open (Vygotsky, 1978). This is only one of many possible research topics that will add to this nascent area of educational thought. Because of ties to the digitized economy and the daily lives of people it is reasonable to believe that OEP and its related research results will permeate educational policy and will continue to change pedagogical actions and thinking.

Open Educational Resources (OER)

The umbrella of OEP covers Hegarty's Open Pedagogy (2015), network interactions and feedback, levels of openness, designing for openness and the most commonly discussed, open educational resources (OER). In 2012, the UNESCO Paris declaration called upon national governments to make publicly funded educational materials openly licensed. To help reach the UNESCO millennium development education goals, OER are a key piece to achieving success and K-12 OER growth is occurring throughout the globe. UNESCO defines OER as "any type of educational materials that are in the public domain or introduced with an open license. The nature of these open materials means that anyone can legally and freely copy, use, adapt and re-share them. OER range from textbooks to curricula, syllabi, lecture notes, assignments, tests, projects, audio, video and animation" (UNESCO, 2017, para 1). For the K-12 context, the granularity of openly licensed learning objects is frequently smaller than what is discussed in HE (Blomgren, 2017d) where discussions and research currently focus primarily on textbooks and the associated cost-savings of OER for post-secondary students.

According to Wiley (2014), to be considered an open resource, an Open Educational Resource should include the following five Rs of Openness: [block quote]

- **Reuse**: the right to use the content in a wide range of ways (e.g., in a class, in a study group, on a website, in a video);
- **Revise**: the right to adapt, adjust, modify, or alter the content itself (e.g., translate the content into another language);
- **Remix**: the right to combine the original or revised content with other open content to create something new (e.g., incorporate the content into a mashup);
- **Redistribute:** the right to share copies of the original content, your revisions, or your remixes with others (e.g., give a copy of the content to a friend);
- **Retain**: the right to make, own, and control copies of the content (para. 12). [block quote]

These characteristics of openness for OER promote a collaborative learning culture that encourages the building and sharing of knowledge (Conole, 2013). Instead of the restrictive copyright license that has dominated in the previous century, the 5 Rs of openness affords to K-12 teachers access to an open pedagogy and open educational practice. By using public domain content and Creative Commons (CC) licensing teachers and learners demark how they would like to have the resource reused, remixed or shared, thereby providing permissions associated with the CC license selected. Unlike the more familiar licensing regime, there is no need to contact and request copyright permission as it is inherent within the CC license that travels with the resource.

OER are distinguished by being found in the public domain (free content to be used without any restriction, ownership and not under any copyright law) or by a Creative Commons license designation . Creative Commons licensing was developed in 2002 and allows creators to retain copyright and to receive attribution for the work created if they wish. Depending on the license selected by the creator, the license may allow others in the sharing and participatory culture to copy, distribute or use part of the entire work with or without attribution. Creative Commons licensing has supported

K-12 learning environments by ensuring access to educational resources for teachers and learners all over the world who would have previously faced a complicated permission process or would have been denied access to materials.

Current K-12 OER Research

Current research regarding the benefits of OER mostly focusses on Higher Education and not K-12 learning environments (Kimmons, 2015). However, K-12 OER research is developing, including an exploration into the cost effectiveness and potential of substituting open textbooks for publisher-restricted textbooks as it relates to students' successful standardized test scores (Wiley, Hilton, Ellington, & Hall, 2012). Although much more research needs to be completed, preliminary discussions among practitioners and scholars (Blomgren, 2017c) suggests that OER adaptation and remixing helps teachers better meet the needs of students.

Research also indicates a connection among the benefits of using or adapting open resources and student learning. Tammets & Pata (2014) focused research on the implementation of a technology-supported learning and knowledge building framework across organizations to create an extended K-12 professional community. This framework applied the concept of the knowledge creation SECI model from Nonaka and Takeuchi (1995) based on systems thinking. Since 2002, the William and Flora Hewlett Research has supported and invested in the access to OER for all learners, OER awareness, and use of OER by educators. This foundation continues to sponsor research projects linking K-12 OER with their benefits to education (William and Flora Hewlett Foundation, 2013). In 2014, Kelly examined K-12 teachers' OER perceptions and found that teachers support the use of OER. Additionally, this research indicated that the ease of use and design of the OER is a primary reason for teachers to consider changing their practice. In an extensive global research project, further investigation into K-12 teacher perception of OER (de los Arcos, Farrow, Pitt, Weller & McAndrew,2016) found that teachers adapt rather than just adopt OER and there is a connection to personalized, authentic learning opportunities for teachers and students as a result of their OER adaptations. Open educational resources activate teacher collaborations and discussions regarding new practices, and support various forms of innovation in teaching and rethinking resource development (Petrides, Jimes, Middleton-Detzner & Howell, 2010). In terms of supporting a pedagogical transformation, this research explored how "OER, as digital and dynamic resources, have the potential to enhance teaching and learning practices by facilitating communities of teachers who collaborate, share, discuss, critique, use, reuse and continuously improve educational content and practice" (p. 2). In a similar manner, Tonks, Weston, Wiley, & Barbour (2013) described an increase in student empowerment as a result of the ability of their teachers to personalize course content in an OER based school. As part of open pedagogical methods, teacher digital literacy and instructional design skills also improve because of the need to, apply the 5Rs of openness in order to create or repurpose existing OER (Conole, 2013; Tonks, Weston, Wiley, & Barbour, 2013).

Kimmons (2015) examined K-12 teacher's perceptions of OER and their willingness to consider using OER rather than copyrighted textbooks. The teachers within this study demonstrated clear evidence of applying the 5Rs of openness demonstrating that using OER and application of the 5Rs are not an uncomfortable shift for K-12 educators. His further research, which was as a result of a professional development summer open education institute and open Professional Learning Communities (PLCs) demonstrated that "participants uniformly believed that openness offers pedagogical, economic, and professional potentials for practice, but that major barriers to diffusion exist at the macro and local levels, due to the political and economic realities of the teaching profession" (Kimmons, 2015, p.4). Kimmons suggests that the potential of OER will not be unleashed until policy makers and educational leaders consider OER in terms of its potential to transform the process behind how teachers teach, rather than considering it a cost effective substitution for classroom content thereby misrepresenting the concept of what openness authentically means (Kimmons, 2015; Petrides, Jimes, Middleton-Detzner & Howell, 2010). Educators who value the creation and use of OER in Higher Education environments do so for several reasons: A belief in importance of academic voice over commercial market forces; an acknowledgement of the importance of rapid dissemination of information for development and research purposes; and, an awareness of the enhanced reputation and publicity that might result from creation of OER (Hylén, 2009). Within K-12, Blomgren (2017d) identifies the benefits to include teachers' abilities to differentiate and personalize learning activities; expression of teacher creativity; contextualizing curriculum; supporting the development and sharing of learner-generated content; and extending professionalism through a network of teacher colleagues. Additionally, Tonks et al. (2013) assert that when teachers are expected to create, remix, and update their own curricular resources the role of teacher becomes professionally stronger, and less managerial (Gur & Wiley, 2007).

Throughout the USA and beyond, notable examples of OER projects for various purposes exist. For use by K-12 students and teachers are Curriki (www.curriki.org), CK-12 (www.cK-12.org), OER Commons (www.oercommons.org), Open Up Resources (https://im.openupresources.org/) and Khan Academy (www. khanacademy.org). The OER Research Hub (http://oerresearchhub.org/) consists of a group of researchers and institutions compiling research into the impact of OER in education. Their research site (http://oermap.org/) provides a comprehensive consolidation of OER research, policy, and links to resources about OER. The site includes a map outlining the impact of OER in Higher Education and K-12 and includes compilations of OER policy by country/location, links to lists of OER projects, and other emerging practices.

Cautions and OER Use

A caveat in the use of OER, as noted by Baraniuk (2007) concerns the challenges regarding reuse. Many open resources restrict reuse by requiring software and certain publishing formats such as Adobe's Portable Document Format (PDF) or Microsoft's Word, or a host of other software. There may be user restrictions that do not allow for easy remixing of content into other forms or require proprietary tools in order to do so. In order for a resource be truly "open" little or no restriction would be present. The same situation often occurs with repositories of OER that require registration and are restricted to particular groups or organizations. It is possible to create repositories built entirely on open source formats populated by open resources. However, given restrictions on ease of use, lack of collaborative features, and an entrenched user base it is more common for educators to use cloud-based applications and services, especially in K-12 districts and organizations.

Bliss et al. (2013) argue that the transformation of K-12 environments to open learning requires sharing and a collaborative environment within which to do so. As educators turn to participatory approaches to foster trust and understand user needs, practices take on a variety of forms. Each of these forms, however; share the ability for participants to collectively negotiate the agenda and activities, ensuring the potential for voice and engagement. Emerging policy initiatives of competency-based and personalized learning, along with common curriculum standards, are driving the need to share learning materials simply and easily between and among educators within and beyond state or provincial boundaries. In most classroom environments whether online, in a regular classroom or a blend thereof, teachers require more granular, searchable outcomes-based learning materials. Being able to locate and select applicable components of a resource is essential to maximizing the potential of OER. Without intuitive organization tools such as tagging, curating, and remixing, OER could become a colonizing monolith – the antithesis of openness and OEP.

It is important to distinguish OER from learning objects and open source software. While both OER and learning objects are designed for sharing, learning objects are seldom publicly accessible as they are in a Learning Object Repository (LOR), and by nature most LORs are proprietary – not necessarily free for public use (Robertson, 2010). LORs may house both OER licensed for public use and sharing along with learning objects licensed for use by a restricted audience. As a result, many learning objects are housed in closed repositories thus losing the 'open' from the education resource. Open source refers to open coding within a technology product or process, and is often collaboratively built code, produced within a shared group. The learning system Moodle (http://moodle.org) is one example of an open source product, and Moodle could be the vehicle for sharing and delivering content that may include OER or proprietary, closed content.

Effective teachers adapt and share materials to meet the needs of their learners and the learning environment. The flexible licensing inherent in Creative Commons-licensed OER provides the opportunity for students to remix content: an important advantage in engaging students in their own learning and personalizing their education. OER allow teachers to tailor curriculum to meet individual student needs without the traditional obstacle of textbooks and curriculum written for a more generic audience. Use of OER principles for the development of curriculum has the potential to enhance the development and adoption of new curriculum while shifting the cost of resource support from educational publishers to now include the development of OER. Frequently OER, because they are perceived as being free, are conflated with no or fewer costs for public education. This inaccuracy could work against establishing the supports that OER sustainability requires. Instead, the viewpoint of the wise use of public dollars makes a stronger argument in favour of OER.

The challenge for educators in using open learning materials and content is that the transitory nature of the Internet creates a mixed blessing. On one hand, the Internet can be an empowering tool that allows individuals to create, share, connect, and learn with other like-minded individuals around the globe. On the other hand, open, digital teaching and learning provides challenges for educators who want to bring this into their classroom. Skills in open digital literacy increase the opportunity for this to occur. At the same time, there are questions about the credibility, value, reliability, and permanence of access to online materials (Salmon, 2004; Zhang, 2001). As well, with many online sources there are challenges regarding sourcing, and credibility. Many online sources do not reveal an audit of changes or revisions to the information presented (Flanagin & Metzger, 2000; Alexander, 2006). As a result there is a certain reticence on the part of K-12 educators and administrators to use and share open learning resources (Weller, de los Arcos, Farrow, Pitt, & McAndrew, 2015). For the most part, literature on the use of open learning in K-12 settings is still focusing on defining and then detailing the affordances of open learning and OER (Cavanaugh, Barbour, & Clark, 2009). There is an understanding that online and digital literacy are important to the future of students (Warschauer, 2007), and open learning experiences may hold part of the solution (Atkins, Brown, & Hammond, 2007)

In K-12 education there is often a privileging of traditional or offline texts (Alvermann, 2002) and a conventional belief that textbooks, magazines, or newspapers are a more credible and valid source than online, digital sources (Abdulla, Garrison, Salwen, Driscoll, & Casey, 2002; Metzger, Flanagin, Eyal, Lemus, & McCann, 2003). This privileging is extended when the creator or publisher of the online digital material is not well known or accredited (Forte & Bruckman, 2006; Tapscott, 2009). Additionally, there is an assumption that because something is printed in a book, magazine, or newspaper it has been fact-checked, and has to be true. For the most part, and especially in the case of open, digital content, the review and value evaluations are less clear (Lynch, 2003). These challenges are exacerbated as students take on new responsibilities when reading and writing in the open. They take a more engaged role in their learning (Moreno & Mayer, 2000), acting in a leadership role as they craft and revise new learning processes and products. However, given these new opportunities, there are concerns regarding ownership of content, and recognition of intellectual property as students and educators write and share content openly online.

Adoption of OER, because of Creative Commons licensing, reduces risks and legal costs for educational institutions, as school districts no longer need to monitor 3rd party copyright restrictions thus lowering risks of copyright vulnerability. Within an open educational practice, teacher copyright vigilance subsides because with CC licensing they can copy, share and remix without worry. Bliss, Tonks & Patrick (2013) stated this well: "By sharing publicly funded learning materials … we can move away from 're-creating the wheel', enabling sharing and collaboration with learning materials, resources, and professional development" (p. 2). Open educational resources have the potential to provide equitable access to high-quality, openly licensed content as well as give school districts local control over instructional materials and also support educators as creative professionals.

K-12 OEP Innovations

#GoOpen: OER in U.S. K-12 Education

In late 2015, the U.S. Department of Education responded to President Obama's ConnectED initiative that called for equitable access to high-speed broadband connectivity in all schools, devices and software, professional learning, and high-quality, affordable digital resources. The initiative called #GoOpen developed a national movement that supported states, districts, and educators transitioning to the use of open educational resources.

Launched on October 29, 2015 at the Open Education Symposium, an event that brought together district and state leaders, nonprofits, foundations, and private sector companies, #GoOpen brought K-12 OER into the limelight. The 2016 and 2017 #GoOpen Exchanges brought stakeholders together to share best practices and implementation strategies, as well as discuss research needs and strategic planning for sustainability. Since July 2016, nine districts across the USA have hosted #GoOpen Regional Summits to facilitate conversations between districts and share best practices for using open educational resources, reaching nearly 1,500 educators from more than 250 school districts. Taking many of these lessons learned from districts, the Office of Ed Tech released the #GoOpen District Launch Packet which is the initial guide for a school district when strategically adopting and maintaining open educational resources as an integral part of the district's curriculum plan.

As of August 1, 2017, 110 districts have committed to transitioning to the use of open educational resources to replace traditional, static instructional materials. Additionally, 20 states have committed to providing guidance and leadership for districts making this transition, as well as developing a statewide repository to search and discover resources. Because of their size and importance to K-12 teachers and administrators, states and districts are powerful collaborators in supporting and scaling innovation. They can connect educators, facilitate sharing of effective ideas and approaches, amplify successes, and support school leaders in leveraging limited resources to make lasting change. The mentorship and collaboration among #GoOpen states and districts is laying the foundation for a strong community that will continue to grow and sustain OER efforts into the future.

#Gamifi_ED: Designing for K-12 Open Learning

An example of OEP K-12 instructional design that emerged in an authentic collaborative, participatory, and networked environment was #Gamifi_Ed. This project ran from January-April 2013 and occurred because of the generative possibilities that participatory platforms such as Twitter enable.

In the fall of 2012, two educators were tweeting about possible projects using Twitter as a connectivist tool to explore the nodes of learning and their networks which can take a variety of unanticipated forms (Ito et al. 2013). The serendipitous Twitter discussion focusing on a networked project based on the novel *The Hunger Games* (Collins, 2008) pivoted when a professor of graduate Education students suggested a project that would explore Minecraft and gaming. The professor then bridged the boundaries between Higher Education and Grade 9 by connecting with an experienced, connected K-12 educator who suggested a networked project about serious games. From these tweets, #Gamifi_Ed emerged and it was initially evident that an iterative and flexible instructional design process was necessary to ensure all learners felt heard, that learners could risk making mistakes, and that all learners could appropriate the learning interactions based on their personal learning contexts. The two educators created a team of facilitators, which included an expert in Minecraft and an open learning consultant. Four facilitators, who were also learners throughout the project, each had specialized skills and would eventually lead learning activities that were integrated throughout the phases of the networked project, supported all of the learners in different ways. The actions of the facilitators were interconnected and the skills and competencies that each facilitator contributed encouraged a collaborative culture of individuals who were dependent on each other (Conole, 2013; Resnick, 2007).

The organization of the #Gamifi_Ed design process also demonstrated a learning design process (Conole, 2013). Learning design enables:

> …teachers/designers to make more informed decisions in how they go about designing learning activities and interventions, which is *pedagogically* informed and makes effective use of appropriate resources and technologies. *A key principle is to help make the design process more explicit and shareable* (Conole, 2013, p 7-8) [emphasis added].

Although these skills, knowledge and abilities inform the professional practice of many teachers using OER and employing attributes of an OEP, the conceptual move from a conventional instructional method to the attributes of a learning design process are not specifically called out nor labelled as design thinking. Additionally, the current landscape of K-12 educational research houses a void of recognizing or pursuing this shift in educational practice and its implications for OER and OEP.

The initial facilitator meeting ensured that there were goals and expectations for each project phase. Initially in phase one, both the grade 9 student and graduate students worked on the same problem solving activity which determined how to develop a peer reviewed encyclopedia of serious games. While building content knowledge together, the graduate students and grade 9 students also worked on separate activities focused on game based learning that were scaffolded to meet their personal learning needs. The grade 9 students were split into a wikispace guild where all learners contributed to the design and organization of open educational resources (OER). Learner-generated OER content was also being created by the graduate students who co-edited the wikispace and contributed to the development of shared project meanings by collecting their blog URLs and adding them as examples of personal learning narratives.

Throughout all the phases, the open learning consultant connected with global gaming experts to record interviews in Google Hangouts for possible asynchronous course content. This interview content was ready when needed for the two intergenerational communities as they intersected their learning trajectories through developing the wiki (Conole, 2013; Ito et al., 2010, Jenkins et al., 2008). The recorded Hangouts sessions meant they could be used for OER content-creation and were perceived as a risk-tolerant space for the facilitators and students to synchronously connect and learn with the interviewers. The experts interviewed included a range of contributors with expertise from Higher Education professors, to gaming creators, gamers, YouTube gaming video creators, and K-12 students. This range of contributors exemplify the boundary crossings between Higher Education, K-12, and the real world (Ito et al., 2010) that are possible with participatory technologies used in tandem with OEP. The wiki, the online and face-to-face classrooms, and the Google Hangouts expert interviews were all examples of cognitive and process artifacts that created and extended proximal zones of learning development where learners, peers, teachers, and experts connected and scaffolded individual learning opportunities for learners around the world (Vygotsky, 1978).

Phase two of this learning design process involved an introduction and exploration of Minecraft by the Grade 9 learners and the graduate students, which also included extensive peer feedback (Conole, 2013; Jenkins et al, 2008). After initial scaffolding and basic training to learn Minecraft, all students were now encouraged to learn together in a virtual space. As a result of the scaffolded collaborative learning experiences in developing a serious games encyclopedia, it was assumed that all of the learners would have a shared meaning of social roles and expectations in this unique collaborative project. However, because all learners were equal and everyone scaffolded the learning for each other by collectively developing shared meanings, it became clear that all meanings to describe norms, behaviours, and expectations in a Minecraft community were not shared. After initial conflict in trying to collaboratively create shared societal norms, Minecraft's virtual learning design eventually afforded the ideal signs and limitless boundaries to mediate the interest, motivation, and engagement for all learners while ensuring equity for all. The graduate students had an additional activity which involved creating a video based on game based learning with *The Hunger Games* as the core of the learning activities. In phase two, the grade 9 students demonstrated greater experience and expertise in Minecraft than the graduate students. Although the graduate students were required to connect their #Gamifi_Ed learning to a graduate level assignment, the grade 9 students scaffolded the Minecraft experiences for the graduate students, thus enabling the graduate students to design stronger transformational learning opportunities for students within their respective classrooms. Minecraft activated a zone of proximal development for all #Gamifi_Ed project learners because the graduate students willingly accepted the help and support of the grade 9 students (Ito et al., 2010; Vygotsky, 1978).

Phase three included a celebration of learning for the #Gamifi_Ed students. The grade 9 students voted and gave feedback on the video game pitches that they would like to see created. The graduate students used Google Hangouts to listen to the grade 9 students as they presented their examination of serious games and learning throughout the project. In addition, K-12 students who had been invited to complete interviews and other K-12 teachers and their students who had been following the project also presented their learning to the grade 9 and graduate students. #Gamifi_Ed proved that it was not only a project which focused on two classes with four facilitators. By the end of the project, students, experts, and participants from around the world contributed their knowledge into building something bigger than any one individual could ever achieve. This project exemplifies an emerging open design of intergenerational and connected learning for all (Conole, 2013; Ito et al., 2013; Ito et al., 2010; Jenkins et al., 2008). ; Vygotsky, 1978; Dewey,1938) and highlights the contributions and interactions among the eight attributes (Hegarty, 2015) of an open pedagogy.

There are a variety of factors that influence the potential for deeper and more meaningful learning opportunities and development of identity for K-12 learners as a result of access to openly networked learning like #Gamifi_ED. White and White (2016) describe a third space design (i.e. wikispaces and Minecraft in the #Gamifi_Ed project) to create a design space where multiple stakeholders within a framework process build relationships while learning and collaborating together. Soulis & Nicolettou (2015) suggest that the learning design for digital environments consider the elements of design thinking, teacher as learner, and learner as designers and all elements as part of a flexible and agile process.

Alternatively, a practice-oriented design framework is the Stanford dSchool's Design Thinking Protocol which includes five phases: empathize, define, ideate, prototype and test (Plasso, n.d.). Other open collaborative design research suggests a framework such as Conole's (2013) 7Cs of Learning Design Framework: Vision (*conceptualize*); Activities (*create, communicate, collaborate, consider*); Synthesis (*combine*); and Implementation (*consolidate*). Designing for learning in K-12 learning contexts is described in the #Gamifi-ED example and highlights that there is vast potential in designing K-12 digital learning spaces through openly networked learning as part of an open educational practice.

Designing for an Open Educational Practice

Designing learning experiences as part of OEP differs substantially from traditional instructional design whether this is lesson planning by teachers or by instructional designers who develop online courses. By virtue of the experience of being open, and possibly more informal, teachers and instructional designers may have minimal input as to the way the knowledge gained from the learning experience will be used, or to the extent the participant will engage or persist in the learning experience (Nov et al., 2011).

Common OEP Design Hindrances

Decision making that focuses on specific technologies rather than on pedagogy has been identified by Couros (2006) as a barrier to adopting an open pedagogy including a general lack of awareness and understanding of OEP and OER in the K-12 sector. OER scholars based on their observations and experiences identified additional concerns for teachers when considering and designing for an open pedagogy (Blomgren, 2017a) that included teacher apprehension concerning the tenets of openness or a lack of confidence in the technology skills required. Another barrier identified was that of teacher perceptions regarding technology use and its interoperability. Loss of a competitive edge when giving away resources to less capable colleagues can involve financial loss in districts that apply merit pay and the associated loss of power and control over creative products can also be viewed as a hindrance. Although these are notable considerations in the instructional design process that is part of OEP, individually nor collectively these barriers are not insurmountable.

Unlike an adult learning environment, learning in K-12 generally takes place in structured settings, overseen by a teacher, has defined objectives for student achievement, with an curriculum determined by various stakeholders (i.e. curriculum in the USA is determined at the local and state level with limited federal influence in contrast to Canadian provincial governments determining K-12 curriculum). While student choice and autonomy are important to an open learning environment, this autonomy is significantly controlled in the K-12 environment simply by the nature of the curricular and policy demands of the educational system. As a structured environment, open pedagogy in K-12 takes on different and unpredictable outcomes due to controlling influences that do not exist in Higher Education and adult learning environments (Roberts, 2013). In Canada, examples of emerging OEP include educator professional development opportunities and networked student learning (Roberts, 2013) but as with all areas of K-12 OEP more support and research is required to further understand the instructional design needs of face-to-face, blended and online open educational practice.

OEP and Digital Learning Environments

While research in Higher Education and adult learning environments has embraced concepts related to OER and the tenets of open learning, similar and current research in K-12 is limited or non-existent. In fact, any research on online or distance learning in the K-12 sector is limited (Barbour & Reeves, 2009; Cavanaugh, Barbour & Clark, 2009). According to Cavanaugh et al. (2009) the current research in K-12 has focused on defining distance learning and its current strengths and weaknesses. However, many K-12 classrooms, both online and onsite (traditional school-based classrooms) are incorporating technology-supported open educational practice. Rice (2009) used a Delphi method to conduct extensive research in K-12 online learning and suggests that while there is clear evidence for priority research in online course design and online best practices, little has been done. According to Rice, (2009) priority areas for research include defining best practices, evaluation of course design, delivery, access, and teacher training and accountability. Although the 2014 New Media Consortium Horizon Report for K-12 supports a call for further study to evaluate innovative learning models, such studies have not yet been reported.

As OEP evolves in K–12 environments, blended learning environments are emerging and hold a great deal of promise. According to Horn and Staker (2014), as cited on the Clayton Christensen Institute website, blended learning occurs as part of a formal educational program and encompasses: [block quote]

> 1. at least in part through online learning, with some element of student control over time, place, path, and/or pace;
> 2. at least in part in a supervised brick-and-mortar location away from home;
> 3. and the modalities along each student's learning path within a course or subject are connected to provide an integrated learning experience. (para 1). [block quote]

Through blended learning, classroom teachers are extending classroom learning into the online environment, creating digital learning opportunities outside of, and integrated with, the classroom. Means et al. (2010) conducted a meta-analysis of available research in blended environments and assert that they demonstrate a higher level of effectiveness than fully online or fully face-to-face environments. In addition, they found that when online courses are either teacher directed or contain a great deal of peer-to-peer support, the effectiveness of the approach is greater than courses that use a purely independent study. Because of the conflation of technologies and the eventually narrowing of the daily divide, blended learning approaches that combine the best elements of online and face-face instruction are likely to emerge as the predominant teaching model of the future. Blended learning can be a catalyst for change as it encourages the use of Web 2.0 technologies and enhances student collaboration (Watson, 2008). Students that work in a collaborative K–12 blended learning environment also have the opportunity to create or expand their own personal learning, leading to enhanced formal and informal learning (Horn & Staker, 2014).

Despite its attractiveness and practitioner use in many educational contexts (Mahwah, Picciano, Seaman, Shea, & Swan, 2012; Staker, Chan, Clayton, Hernandez, Horn, & Mackey, 2011), research in blended learning environments lags behind its current K–12 use (Means, Toyama, Murphy, Bakia., & Jones, 2010; Drysdale, Graham, Halverson, & Spring, 2013). Additionally, research in blended learning may be problematically categorized as online learning research and it is for this reason that Picciano and Seaman (2009) emphasize the need for researchers to differentiate between distinctly online environments and distinctly blended learning environments and should classify their research accordingly.

Conclusion

The emergence of open learning practices in K–12 education has numerous implications for policy makers and teachers' professional practices. From acceptable use policies and digital literacy, to the ownership and use of open educational resources, educational stakeholders are challenged to keep up with the rapid and emerging world of technology-driven online, networked, and open learning.

Because of the nature of K–12 education, there are moral, ethical and legally binding considerations for K–12 students. Legislation and school policies affect how educators include learners in online networks as school officials are required to protect students' identities and personal data. While Cronin (2017) identified levels of sharing openly based on a practitioner's personal beliefs and values, K–12 educators in addition have legislation and policies to follow when considering open educational practice. Open learning spaces are not always safe nor appropriate environments for K–12 students for a wide variety of reasons. However, walled gardens that restrict access provide scaffolding opportunities for open learning and may thus enable K–12 learners, as they grow and mature, to encounter a continuum of open learning experiences. Understanding open educational practice as a set of actions and processes that differs from its historical predecessor requires more than a superficial acceptance of educational technologies and a belief that OER are free resources. As the #Gamifi-ED project illustrates, the *Multiply K-12 OER* media explores, and the #GoOpen initiative encounters, open educational practice disrupts conceptions of K–12 education as a staid endeavour and highlights the complexities involved to move toward open educational practices.

The previously unchallenged continuity of education has been disturbed. Educational technologies in combination with participatory actors can no longer be asked to endure the daily divide. Face to face, blended and online teachers cannot individually build the bridge to open educational practice. They require extensive and immediate support through relevant research, perceptive policy development and recognition that education cannot be slow to change.

Open educational practice offers an opportunity to bridge the gap between what is being learned at home and school by bridging the networks between informal and formal learning environments (Ito et al., 2010). Educators need to promote students' engagement in their own learning and the various environments in which it occurs. Through the thoughtful use of an open pedagogy by K-12 teachers and supportive policies and legislation, an open learning environment with thoughtful open educational practice, offers students an opportunity to personalize their learning and to make it meaningful, authentic, and engaging. Open learning creates the opportunity to offer network participants a chance to connect and learn together so that collectively we may use openness as a means to facing our future.

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Virtual Reality and Augmented Reality

Enrico Gandolfi

Abstract

This chapter provides a wide overview of Augmented Reality (AR) and Immersive Virtual Reality (IVR) in education. Even though their role in K-12 online learning and blended environments is still at an early stage, significant efforts have been made to frame their core affordances and constraints, and potential future developments are outlined. Therefore, in the following pages AR and IVR are introduced along with significant research and highlights from scholars and practitioners. Furthermore, a reflection about current challenges and next steps in terms of policies and integration is provided. Additionally, suggestions to help inform further investigations and inquiries are shared. Despite high costs, inadequate pedagogies, and continuously developing technology, these tools can provide a significant opportunity for immersion and will play a key role in future educational settings; therefore, scholars and practitioners need to be properly involved and trained.

Introduction

Virtual reality (VR) and augmented reality (AR) can be considered two sides of the same coin. They both aim to extend the sensorial environment of an individual by mediating reality through technology. The former relies on an alternative setting to experience, while the latter improves existent elements with additional layers of meaning. Recently, these technologies have been thriving. According to the Augmented/Virtual Reality Report 2017 (Digi-Capital, 2017), the VR/AR market should reach $108 billion revenues by 2021, while an overview by Goldman Sachs (2016) suggests a business of $80 billion in 2025.

VR is strongly associated with the development of personal computers and digital simulations. The idea of an alternative reality to inhabit was advanced by Morton Heilig with his *Sensorama* installation in 1962. This mechanical machine allowed spectators to watch short movies while having multiple senses involved (sight, hearing, touch, smell). Since then, computational developments supported the creation of increasingly advanced technology-mediated environments. Milestones of this path were the first head-mounted display (HMD) device by Ivan Sutherland and Bob Sproull in 1968, the *Aspen Movie Map* simulation developed at MIT in 1978, and the work of Jaron Lanier and his company VPL Research, which explored how to combine sensorial inputs to virtual settings in in the 1980s. VR has spread and been reformulated through several waves of innovation. Its features and traits are constantly changing, and socio-economic factors have affected its definitions and scope. In the last 30 years, virtual worlds and immersive virtual reality (IVR) have emerged as trending topics. The former is connected to the rise of the World Wide Web 26 years ago, outlining shared virtual environments where users can interact with each other. Multi User Virtual Environments, virtual worlds, and massive multiplayer online (MMO) settings are glaring instances of such a phenomenon, which highlights the social dimension of VR. From textual MUDs (Multi-User Dungeon) to recent MMO worlds, virtual spaces have become popular and highly sophisticated, providing tools for cooperation, distance learning, and social relations (e.g., *Second Life*) (Merchant et al., 2014; Pellas, 2016; Reisoğlu et al., 2017). The latter aims at a multi-sensorial involvement by the user.

While common VR is experienced though a screen (i.e., Desktop VR or DVR), IVR tries to take a step forward by enriching the feeling of "being-there" (Freina & Ott, 2015). As observed by Lorenzo, Pomares and Lledó, "Compared to conventional VR environments, in IVR systems the student is completely surrounded by the environment and constantly receives stimuli and has the possibility to interact with it" (2013, p. 89). The first CAVE – i.e., a room with computer-generated elements that users visualize with special glasses/HMDs – (developed by Carolina Cruz-Neira in 1991) represented a turning point in this direction, and now multiple strategies can be deployed for obtaining such an outcome, from covering the whole sight rotation (e.g., HMD systems) to reproducing vibrations (haptic media) and environmental sounds (3D sound). Devices like Oculus Rift, HTC Vive, PlayStation VR and Google Cardboard/Daydream (etc.) lead the way of such an innovation, but it should be argued that *immersive* is a contextual and fluid attribution, which relies on expectations and technological trends. What was immersive yesterday is not today, and what it is immersive today will not be tomorrow.

While AR and VR share origins and premises, AR has undertaken a different path. Rather than focusing on a divergent setting, it relies on improving a real element through technology. AR can be interpreted "as a view of a physical, real-world environment whose elements are integrated with computer-generated sensory input" (Freina & Ott, 2015, p.3). The objective is to "see and experience the real world mixed with various virtual objects, without losing the sense of reality" (Persefoni & Tsinakos, 2015, p.45). An intuitive example is the hologram (e.g., in *Star Trek* TV show or in the movie *Minority Report*), and now several mobile apps enrich our surroundings with geolocated information. The term of AR was suggested in 1990 by the Boeing researcher Tom Caudell, and then in 1994 the first AR theatrical dance – Dancing in the cyberspace – was performed. Then, NASA and the U.S. Army spent pointed efforts in bringing AR's potential to reality (e.g., X-38 spacecraft- HSV system; Battlefield Augmented Reality System). Recently, the release of the free AR kit *ArToolKit*, the rise of geolocation and the miniaturization of mobile and wearable devices have entailed a relevant diffusion of this technology (Arth et al., 2015), with hits like *Pokémon Go* and *Snapchat* downloaded by million users. Moreover, HMD-based AR projects such as *Microsoft Hololens* and *Magic Leap* have generated elevated expectations about its future installations.

AR and VR have been tied by bridging concepts like "mixed reality" (e.g., Bower, Lee & Dalgarno, 2016). As Nardi (2015) claims, reality and virtuality are merging indeed, and there are several *grey zones* in between the two approaches (e.g., 360-degree videos on mobile devices). However, their objectives are still divergent, and these peculiarities can help in framing the related educational affordances, which are increasing and getting more and more diversified. VR has been used for addressing conditions and situations that are challenging to experience in real life (Lau & Lee 2015; Webster, 2016) and allow for the acquisition of novel perspectives (Höffler & Leutner 2011; Lee & Wong, 2014). Conversely, AR shows potential in supporting informal learning and cooperative thinking (Kidd & Crompton, 2015; Persefoni & Tsinakos, 2015).

In this chapter, a summarizing overview of both is provided with an emphasis on IVR – i.e., HMDs, mobile-based IVR (e.g., Google Cardboard, Samsung Gear VR) and CAVEs – and mobile AR. The rationale behind the former choice is that IVR is the most cutting-edge VR installment, with an increasing public awareness but a poor adoption by educators. The latter is motivated by the popularity reached by AR via smartphones, while immersive/in-situ AR (e.g., with HMD like Hololens) is currently at the beginning of its path. Finally and differently from DVR, both AR and IVR focus on acquiring information with multiple senses and ideally the whole body (Shapiro, 2014; Shayan et al., 2015) -, which is an approach that requires a proper attention to be successfully unpacked. Therefore, these pages will deal neither with DVR nor digital simulations and games in learning (although they represent a possible application of AR and IVR). Even though the spotlight will be on K-12 education in general rather than specifically on online learning and blended environments – due to the current scarcity of studies and products – it can be argued that such a focus may function as a preliminary step toward a future use of these technologies in remote and mixed instruction.

Research Synthesis

Premises

Online learning and blended environments are quite a new frontier for AR and IVR. As claimed by Coburn, Rebenitsch, and Owen (2013), mixed reality tools still struggle with providing immersive and/or augmented multi-user experiences due to the poor implementation and technical limitations. However, attempts have been made to enlighten such an application. Over 15 years ago, Schmalstieg and colleagues (2002) presented *Studierstube*, an installation in which multiple users with HMD were able to interact together with a 3D model in real space. Further developments have harnessed multi LCD-projectors and DLP-based systems (e.g., Fröhlich et al., 2005; Kulik et al., 2011). Beck et al. (2013) developed a telepresence system for multiple groups based on two combined projection-based setups transmitting stereoscopic images to each other. *3d-Board* (Zillner et al., 2014) is a digital whiteboard designed to acquire the virtual embodiments and gestures of remote users. *Holoportation* (Orts-Escolano et al., 2016) supports IVR and AR telepresence by creating high-quality 3D objects and harnessing new depth cameras and HMDs. Ekong et al. (2016) worked on a hybrid interface in which teachers (assisted by a large 2d monitor and a tracking system) lead students with HMD through immersive experiences; a real-time 3D representation of the instructor is provided within the virtual environments, guiding the interaction in a live space. Fominykh, et al. (2013) argue that motion-tracking technology and HMD can improve immersion in shared environments, and Bower, Lee, and Dalgarno (2017) investigated the potential of cooperative learning and co-presence in a blended learning environment, discovering facilitation of communication and collaboration. Regardless, IVR and AR are just starting to be adopted for remote education and distance learning. Therefore, in this chapter, I take a step back to shed light on what we know (and do not know) about their educational use. However, an awareness of what is available will potentially help in introducing them in online learning and blended environments in the future.

Immersive Virtual Reality

Online learning has been benefiting from DVR since the beginning of the century. The opportunity to build shared settings in which educators and learners can interact and work together is a significant one (Correia et al., 2016; Huang, Rauch & Liaw, 2010; Merchant et al., 2014), and virtual worlds like *Second Life* have been widely utilized (e.g., Pellas, 2014; Potkonjak et al., 2016). IVR represents a novel move to a more complete sensorial involvement; it has been the subject of several applications in higher education, therapy, and professional development (Freina & Ott, 2015). Medical training (e.g., Hamacher et al., 2016; Randall et al., 2016) and STEM and computer science (Connor, Marks & Walker, 2015; Potkonjak et al., 2016; Rodriguez, 2016) represent well-established fields of IVR use.

Buttussi and Chittaro (2015) tested three types of display (HMD, narrow HMD, DVR) in security training via a serious game; the learning outcome was the same, but engagement and presence improved within the IVR-related interventions (see also Chessa et al., 2016). Kim et al. (2014) tried a similar experiment (based on searching objects in a virtual environment) by comparing CAVE, HMD, and DVR. The first two fostered more emotional arousal and presence than the third. Hupont and colleagues (2015) have compared 2D and 3D virtual versions of a forklifting game, and results point to a higher degree of immersion, usability, and amazement of the former in comparison with the latter. North and North (2016) involved 70 subjects with a virtual airplane simulation, finding that in the IVEs (immersive virtual environment) the sense of presence is more significant than by deploying DVR. Schuster, Richert, and Jeschke (2016) have designed three locating tasks to perform with either an HMD-based system or a laptop; they found that IVR guaranteed more flow, level of absorption, and self-location in individuals recruited. Finally, the results of the study carried by McMahan and colleagues (2012) show that the levels of display and interaction fidelity strongly influence performance, presence, engagement, and usability; therefore, IVR may be preferred.

Just recently K-12 learning has started using IVR. The lack of quick adoption of the technology in K-12 has much to do with the high price of implementation, which is still out of reach for the majority of researchers and educational institutions. For example, CAVEs require relevant efforts and resources to be created and maintained, while HMDs are still expensive. Unsurprisingly, the main adopters are universities and major companies. The number of software supporting IVR is increasing. For instance, *LectureVR* is a platform for delivering IVR lectures, while *AltSpaceVR* provides shared instances especially designed for HMD devices. *Google National Parks* and *Google Expeditions* are further initiatives that show potential in pursuing online learning and blended interventions via IVR.

Regardless, this accessibility issue means also a general indifference toward the potential of these technologies. For instance, individuals tend to consider the use of HMD more socially acceptable if the device is being used to support a person with a disability (Profita et al., 2016). Shen and colleagues (2017) have shown that previous experiences with HMDs have a significant impact on future intentions to use them for learning. However, mobile-based goggles (e.g., Google Cardboard;

for a list of tools to use in classroom, see Brown & Green, 2016) and gaming trends (e.g., PlayStation VR) are reducing the gap by allowing a growing audience to try such an innovation.

Due to their older ideation, CAVE systems have been widely explored with evidence of learning outcomes (Keengwe & Onchwari 2011; Lee & Wong 2014), while stand-alone HMDs have not been studied as much. Pioneering projects included *Physics Playground* (Kaufmann & Mayer, 2009), in which HMD, a wireless pen, and an interactive panel were used to teach Physics and specifically forces (e.g., friction) to primary schoolers, and the study by Passig and Eden (2010) on how children with hearing impairment could express temporal and causal relations with technology; IVR was found to be supportive in these processes.

Focusing on recent research, Computer Science, Science, and Math are gaining more and more interest by IVR for visualizing content that would be challenging to perceive. For instance, the *WeaVR* project (Hodgson et al, 2015) combines HMD and motion tracking for staging exploratory field trips. It was the focus of a computer science class, and first reactions by students were encouraging. Weppener et al. (2014) developed *gPhysics App*, a program based on the Google Glass platform that aims to experience educational physical experiments in the area of acoustics. *Space Rift* (Peña & Tobias, 2016) is an IVR game via Oculus Rift that puts students inside the solar system with additional content. First responses have been positive, but further work is required for integrating immersion and learning materials.

Arts and cultural heritage were addressed as well; in this case, the core objective is to overturn a temporal impossibility or express subjective (hidden) statements in novel ways. For instance, Chan, Yuen, and Lau (2016) have adopted a CAVE system (ILEVA – Immersive Learning Environment for Visual Arts) for teaching visual arts. Students were asked to design an art gallery (based on ILEVA) and introduce it to their peers, which raised encouraging feelings about this technology. However, experiencing others' work was perceived less positively because of the single-oriented focus of IVR. Ip et al. (2016a) designed a mobile app that uses IVR (via Google Cardboard) for providing a MOOC (Massive Open Online Course) about Hong Kong and its past.

Another area of application is social skills with an emphasis on special needs. As argued by Bombari et al. (2015), interaction and shared conditions are an ideal area of application for IVR. Ip et al.(2016b) deployed a CAVE system for supporting children with autism in the transition from kindergarten to first grade; emotion recognition, affective expression, and social reciprocity were significantly improved. Lorenzo et al. (2016) designed an IVR experience (CAVE) for training emotional competencies of primary school students with autism. By providing different social scenarios with appropriate feedback, they noticed an increase in the emotional skills in the 20 children recruited in comparison with the control group (see also Lorenzo, Pomares & Lledó, 2013). Newbut and colleagues (2016) recruited individuals with ASD (Autism Spectrum Disorder), finding that they enjoy using HMD and perceive significant levels of *presence* with it.

Augmented Reality

Differently from IVR, mobile AR is getting accessible for most people. Several applications are currently available for free with undemanding technical requirements. According to Arth et al. (2015), AR has been evolving from its association with wearable AR (based on heavy equipment) to the most recent connection to *mobile device*, which relies on geolocation features and related software. Azuma et al. (2001) depict AR in terms of incorporation, collaboration, and interaction between real and virtual elements. Therefore, object recognition and visualization, synergy between formal and informal settings, and real-time support emerge as potential advantages (Chen et al., 2011; Dunleavy, Dede & Mitchell, 2009; Santos et al., 2014).

Research and concrete applications are increasing in a variety of fields, from tourism and marketing to education. Regarding the last domain, location-based AR could address the difference between formal and informal learning and stage a more authentic, collaborative, and situated educational process (Bronack, 2011; Kidd & Crompton, 2015; Wu et al., 2013). Chen and colleagues (2016) have noticed an increase in empirical studies in educational settings since 2013, with a specific focus on Science, Social Sciences, and Engineering. Akçayır and Akçayır (2017) came to similar conclusions, with studies in the last four years having a strong focus on K-12 education and mobile applications. Despite this technology seeming to trigger a relevant learning outcome, there are still issues in usability and technology, and educators are usually not prepared enough.

Dunleavy and Dede (2014) discovered that AR applications in education are increasingly addressing teamwork skills (thus, saving the social dimension), but cognitive overload and concrete implementation remain a challenge. Di Serio, Ibanez, and Kloos (2013) recruited 69 middle schoolers for executing a set of AR based learning activities finding that their motivation increased more than in the control group. In presenting the *Zspace* device, Noor and Aras (2015) claim that AR can trigger multimodal and multi-user learning.

Recently, science has been the elected area of application for AR in K-12 education. This is not surprising if we consider its potential in terms of visualization and informal learning. Chang, Wu, and Hsu (2013) designed a mobile AR experience (based on inquiry tasks) with 22 ninth grade students for teaching radiations' effect. The targeted topic was positively perceived and understood by the subjects. Chiang, Yang, and Hwang (2014) used an AR mobile system for involving 57 fourth graders about aquatic animals and plants. Learning outcome, confidence, and engagement were founded higher than in the control group, which was approached with no-technological support. Echeverría, Gil, and Nussbaum (2016) developed and tested an AR collaborative game about electrostatics with positive outcomes in terms of engagement, usability, and knowledge (see also Ibáñez et al., 2014 for alike conclusions). Fleck, Hacket, and Bastien (2015) created the AR software AIBLE-HELIOS, which supports astronomy learning by combining virtual and real objects with the support of concrete information. Furió et al. (2013) used an AR mobile game to teach the water cycle to primary schoolers. Motivation triggered was higher than in the control group, but the learning outcome was similar. *EcoMOBILE* (Kamarainen et al., 2013) is an AR project about environmental awareness and related best practices. Students are asked to measure water quality with the support of informative material. The related user test pointed to a positive impact on learning and cooperation between peers. Lindgren et al. (2016) studied 113 seventh grade students interacting with the *MEteor* system (an immersive AR installation) about science teaching, discovering a significant understanding of the targeted topic.

Sommerauer and Muller (2014) directed similar research with 111 participants using a mathematics AR exhibition; knowledge acquisition and retention tests were higher than in the control group. Zimmerman, Land, and Jung (2015) directed a four-year research about using tablets (iPad) for the life cycle of trees in informal settings. They focused on strategies to raise situational interest about nature and, assessing the experience of 42 children, AR (i.e., *The Tree Investigators* app, which provides place-based pictures) proved to be supportive in reaching this goal (see also Huang, Chen, & Chou, 2016). Weng et al. (2016) designed an AR app for teaching biology (e.g., mitosis, meiosis) to secondary school students promoting a better visualization and a social dimension in learning (for alike interventions, see Chen, Ho, & Lin, 2015; Cuendet et al., 2013; Dunleavy, Dede, & Mitchell, 2009; Jamali et al., 2015; Phipps et al., 2015; Radu et al., 2015). Among pertinent software, *Smithsonian National Museum of Natural History app* and *Discovery Agents* are other programs that use augmented content to enrich learning settings like parks and museums.

Cultural heritage and place restoration are further AR's targets because of the restoring functions provided by this technology (Buettel & Brook, 2016; Chang et al., 2016; Kysela & Storkova, 2015). Sixteen years ago, *Archeoguide* projects used a HMD to visualize ancient Greek buildings and events in their current location. *Rome Reborn* re-created parts of the Imperial Rome with UMPC cameras and tracking maps. The *LifePlus* project enlightened the Roman city of Pompeii with additional scenes from the past by combining geolocation systems, HMD, and built cameras. *AR View* allowed visitors to see from a fixed position a restored version of Ynuangmingyu, a Chinese royal garden damaged over 100 years ago. Bostanci, Kanwal, and Clark (2015) harnessed the power of Microsoft Kinect for stating an in-situ augmentation (e.g., arcs, swords). Recently, the mobile orientation of AR has led to several applications aimed to improve the user's context. Djebbari, Ailincai, and Boissaire (2014) designed *Mobilearn*, a museum AR platform that locates and guides visitors with tag scanning, database connections, and significant social features. This line has been pursued by other projects (e.g., Duguleana et al, 2015; Gordon, Walters, & Michlowitz, 2016; Martínez-Graña et al, 2017; Pacheco et al., 2014; Pendit, Zaibon, & Bakar, 2014), which try to combine maps, additional content, and real visuals for fostering users' understanding of specific places and environments. As argued by Saggio and Borra (2011), "the virtual reconstruction/restoration can be even improved taking advantages of the AR, which furnish lots of added informative parameters, which can be even fundamental under specific circumstances" (p.59).

Implications for Policy and Practice

Despite their differences, IVR and AR present similar goals and fields of application. They try to inform an ideal setting for maximizing a learning intervention. In the former, this environment is virtual; in the latter, it is blended. This difference entails peculiarities and specific affordances. AR seems to promote a feeling of authenticity and cooperation, and IVR appears a priceless instrument to create straightforward learning environments about the *unseen*. IVR and AR also show similar constraints. Four key issues should be considered before implementing these tools in educational processes.

- Costs: despite the price of HMDs decreasing and AR via mobile's increase in popularity, these technologies are still quite inaccessible for the majority of educators and school districts. Such a situation also influences the development of AR and IVR software for learning. This is especially glaring for the latter, whose applications are still few and mainly with an escapist focus.
- Teacher preparation: educators still struggle with AR and IVR. Usually, they are not ready to deal with technical problems and usability concerns. With AR, security and poor internet connection in moving outdoors (Akçayır & Akçayır, 2017) are primary issues, while IVR may trigger nausea and sickness in some subjects (e.g., Hupont et al., 2015; Rebenitsch & Owen, 2016). A better awareness means more effective learning. Wojciechowski and Cellary (2013) involved 42 students from the second grade of a lower secondary school in 3D image-based AR learning environments about chemistry; the utility of the technology was strongly influenced by interface style and perceived ease of use. Moreover, informed teachers can deal with ethical issues (e.g., copyright, privacy, unappropriated content), which may emerge in virtual environments (Correia et al., 2016), more effectively.
- Pedagogy and content: The aforementioned lack is followed by a still poor integration between pedagogy, content, and technology. As Ferdig (2006) claims, the success of a technological intervention relies on the conditions in which it is staged and directed. Following the well-known TPACK model (Technology, Pedagogy and Content Knowledge) (Mishra et al., 2013; Rosenberg & Koehler, 2015), it can be argued that the tie between the three dimensions is often weak in integrating these technologies. The WOW – or novelty – effect is easy to achieve, but a learning activity should go beyond the mere engagement and avoid using technology just because it is available. It is not a case that several investigations found that the learning outcome did not change with AR/IVR but just the involvement per se. Addressing online learning and echoing DVR dynamics, constructivism-oriented strategies should be promoted. VR means a setting to inhabit, then a more autonomous agency should be stimulated; virtual worlds tend to be more positively experienced when students are not repeatedly monitored nor confined (Merchant et al., 2014).

Therefore, future studies and applications should target new pedagogical strategies rather than an iteration of the traditional ones. As O'Shea and Elliott (2016) notice in their overview of AR apps for education, their quality is still average due to the lack of resources, expertise, and planning. Seeking pedagogical proposals, Wei et al. (2015) suggest a teaching scheme (based on ARCS motivational categories of attention, relevance, confidence, and satisfaction) for educators and students to use AR in creative design in high school teaching/learning. AR would be able to positively affect all these phases. Echeverría and colleagues (2016) claim that technology and pedagogical models should be aligned. They combine AR and the face-to-face CSCL (Zurita & Nussbaum, 2004) for leading the use of AR games in classroom. A strong emphasis is put on teamwork and collaboration between peers, while the teacher has a central role in supervising group activities. Ritz and Buss (2016) suggest several strategies for a successful IVR intervention (especially with CAVEs). Among them, they suggest planning the content to deliver carefully and without redundancies to reduce the cognitive load. In addition, materials should be manipulated and easy to navigate, and students should be prepared before the intervention to prevent the novelty effect. In conclusion, their advice is to get familiar with technology before adopting it to teach. The EDALM approach (Huang, Chen, & Chou, 2016) successfully connect AR technology to the four stages of Kolb's experiential learning cycle (Kolb, 1984): concrete experience, reflective observation, abstract conceptualization, and active experimentation. According to Cabero and Barroso (2016), using AR for teaching requires careful planning in order to avoid technical issues, maintain a proper awareness of how to combine content and technology, and a previous competence about tools and software adopted.

The implications of such an overview cause us to reconsider professional development about technology. Educators need support for familiarizing themselves with IVR and AR and specific insights for integrating these tools into their pedagogy. In their overview of learning immersive virtual environments, Karutz and Bailenson (2014) argue that more awareness is required for educators to use this technology, which is usually deployed without a clear focus. Bower and Sturman (2015) asked 66 educators about wearable technologies' (among which IVR and AR devices) pros and cons. Immersion, in-situ information, keeping trace, and monitoring features were highlighted, but also technical problems and the risk to put technology before pedagogy were identified.

For addressing these issues, policies should frame AR and IVR as a part of education offerings rather than a stand-alone extemporaneous experience. Proper training and pertinent curricula changes are mandatory to reach this goal. The reference is to a not-so-far future: the aforementioned obstacles (e.g., costs, usability) will be narrowed down in coming years along with the related *domestication* by teachers and pupils. Hence, blended interventions and remote learning will become doable and even more of a game-changer because of the increased immersion. Here and now, as far as the availability is concerned, AR and mobile-based IVR seem the most affordable experiences. Moreover, they preserve the social dimension of learning, which is weakened in HMD and CAVE systems (usually single-user oriented). Despite their fidelity being lower, their effectiveness is still remarkable and guarantees a satisfying level of engagement.

Implications for Research

Research is supposed to help this process by giving a clearer picture of IVR and AR affordances. There are still several open questions related to their educational impact; four possible developments are listed below:

- First, it would be interesting to uncover how collaboration and interaction may work through these technologies remotely. Cooperative thinking via AR is taking a foothold in educational technology and provides a solid premise, while active engagement (Ahn et. al., 2013; Gallagher & Lindgren; 2015; Kulik et al., 2011; Tran, Smith, & Buschkuehl, 2017) may help in making online learning more concrete and authentic. Moreover, haptic devices (e.g., Oculus Touch) are a further front that should be investigated from this perspective for addressing how human sensorimotor system might be stimulated (Chang et al., 2017; Tran, Smith, & Buschkuehl, 2017). For instance, hand-tracking (and related interaction) is becoming a leading feature for staging immersive remote collaborations (Oh et al., 2016; Yu et al., 2016).
- Second, pedagogies and subject areas need to be researched in a more focused way (Fowler, 2015). The current references are to traditional models (e.g., ARCS, Kolb's learning style) and the core content domains are STEM and cultural heritage. However, new frameworks should be tested along with design and interactive features, and other didactical topics must be deepened with long-term studies. In addition, the alternation between IVR/AR sessions and face-to-face interventions has to be explored. Currently, studies point to compare them separately, but much could be learnt by merging them in blended settings.
- Third, researchers may want to enlighten how IVR and AR effectiveness is influenced by students' profiles. For instance, the cognitive load triggered by AR is still a debated topic (Akçayır & Akçayır, 2017). Zhang et al. (2016) found that AR works better in improving learning gains in first through fifth grade pupils when they have a kinesthetic approach to learning. The importance of these factors relies on the specific need of the learner and goes beyond usability and accessibility concerns (CAST, 2011; Nielsen, 2012). Lee and Won (2014) proved that DVR works in education according to spatial ability and learning mode, and that low spatial ability learners benefit more in using it. Otherwise, Cheng (2014) found that in *Second Life* active learners appreciated the ease of use and usefulness of the program, while verbal ones highlighted its sharing and interactive affordances. Alike investigations should be directed toward the technologies targeted in this chapter.
- Fourth, more efforts are required to explore IVR/AR use in special education. Their potential is promising (Kalyvioti & Mikropoulos, 2012; Passig, 2011): by providing a controlled setting and filtering learning and sensorial inputs, these technologies can make a difference in designing sustainable and personalized experiences. Nevertheless, further studies are fundamental to set the stage for a more inclusive learning (Walker & Logan, 2009) and address a wide range of special needs rather than just some. An alike situation could be found in the use of mobile learning for special education (Gandolfi et al., 2016), which is split between enthusiasm and lack of long-term studies.

In addition, more multidisciplinary studies should be directed for achieving wider findings and building bridges between different subject areas. IVR and AR are broad umbrella terms, within which several approaches and modes can be developed. From educational gaming to simulative attempts, researchers can stage and problematize ideal matches and potential incompatibilities in online learning. In other words, IVRs and ARs are still developing, due to their recent emergence. Regardless, both are characterized by a fast evolution, with new devices and techniques released every year. Therefore, their progress must be constantly monitored and put to the test for unpacking their affordances and limits.

Blended and online learning at IVR/AR stake

As mentioned above, AR/IVR in online and blended learning is still an overlooked topic. However, they appear as a natural fit for such educational fronts, and we can envision three potential applications of this implementation in the near future.

1. Online instruction still raises doubts and criticism across the teaching community. One of the most frequent reasons of such a position is the absence of the physical and temporal co-presence of instructor and students. IVR can address this deficiency by providing a novel sensorial engagement in a simultaneous environment. The abstractness of DVR shared settings will be narrowed, and remote learners will be able to experience the virtual class in a more complete way.
2. IVR can help blended interventions by offering an alternative layer to assist face-to-face sessions. Aside from staging situations and environments that are challenging to experience (e.g., Mars, oceans – from a traditional introduction to a mediated involvement), teachers can use them to plan several activities in which the real context is overturned and critically used (e.g., role-playing games in which the students do not know the identity of each other)
3. AR experiences will represent effective means to evoke presence and participation in online and blended teaching. Its geolocated and augmented affordances can help in fostering attention and commitment outside the classroom or in MOOCs. This strategy means to reflect on the student's context for related informal learning, which is an ideal orientation of AR. In addition, this technological support might reduce the abstractness of online learning by combining interactions with the real environment and individuals.

To summarize, AR/IVR in online and blended learning can support an immersive "liveness" (Auslander, 2008) – i.e., a mediated experience that aims to highlight the "here and now" rather than stage post-produced content. Live streaming (e.g., Twitch.tv, Facebook live) is another example of such an approach, which entails immediacy, intimacy, and transparency, but the technologies targeted in this chapter can represent a further step forward. They may fix the distance issue of remote instruction, and make a difference in convincing skeptics about online and blended learning. The potential for special education is promising too, if we consider how such innovations can improve the delivery of instructional content for who cannot regularly attend classes or have problems in using traditional tools.

Envisioning concrete challenges in K-12 education, IVRs can be used for improving flipped classroom techniques (by harnessing an introductory immersive experience exploring a natural environment and then discuss its characteristics). Smartphones and paper headsets represent the most accessible option for this instructional strategy. However, more research is needed to understand how immersive experiences are perceived and "read" by learners outside the classroom, and how the consequent debriefing should be managed. Otherwise, students can create their own virtual realities and then ask for feedback. Such an agential commitment can expand the scope of peer-tutoring and creative storytelling, but may also weaken attention and focus.

AR is probably part of the future of mobile learning, and informal learning opportunities can be easily sketched. Children would have the opportunity to contextualize what they learned within the real environment, see situational information, and develop a more aware attitude toward their surroundings. These activities may be creative tasks in which the learner concretely adds content, personalizes his/her own learning, and enriches the educational value of a location; moreover, online instructors can anchor their materials to real spaces, filling the gap, and making their teaching more authentic. Nevertheless, ideal target settings for AR are natural ones, which are often characterized by connectivity issues and contextual limitations; in addition, balancing augmented and real elements is not an easy task (see the issues encountered by several users of *Pokémon Go*). Non-mobile AR can make a difference in visualizing abstract concepts and stage group activities, but its usability is still debatable and further studies have to be directed concerning this point. In the end, IVR and AR share the same limitation, which is the relevant expertise requested in terms of production and application to teachers and students. It is not a surprise that several instructional integrations have coding and programming tasks at their core. Future investigations need to problematize accessibility and interaction of these technologies, pointing to the development of more inclusive tools and then more significant inquiries.

Conclusions

IVR and AR are at an early phase and, despite their growing popularity, how to use them for learning goals is still a complex challenge to address. This is especially true if we consider their adoption in online learning and blended environments, which have been secondarily investigated. More pedagogical reflections are needed to shed light on their ideal application; just adopting them because they are *the new normal* represents a mistake, which often weakens the learning process rather than empowering it. However, they show an outstanding potential in terms of immersion, engagement, and pedagogical horizons.

Aside from pedagogical and didactic issues, the former has relevant availability constraints and a marginal social dimension. Regardless, the smartphone-based IVR with the adoption of pre-built content (e.g., 360-degree videos, Google Expeditions) is getting more and more affordable, allowing teachers to engage students with virtual tours all around the world. Moreover, *AltSpaceVR, Facebook Spaces, Project Sansar*, and *High Fidelity* are the first generation of social media with a strong emphasis on IVR, and they are going to provide a first stress-test for immersive shared experiences. The latter has to deal with still significant usability issues and a lack of proper software. Moreover, mixed reality installations are still out of reach for the majority of researchers and instructors. Furthermore, educators seem to struggle with IVR and AR. A survey by Project Tomorrow (2017) recruiting over 510,000 K–12 students, parents, and educators about AR and IVR use in STEM; the survey found just 5% of educators use AR or IVR in classroom activities. Teachers, principals, and parents have quite negative feelings about these innovations: AR apps are requested by a minority (12% parents/principals; 13% teachers), while IVR is more appreciated (17% parents; 23% teachers; 29% principals). Regardless, teachers claim that technical support (56%) and professional development (48%) can make a difference in properly introducing these tools in their educational settings.

In conclusion, insufficient competence and prejudice toward AR/IVR adoption are alive in the field. To help mitigate this situation, educators should be supported in their use of these technologies, which will be extensively available in the short term, hopefully helping to narrow stigmas and fears. The potential co-presence triggered by IVR and the situational learning and cooperation promoted via AR are playing an increasingly significant role. As scholars and practitioners, our mission is to be ready and make teachers ready to embrace such a turning point. Further extensive studies aimed to outline proper instructional practices in online and blended environments and focused on professional development modules are needed. Additionally more resources for IVR/AR content are crucial in order to reach this goal. The wished outcome of this chapter is to have brought an awareness among researchers, educators, stakeholders, and families to AR and IVR progress.

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Critical Perspectives on Implementing Serious Educational Games

Providing New Research Paradigms

Leonard A. Annetta, Marina Shapiro, & Sunmbal Abbasi

Abstract

Through fifteen years of research on technology integration and Serious Educational Games, this chapter takes the position to argue for Serious Educational Games in science teaching and learning and against some of the alternate argument against the use of technology; in general, in society that affects educational endeavors. We include both arguments and counter arguments for the inclusion of Serious Educational Games in science teaching and learning. From a review of contemporary literature, we illustrate common topics that pervasive in educational technology but could be potential new research areas in Serious Educational Game research. We conclude with future directions for Serious Educational Game research and development and their potential impact on science teaching and learning. In particular, we discuss the importance of assessment and how these environments can create new and dynamic assessments.

Introduction

The use of technology has been viewed from both positive and negative perspectives in terms of its influence on human intelligence (Postman, 1986). While there has been a bias toward video games due to the viewpoint that said games can deter one from learning, research continues to show how game-based learning leads to knowledge gains and continues to benefit education in various ways. For instance, computer games have been linked to facilitating improvement in education for students in a number of ways, including: strategic thinking, planning, communication, decision making, as well as cognitive, emotional, social, and psychomotor skills (Demirbilek & Tamer, 2010). According to Egenfeldt-Nielsen (2007), the perspectives about commercial games and their potential use for learning has become more positive due to the games' ability to increase motivation, increase interest in specific subject areas, multiple representations, open-ended approach to information, the ability for students to be in control of their own learning process, as well as providing a collaborative learning environment for students and their peers.

There is a cultural divide with respect to what K-12 students do outside of school to what they do in schools. For many years, there has been an inherent bias toward integrating technology, in particular videogames, in the teaching and learning process. Although this divide continues to slowly decrease as time passes and more data is published supporting the efficacy of new technologies, there are still external pressures impacting the use of technology and its infusion into the curriculum. We posit these pressures with critical perspectives through supporting literature on why and how videogames, specifically Serious Education Games (SEGs) (Annetta, 2008), should be more accepted by now. To this end, we will use Annetta's term when referring to these platforms.

With that, the goal of this chapter is to provide some of the literature surrounding SEGs but more specifically, SEGs for online teaching and learning and illuminate some potential new avenues for research. Four areas have been chosen to review (societal pressures, cognitive attributes, assessment, and learning through failure) because these themes fell out when reviewing contemporary literature on educational games (Lamb, et. al, in press). It is important to note that it is impossible to cite all relevant articles in these areas but the crux of this chapter is to provide a background for our colleagues to delve deeper into the literature on these four topics as they pertain to educational games in science.

Societal pressures affecting technology integration

According to Orwellian (1949) and Huxlean (1932) perspectives, the use of technology would have disastrous effects for mankind. Postman (1986) explains Orwell and Huxley's ideas about technology but summarizing Orwell's beliefs as the use and reliance on technology will produce a civilization of brainless and languidness people. Huxley believed people would become so reliant on technology that they would not be able to think. He believes people will be so preoccupied by the ease and pleasure of technology that erudition will be an ancient concept. Society will lose the aspiration, desire, and yearning to learn (Postman, 1986) and this cause pressures within a society to rely on or disagree with technology.

Innately, human learning evolves over time with both physical and cognitive maturity. According to Hermann (2012), there are two important periods for brain development. The first growth occurs from birth to age six and the second important period begins at age eleven and lasts for a couple of years. This is where the "brain constructs meaningful cognitive functions" (Herman, 2012, p. 2). This stage is crucial and it is important for teens to have human interactions. Children that spend too much time with technology will not be able to comprehend social cues or emotion.

Most notably from a Huxlean perspective, Clough, Olson, and Niederhauser (2013) edited a volume claiming in large part that science educators have blindly taken to technology as a way of teaching and learning without thinking through technology's implication on practice or society. They state, "When educators and the general public do consider the pros and cons of technology, they usually do so only in Orwellian terms – the explicit and overt ways that technology affects individuals, groups and society (p. 12). They explain eating is fundamental to organisms but eating blindly without thinking of the consequences can have dire effects on one's body. They further state, "That is, how does technology change individuals, social institutions, and cultures when it is embraced without critique?" (p.13). Most of this volume argues in favor of Postman's view of technology and media that there is too much of it and in education, too often educators use technology because of the 'cool factor,' (Clough, M.P., Olson, J.K., & Niederhauser, D.S., 2013). Serious Educational Games, being one technology that has gained attention in recent years as a means for engaging students in the learning process, is often viewed as if it is being forced upon teachers and students, or worse, being forced into schools without a critical eye. We will debate these points through this chapter and provide the reader with information for them to make their own decisions.

Cognitive attributes of learning with technology

In touching: the human significance of the skin, Montagu (1971) explains that it is very important for children to have direct physical contact with their parents for three to four hours a day. The computer can't be used as a babysitter and replace human interaction. Replacing human interaction with technology can lead to psychological and sociocultural issues in children. Further, The American Academy of Pediatrics says excessive technology can cause ADHD, depression, sleeping disorder, and obesity. They also suggest that technology should not be used for kids under two years old because the development of the brain occurs during this stage. Familial and social interaction is integral for the development of a healthy child (1995).

Romer, Bagdasarov, and More (2013) conducted a study on the effects of technology on young adults between the ages of 14-24 years. They correlated the amount of time spent on the Internet and playing videogames to success at school, level of physical activity, and mental health. Adolescents who used moderate levels of technology participated in clubs and sports. Adolescents who used technology greater for information gathering attained more positive mental health. On the other hand, teenagers who used technology excessively suffered from depression. The authors further stated they did not know if the depression came first or the overuse and reliance on technology. Between one to four hours of Internet use was categorized as moderate usage and over that amount was considered excessive. The study also drew correlations between reading and GPA. The more the students read books, the better their GPA. The longer they played videogames and used the Internet, the lower their GPA. They also suggested that book reading, media usage for informational purpose, and peer engagement have a positive relationship with success at school and level of health and happiness (Romer, Bagdasarov, & More, 2013).

Rosen et al. (2014) conducted a study to determine the effect of technology on children's mental health. They studied three age groups, children 4-8, adolescents age 9-12, and teenagers age 13-18. They looked at the correlation between technology usage and psychological issues, behavior issues, ADHD, and physical health. They determined eating habits affected the health of teenagers and adolescents. The level of physical activity was positively related to the occurrence of behavior issues of adolescents. For teenagers, the level of physical activity had a positive correlation to the level of mental well-being. They also stated the overuse of technology was harmful to children and adolescent and detrimental to teenagers. Technology in the bedroom had negative effects on teenagers affecting their eating habits, their academic achievement, and caused aggressive behavior.

In a review about Internet addiction and psychiatric addiction, Ko, Yen, Yen, Chen, & Chen (2012) suggested treating mental illness first to prevent the effects of Internet addiction. They explain the detrimental effects of Internet addiction on family relationships, mental instability, and emotional instability. In the Diagnostic and Statistical Manual of Mental Disorders 4th edition, Internet addiction symptoms are "preoccupation, tolerance, withdrawal, failure to control, use longer than intended, functional impairment, lying, and escape" (as cited in Ko et al., 2012, p. 1). Ko et al. (2012) describes the relationship between psychiatric disorders and addictive disorders. Internet addiction is seen as an addictive relationship. They explain four different relationships between the two. A psychiatric disorder can exacerbate Internet addiction or Internet addiction can be the cause of the psychiatric disorder. Internet addiction can cause other psychiatric disorders. There is a genetic similarity between the addictive disorder and psychiatric disorder. Ko et al. (2012) also state that Internet addiction can cause depression and aggression. They also linked Internet addiction to ADHD.

Koepp et al. (1998) conducted a study, which showed striatal dopamine is released while playing videogames. Oades (2008) explains dopamine levels are really low in people with ADHD. Badgaiyan (2010) conducted an experiment using dynamic molecular imaging technique to observe the pathway of striatal dopamine. He concluded the ventral striatal processes positive emotions and the dorsal striatum processes negative emotions. This allows adolescents to become addicted to video gaming. Ko et al. (2012) states ADHD adolescents have "impaired inhibition" and suffer from social anxiety (2010, p. 5).

In 2008, Annetta suggested that there should be a different category of Serious Games for those that focused on K-16 teaching and learning; for which he called Serious Education Games. The attraction of games for learning continues to grow and can be attributed to a number of various factors. Research has shown that videogames, in general, may have the potential to be used as a method of self-medication for children with attention-deficit/hyperactivity disorder (ADHD) (Han et al., 2009); albeit, previously mentioned research suggests otherwise. There has been a link between ADHD with stimulant, alcohol, and nicotine abuse (Greenhill, 2006; Lambert & Hartsough, 1998; Molina, Pelham, Gnagy, Thompson, & Marshal, 2007). Stimulants that are commonly administered for the treatment of ADHD, such as methylphenidate have been shown to increase synaptic dopamine (Han et al., 2009). Methylphenidate is commonly known as Ritalin (Lu, Kuang, & Chou, 2006). While the findings appear to be inconclusive what is known from the research studies presented is that individuals who have ADHD have been found to show low levels of dopamine. On the other hand, dopamine is released during videogame play, which could counteract that belief that videogames may lead to ADHD.

Dunleavy, Dede, and Mitchell (2009) conducted a qualitative study with middle and high school students in which students participated in the augmented reality game environment called *Alien Contact*. In this study, students were assigned to work in teams of four in order to explore the gaming world, interview virtual characters, collect digital items, as well as solve math, language arts, and scientific literacy puzzles in order to learn why the aliens landed on Earth (Dunleavy, Dede, & Mitchell, 2009). In *Alien Contact* each of the students takes on the role of a chemist, cryptologist, computer hacker, or FBI agent. Results of the study demonstrated high student engagement and motivation toward learning math, science, and English concepts, which also lead to solving problems collaboratively (Dunleavy, Dede, & Mitchell, 2009). Of particular interest is the fact that students who were usually not engaged in class and students who had ADHD were engaged and focused the entire time during the implementation of *Alien Contact* (Dunleavy, Dede, & Mitchell, 2009).

Videogame play has been found to activate visuospatial functions as well (Castel, Pratt, & Drummond, 2005; Green & Bavelier, 2003; Green & Bavelier, 2007). According to Green and Bavelier (2003), playing videogames for 10 days increases one's ability to detect objects, visuomotor coordination, and spatial attention. The improvement of visuospatial function occurs due to the fact that visual spatial resolution is enhanced (Green & Bavelier, 2007). Vallett, Lamb, and Annetta (2013) found that there is a significant difference between individuals who play action videogames and those who do not in terms of their ability to perceive new objects in the visual field. Research shows that individuals who play action videogames show a higher rate of attention capture for visual stimuli (Boot, Kramer, Simons, Fabiani, & Gratton, 2008; Green & Bavelier, 2007; Vallett, Lamb, & Annetta, 2013). Additionally, Guillén-Nieto and Aleson-Carbonell (2012) found that Serious Educational Games lead to enhanced brain chemistry and increased time on task. Further, Cheng, She, and Annetta (2015) suggested the immersion factor SEGs provide as a strong indicator of learning and Annetta et. al. (2014) illustrated the connection between immersive technological endeavors in SEGs and increased science interest.

Shelton, Satwicz, and Caswell (2011) evaluated a game called *Portal* that was developed in 2007 by *Valve Entertainment*. *Portal* was evaluated from the perspective of Piaget and Vygotsky. The game design of *Portal* shows a variety of ways in which the player would have to adapt in order to maintain equilibrium. *Portal* is a first person shooting game in which the goal is for the player to devise a plan that will allow them to approach the exit. The portal gun creates a challenge for the player of the game to direct objects in the virtual environment through the three dimensional space by opening doors in the different surfaces of the game (Shelton, Satwicz, & Caswell, 2011).

In the game *Portal*, there are sets of conditions that are constantly changing, which lead the player to discover the moral conditions of the game (Shelton, Satwicz, & Caswell, 2011). This is similar to what Piaget describes as situations that influence the moral development of a child. Piaget (1964) described that how a child is able to develop a sense of morality is also greatly influenced by the decision making process (as cited in Karplus, 2003; as cited in Lawson & Wollman, 2003; as cited in Piaget, 2003). In order to succeed in the game *Portal*, the player has to properly make decisions about how to progress through the environment of the game (Shelton, Satwicz, & Caswell, 2011). Each level of the game *Portal* becomes more challenging than the previous level. The game is designed to stretch the skills of the player and for the player to make decisions that allow him/her to succeed in each consecutive level that creates more challenge than the previous level (Shelton, Satwicz, & Caswell, 2011). One of the ideas that arise from Piaget (1964) is that there should be teaching strategies created by providing environments that cause the student to question and experiment (as cited in Karplus, 2003; as cited in Lawson & Wollman, 2003; as cited in Piaget, 2003). The environment in the game *Portal* is open-ended and it allows players the opportunity to have free will when making decisions and entering wherever the player wishes throughout the game. When the player is new to the game they may not have knowledge of the environment within the game and where and how they should proceed in the game. However, as the player becomes more familiar with how to interact in the virtual environment of the *Portal* game, the movement restrictions of the game are removed and new opportunities to interact with the game become revealed. Therefore, at the beginning the player is becoming familiar with and adapting to the environment of the game. This is similar to how Piaget describes a child who goes through assimilation and accommodation to maintain equilibrium in their environment. Piaget described assimilation in which one uses and preserves mental structures to resolve a conflict. The game environment also contains a set of rules that the player has to uncover and follow in order to proceed from one level to the next and to succeed in the game. The belief of Piaget is that the structure of rules in games is able to simulate important experiences that require children and young adults to learn and understand a set of rules (Shelton, Satwicz, & Caswell, 2011). Piaget (1964) described that an important attribute of development is to maintain an evolving state of equilibrium (as cited in Piaget, 2003).

Assessment in Serious Educational Games

The main difference between learning in games and learning via traditional educational methods lies in the types of assessment that are used (Sharritt & Suthers, 2011). Traditional educational methods mostly utilize summative assessment, whereas games use formative assessment in a situated environment. Games can scaffold learning through programmed logic and artificial intelligence (Annetta, Lamb & Stone, 2010) where the machine acts as the teacher as proxy to help the player/learner through the progression of skills and knowledge provided in the SEG.

Formative assessment in games enables players to receive continuous feedback that is pertinent to their learning (Guillén-Nieto & Aleson-Carbonell, 2012; Sharritt & Suthers, 2011) and these embedded assessments mitigate the Hawthorne Effect (Holmes, et. al, 2012). This type of ongoing assessment that takes place in videogames leads to the encouragement of learning by providing videogame players the opportunity to receive constant evaluation of their strategies (Gee, 2003). Shute (2011) describes how computer based games can be used as tools for assessment when players of a game interact with the environment causing the values of the different variables that relate to the game to change. For example, if a character in a game is injured and begins to experience a reduction in their health, it could be assessed in their health meter in the game. Shute (2011) argues that players in a game could have the ability to monitor their thinking skills, creativity, and teamwork skills by having a meter in the game that keeps track of all of these variables' levels. Once these variable levels drop then the player in the game would have to figure out what action to take in the game in order to increase the variable levels again.

An example of a Serious Educational Game that demonstrates the incorporation of assessments within the game environment is *Mission Biotech* (MBt). The MBt game consists of multiple levels with challenging tasks and rewards, which serve as methods of learning and assessment for knowledge of the player of the game. Examples for how these levels serve as tools of assessment are as follows: in the first level, players are introduced to the background of a viral disease, how a viral disease spreads through a population, as well as molecular techniques that are used to diagnose a virus. The first step is to extract DNA from infected individuals, which allows the game players the ability to learn and apply concepts of DNA analysis. This occurs via a setup with a virtual laboratory that contains the following virtual tools: a lab notebook, a virtual micropipette for adding reagents to patient sample, a virtual water bath to manipulate the temperature of a sample, and a virtual centrifuge that is used for differentiating parts of the solution. If a player made selections appropriately and accurately at the end of the analysis steps, in regard to parameters, such as reagent volume and centrifuge time, then they will have a virtual centrifuge that contains a liquid solution of isolated DNA, which can then be used in later steps in the diagnosis process (Sadler, Romine, Stuart, & Merle-Johnson, 2013). As can be seen from the description of this SEG, MBt provides students with the ability to practice the concepts learned over and over again until knowledge is mastered because if students are not able to end up with a centrifuge containing a DNA sample as described above, then they will not be able to continue through the game and will have to repeat the steps again until they end up with a sample of DNA.

Sadler, Romine, Stuart, and Merle-Johnson (2013) conducted a quasi-experimental study to evaluate the way high school students learn biology concepts via the game-based curriculum of MBt. This study utilized a pre- and post-test analysis and multi-level assessment strategy to evaluate student learning and interactions between academic level and learning as a result of the genetics game, for students across various academic levels (general, honors, advanced). This study provided an example of the importance of creating a well-designed game for teaching, learning, and assessment purposes. It was found that while students in the advanced and honors level classes had higher pre- and post-test scores than students in general level classes, average increase in post-test scores from pre-test scores were similar across all three groups of students across the academic levels (general, honors, advanced). Teachers were then able to monitor this and use this information as formative data when making instructional decisions (Sadler, Romine, Stuart, & Merle-Johnson, 2013). Counter to this argument, Sadler, Eastwood, Romine, and Annetta (2014) suggested caution with technology use because of the rapid advances and evolution of technology and the difficulties in keeping up with said advances and evolution.

DeFreitas and Oliver (2006) devised a four-dimensional framework, which they used to assist tutors with the assessment of game based and simulation based learning in utilization for their teaching practices. The goal of this framework was to attempt to help educators with choosing which game or simulation to use in order to teach a specific learning context, which pedagogic approaches should be used in order to support particular outcomes and activities of interest, as well as determining the validity of using the game or simulation that the tutors selected for instructional use. The four dimensions of the framework developed by DeFreitas and Oliver (2006) are as follows: the focus of the first dimension is the specific context in which playing the game or learning takes place. These include macro-level factors, such as historical, political, and economic factors. Furthermore, micro-level factors are included as well, such as accessibility to resources and tools of interest. There are both benefits and disadvantages to context as it can serve as a supporting factor for learning, or it can lead to substantial obstacles for course delivery. The emphasis of the second dimension is on the attributes of the learner or learner group, such as the age and level of the group or specialized elements of how these individuals learn in terms of their learning background, styles, and preferences. According to DeFreitas and Oliver (2006), games and simulations are able to support learning in both formal and informal education settings, while also providing an effective linkage between the formal and informal processes of learning to increase and accelerate learning outcomes. The third dimension concentrates on the internal representational world of a game or simulation. This refers to the approach by which the game is presented, the interactivity, and the levels of immersion and fidelity that are used in games or simulations. The third dimension is of great importance as it focuses on the difference between the engagement of players within the game and the critical reflection process that occurs outside of the game. The fourth dimension is based on the processes of learning that take place during the learning time of the course of formal curricula, as well as during learning that takes place in informal education settings. The fourth dimension inspires reflection of practitioners upon methods, theories, models, and the frameworks that are used for support of the practice of learning (DeFreitas & Oliver, 2006). Supporting DeFreitas, Cheng and Annetta (2010) suggested students playing SEGs could self-regulate their learning better than using non-technological tools when learning scientific concepts.

Lee, Lee, and Lau (2006) provide a learning paradigm, Folklore-based learning, which is based on the constructivist approach. According to this paradigm, learning occurs in a folklore-based story setting where one is situated in a problem solving learning environment. This is similar to the argument made by Hewson and Hewson (1983) about the importance of evaluating students' prior knowledge and how it impacts one's learning in science (as cited in Hewson & Hewson, 2003). In a game-based learning environment students are not able to proceed through the game until content mastery is achieved. This forces students to obtain a thorough understanding of the topic presented. Each time a student enters a new level in a game their prior knowledge is evaluated, which aligns with the constructivist approach and learning.

Finally, one has to consider the quality of SEG to determine its ultimate impact on teaching and learning. Much like a teacher effect in traditional settings, SEG quality has a broad range with respect to quality. To this end, Annetta, Lamb and Stone (2010) created a rubric to help researchers score the quality of a SEG. If the game is good, then learning should result while if the game design and playability are not solid, then one should not expect learning gains.

Learning through failure

Students' motivation to learn tends to be greater via videogame play since the consequence of failure in videogames is low when compared to traditional teaching and learning methods (Salen, 2008; Sharritt & Suthers, 2011; Juul, 2013). By participating in SEGs, when one finds that their strategies lead to failure they can then attempt to try new or different strategies (Sharritt & Suthers, 2011). However, when one's strategies lead to failure in traditional learning environments then that leads to discouraging consequences, such as receiving low grades, which can further inhibit one's motivation to learn (Sharritt & Suthers, 2011). The assessment that occurs via videogame play occurs as the learner's own self-regulatory process, whereas assessment in traditional learning environments takes place via an external evaluator (Sharritt & Suthers, 2011). According to Erhel and Jamet (2013), a game environment is able to promote learning and motivation as long as it contains features, such as feedback, that prompt the game players to actively process the educational content that is learned. Failure is bad in school but not in games. Games can be designed with a scaffolded safety net where the game differentiates skills and content based on student/player response to actions in game (Vallett and Annetta, 2014).

Franco (2012) presented *Foldit*, a multiplayer online biochemistry game that serves as a teaching tool for the folding, interactions, and structure of proteins for undergraduate university students. This game was to be used not only in biochemistry, but also in general, organic, and biochemistry (GOB) courses. This particular gaming program consists of tutorial puzzles whose purpose is to introduce students to concepts related to not only the subject matter being taught (biochemistry), but also to concepts of gaming. The game also contains scientific puzzles, which serve the purpose of presenting students with the opportunity to contribute to research. Examples of chemistry concepts that are covered by the tutorial puzzles in the *Foldit* game include structures of proteins and other biological molecules, intra and intermolecular interactions, and molecular folding. The intention of this particular gaming activity was to be used as a homework project over a period of several weeks while students cover the topic of protein structure in class. The goal of *Foldit* is to reinforce the concepts that are covered in class (Franco, 2012). *Foldit* provides an example of how games can be used to virtually simulate experiences that are not possible to simulate in real life or via textbook in that it allows students an opportunity to learn about and view proteins and other biological molecules at the molecular level, which is not possible to observe visually with the naked eye in real life scenarios. *Foldit* rose to fame because the game's players solved the protein folding process of an HIV enxzyme through trial-and-error that has riddled practicing scientists for years.

Conclusion

Since the advent of technology, mankind has continued to find new ways to instill fear into the hearts of society. Societal pressures, according to the predictions of George Orwell and Aldous Huxley, suggest mankind is doomed with the advent of technology. Hollywood has made movies about how technology like artificial intelligence and robotics will take over the world and enslave civilization or a super computer will take over mankind through the Internet, controlling everyone's home and handheld computers. On the other hand, the human genome was sequenced due to the advent of technology. DNA fingerprinting, MRI, In-vitro fertilization, satellites, jet airliner, scanning microscope, and genetic engineering makes insulin and medication for hemophiliacs, etc. All of these inventions have changed civilization through the use of technology. Thus far, most of the research that draws correlations between technology usage and negative impact provides examples that are inconclusive. The majority of the research states that excessive use of technology is harmful. However, in reality, and through alternative research literature, it can be argued that anything that is done excessively is harmful. Research makes correlations between depression and psychological issues and excessive Internet usage and they are unsure which came first: the depression and psychological issues or Internet addiction. Many researchers warn against the detrimental effects of violent games (Gunter, 2016; Hilgard, 2016). Likewise, it can again be argued that anything violent will have negative effects on children, adolescents, and teenagers, not just videogames and some argue it is not the game that brings out the aggression but rather an underlying psychological disorder (Ferguson, 2015). According to Piaget (1964), to attain knowledge is not rote memorization but rather is the ability to manipulate the acquired knowledge (as cited in Piaget, 2003). The use of computers can help to go beyond memorization as students can use higher order learning skills to comprehend and manipulate the concept.

Serious Educational Games are somewhat novel technologies being used more-and-more in traditional and online schools. It can be argued that many use SEGs without understanding their impact on the teaching and learning process; but that is a challenge to researchers. The field needs to not only publish more about the efficacy of SEGs in K-12 and online settings, but work to improve the quality of SEGs both technically and educationally. Having high quality SEGs co-designed by teachers, students, researchers, and game designers is a critical step in ensuring SEGs have the flare of commercial games with the educational qualities of the standards-based curriculum. Cognitive attributes pertaining to learning through SEG design and/or play heavily depend on how these technologies are integrated into the curriculum (Cheng and Wu, 2016).

As Sadler, Romine, Menon, Ferdig, and Annetta (2015) contended, implications for game-based science learning and future research include building better awareness of technological and professional development challenges associated with implementing SEGs, the need for new strategies for understanding the impacts of SEGs for learning, and the need for cost–benefit analyses in the planning of game-based educational approaches. To build a SEG based curriculum, teachers need proper professional development to seamlessly integrate such activities. This doesn't only mean teachers integrating SEGs that are already created for students to play (e.g., *Mission BioTech*) but also using the SEG design and development process as a way to include engineering practices in STEM settings (Annetta & Minogue (2016).

Vallett, Annetta, Lamb, and Bowling (2014) proposed a continuum of innovation teachers bring to professional development settings when using new technologies. Using Rodgers' 5-stage Diffusion of Innovation Theory, this research suggested teachers who identify as innovators or early adaptors are more likely to have a positive attitude and more willing to try new technological advances in their teaching practice. This idea suggests some prior planning by professional development facilitators when using new technologies with teachers.

The future of SEG research lay in the use of these environments as a supplement or replacement to standardized tests. This approach would seem radical to many but assessment is one area of education that is under constant scrutiny. As it pertains to science, assessment is often argued to be best when it is more performance based. Standardized (bubble sheet) tests cannot provide true insight into what a student knows about science content or concepts. A lab practicum would be one way to truly assess student knowledge but that is often not practical. Creating SEGs with embedded content and subsequent assessment is the next wave of research for these environments and arguably the most important potential of technology use in schools. With a focus on big data and analytics, SEGs could provide extremely large data streams that if properly coded and tagged could provide real time assessment to teachers regardless of if they are in person or online, synchronous or asynchronous.

The final piece is the understanding the learning is a process and failing is a very important part of that process. As previously mentioned, gamers understand the importance of failure. Game logic allows the player to fail while scaffolding learning subsequent attempts at the game. The challenge in education is the race against time. Teachers and students alike feel pressure to do more instead of doing better (i.e., quantity over quality). As anyone reading this chapter and this book understands, failure is often the best learning experience. Researchers and teachers using SEGs should not be afraid to fail but rather plan well and learn from your students.

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Mobile Learning

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Abstract

Mobile devices have been the focus in many nations and internationally as part of efforts to achieve greater literacy and numeracy among students as core goals, and increasingly in support of non-cognitive skills and the flexible and mastery learning pathways being adopted in schools. Research has shown a strong link between Internet usage, the spread of broadband in a country, and its GDP. Those countries that are the highest performing educationally already integrate mobile devices in their education. This paper synthesizes empirical research on mobile devices from 2010 to 2017 in K-12 schools by focusing on studies that demonstrate emerging themes in this area. It is clear that the pedagogy needed to be effective with mobile learning has to be student-centered with the aim of personalizing the learning experience including rethinking assessment of learning and design of learning spaces. Research found that students could become collaborators in designing their own learning process. As students become independent learners, they become more prepared in the skills needed for college and in their careers.

Keywords: mobile learning, tablet computing, personalized learning, collaborative learning, learning environments

Introduction

Maximizing school learning to best benefit individuals and communities requires individualizing educational experiences and maximizing resources for each learner. The key roles of technology in individualizing learning include providing anytime anywhere access to education tools and content, and guiding the use of the tools and content with flexible and responsive path, pace, and pedagogy according to learner needs, interests, and choices. Ubiquitous access to these learning environments is intended to enhance engagement, thereby amplifying knowledge acquisition, skill development, and application of learning in complex and authentic tasks (Shayovits & Asaf, 2017). Personalized learning is a promising way to differentiate pedagogy, increase equity, and better prepare all students for college, career, and community engagement (Bayse, Grant, Hausman & Johnston, 2015). Effective personalized learning environments provide tools and learning resources that students use in self-directed and self-paced learning. Because learning is deepest with guidance and interaction, the content and tools should be collaborative (Barnes, 2017).

This chapter explores anytime anywhere learning by synthesizing recent research in K-12 mobile learning. Operationally defined here, mobile learning or m-learning includes school learning experiences and environments that are accessible to students in and out of school with devices and services that go with students when and where they learn, including in blended and online programs. These environments may include laptop computers; however, they increasingly include tablet devices and mobile phones, sometimes connected to drones, Internet of Things and other microcontrollers, augmented and virtual reality. A recent meta-analysis found that mobile learning for K-12 mathematics, science and reading resulted in higher achievement scores in all subjects compared with traditional teaching, with significant effects in mathematics (Tingir, Cavlazoglu, Caliskan, Koklu, & Intepe-Tingir, 2017) and a review of research on tablet computing endorses their value to “viably support children so they are able to complete a variety of learning tasks.” (Hassler, Major & Hennessy, 2016). We review relevant research across mobile devices, specifying the form when possible, to enable educators, leaders, and researchers to understand the potential and success factors.

School age children experience a wide range of physical and cognitive development stages from entry to school leaving. Thus, these stages have implications for learning environments, tools and resources, the roles of teachers, and educator professional development, and these differences should be considered when applying the research findings that follow. Table 1 briefly outlines the differences between categories and implications as they pertain to mobile learning.

Category of difference	**Early years (age 5-10)**	**Later years (age 11-18)**
Cognitive development (Piaget, 1973)	Concrete thinking is strengthened as the foundation for abstract reasoning.	Abstract reasoning develops and is refined.
Optimizing learning (Papert, 1996)	Cognitive development depends on manipulation of physical and virtual objects. Logo, Turtle, Scratch are examples that bridge physical and virtual.	Conceptual development depends on exploration and manipulations of ideas and principles. Coding and cognitive mapping are examples.
Learning environments (Vygotsky, 1978)	Schooling emphasizes limited social development, real world experiences, and exploration of things and situations. Learning is guided by teacher feedback.	Schooling emphasizes broad social development, pre-professional experiences, and exploration of roles and identity. Learning is guided by peer and expert feedback.
Pedagogical content knowledge (Shulman, 1986)	Teachers emphasize content through alternative forms of representation.	Teachers combine the two domains of knowledge into pedagogical-content knowledge.
Roles of teachers (Mishra & Koehler, 2006)	Teachers guide psychomotor and cognitive skills, and development of close social ties.	Teachers guide conceptual and reasoning skills, and development of social ties.
Educator professional development (Laurillard, 2012)	Professional development focuses on media to present content, tools to create media in application of content, concrete skill development, personalization.	Professional development focuses on data and abstract representations, tools to visualize and explore concepts, systems for collaboration and integration into communities and professions.
Technology affordances (Jonassen, 2012)	Technology must be media-rich with power for knowledge acquisition and demonstration of learning, embedded in story; technology must be an interface with the physical world.	Technology must be data-and collaboration-rich, with powerful tools that connect to the world of ideas, embedded in relationships; technology must be an interface with communities.

Table 1. Learner stages that influence design of mobile learning approaches.

In the following section we review learning affordances and limitations of mobile technology for primary and secondary students from empirical studies, national and academic perspectives. Then we offer some implications and recommendations for policy, practice, leadership, and research in order to guide adoption and advancement of K–12 mobile learning.

Research Guided Policy and Practice on Mobile Learning

The design and implementation of a mobile learning program depends on the vision and needs of a school or government. Documented purposes include influencing student achievement (Martin & Ertzberger, 2013; Wu, et al., 2012; Hodgson & Hui, 2017), increasing student-centered teaching practices (Cochrane, Narayan, & Oldfield, 2013) closing the digital divide (Traxler, 2010; OECD, 2017), and improving family involvement in education (Kim, Hagashi, Carillo, Gonzales, Makany, Lee, & Garate, 2011). Personalization of learning (Sattler et al., 2011; Melhuish & Falloon, 2010; Peng et al., 2009) is a recent addition to the goals for mobile programs in schools, by capitalizing on student familiarity with and demand for use of mobile devices in their learning experiences (Bayse, Grant, Hausman & Johnston, 2015), and by expanding the learning environment (Sawai, 2017; McCarthy, Maor, & McConney, 2017). Past rationale have focused on improving the conditions that influence learning, such as student engagement, motivation, attitude and confidence and student organization, study skills and study habits (Gardner, Morrison, & Jarman, 1993; Warschauer, 2006; Benton, 2012; Schimanke, Mertens, & Vornberger, 2017). Reasons related to teaching practice now cite collaboration (Park, 2011; Sattler et al., 2011; Pettit & Kukulska-Hulme, 2007; Motiwalla, 2007, Maor, 2008) more commonly than previous goals that included student-centered practices (Fairman, 2004; Cavanaugh, Dawson & Ritzhaupt, 2011), inquiry-based practices (Fisher & Stolarchuk, 1998; Shayovits & Asaf, 2017), cooperative learning and project-based instruction (Warschauer & Sahl, 2002; Fairman, 2004), and differentiated instruction (Fairman, 2004). Academically, with the added emphasis worldwide in measures such as PISA, mobile devices have been associated with student acquisition of 21st century skills (Wakefield & Smith, 2012) and general academic skills (Shin, Norris & Soloway, 2007).

The collaborative capacity of mobile devices and learning environments are very well suited to cognitive development. It is accepted in learning sciences that multiple forms of conversation, interaction, and collaboration amplify learning. Research in mobile learning environments (Ekanayake & Wishart, 2011; Zurita & Nussbaum, 2004) shows significant learning gains with mobile collaboration. Language, mathematics, and academic skills are complex cognitive processes requiring immersion and practice over time. Success can be magnified by mobile learning because learning time and the learning environment can extend far beyond the classroom and class period. Mobile devices, digital resources, and collaborative learning tools give each student continual access to the types of self-directed, personalized learning that expands learning as needed throughout the duration of a course with the teacher's support (Graham, 2006; OECD, 2015). Among the highly effective learning approaches (Hattie, 2013) that are well-supported by mobile learning are vocabulary programs (language practice, games), creativity programs (drawing, writing, video), meta-cognitive strategies (mind mapping, brainstorming), reflection (journals, portfolios, note taking), feedback on performance, especially formative evaluation (annotation of student work, peer review, polling), spaced practice (flashcards and formative assessment apps), and mastery learning (adaptive lessons and games). In the sciences and social studies, much mobile learning research at K-12 levels applies augmented reality in ways that increases meaningful learning of complex concepts and systems due to authentic opportunities to explore time and space (Cavanaugh, 2011).

Learning language and mathematics with technology is most effective by far when the use of the technology tools are controlled by students and when the technology is flexible and open-ended, such as through the use of mind tools including word processors, digital notebooks, and spreadsheets (Hattie, 2013, Jonassen, 2012). Further, learning with technology is far more effective when peer learning and interaction are optimized, such as with collaborative tools (Hattie, 2013) or assistive technology tools (Maor, Currie, & Drewry, 2011).

The World Bank and Brookings Institute research (Yuki & Kamayama, 2013) indicates that school mathematics results correspond to increased GDP and income. Effective mathematics education must engage and inspire, and equip students with cognitive skills by using compelling mind tools and valuing open-ended explorations (Jonassen, 2012). Mobile learning approaches teach mathematical skills and strategic thinking in primary and secondary level students, as well as expanding learning time in mathematics (van't Hooft, 2013).

Regarding language learning, the strongest impact on reading skills comes from attention to spatial and auditory perception, skills that are well-supported using technology (Hattie, 2013). Writing skills are best developed through strategies and practice in planning and revising, especially in peer groups, activities that are effective in shared text and journal apps (Hattie, 2013). It is through this type of "comprehensible input" that seems to be the most direct path to acquiring the grammar and vocabulary of a language, and to applying the language in real communicative situations (Krashen, 2003; Watson, 2009). Mobile learning environments support classroom and out-of-class comprehensible input through engagement in a receptive stage of reading and listening followed by a productive stage of speaking and writing because all of the tools are easily accessed and learned. A large study involving 10 schools in two US states examining mobile learning and literacy suggests that mobile devices have contributed to students gaining broad skills, knowledge, and abilities that support learning and literacy development (Warschauer, 2006). The study documents shifts toward interdisciplinary, iterative, public, collaborative, purposeful, and authentic writing tasks along with increased range in writing. The study also suggests mobile computing leads to higher quality student work, more autonomy in the writing process, more individualized learning, and development of multimedia literacy that integrates 21st century skills (Warschauer, 2006). Overall writing ability increased significantly, with the largest increases noted in groups who used mobile devices in all stages of the writing process (Warschauer, 2009). Mobile language learning systems were found to be effective and engaging for vocabulary development through spaced practice (Thornton & Houser, 2004). Research showed that reluctant readers were more motivated to read eBooks on mobile devices (Maynard, 2010). In language application, students appear to analyze and synthesize text better with graphic organizer apps than when they use non-technology tools (Garcia, 2011). Language learning has benefited from the anytime capabilities of mobile technology (van't Hooft , 2013).

Assessment of student learning in the mobile environment should be a seamless, developmental, and integrated part of the learning process (Hill & Barber, 2015) using forms such as portfolio, project-based, and other performance assessment aligned with development of academic and 21st century knowledge, skills, and dispositions. Marking rubrics aligned to each assessment approach can be embedded in the collaborative environment shared production tools. Assessment that centers on formative feedback is among the most effective practices (Hattie, 2013). Mobile technology enables frequent feedback, as well as reflection on learning that develops metacognition supported by research in persistence (Dweck, 2006). Shared note taking and journaling apps have been shown to improve student exam performance when it is used to prepare and to reflect on learning (Michaelsen & Mohr, 2010), and to improve note taking quantity and efficiency in students with learning disabilities such as dyslexia (Garbo, Mangiatordi & Negri, 2012).

The following section presents an overview of recent research to ascertain what empirical studies say about K-12 mobile learning environments.

What does the research say about m-learning?

Our analysis began with an electronic based search of a number of educational databases of Proquest; Educational Resources Information Centre (ERIC) and A+ Education Informit. The initial search was limited to peer reviewed documents between 2010 and 2017 using the key terms "m-learning" and "mobile learning". The search was further refined by including more keywords, "peer learning" and "K-12", and another set of technological terms such as "mobile learning"; "tablet computing" and "school" and "personalized learning". In the final cull, abstracts and papers were reviewed and those papers which were based on empirical research and within a K-12 setting were kept for further consideration. Finally, we selected 13 studies from 2010-2017 to identify the major themes in mobile learning research

The 13 selected research articles illustrate a very interesting scenario about pedagogical models and the teacher's role in personalizing learning. M-learning in these research studies allowed for flexibility, customization, collaboration, and co-creation. The use of a Mobile Adaptive Learning System in high school (Hsu et al. 2013) or a tailor-made eBook in elementary schools (Yueh-Min et al. 2012) enhanced personalized learning and enabled students to practice language study anywhere and anytime. An investigation (Yueh-Min et al., 2012) into how students' personalized learning using smartphones in primary science classrooms found that a goal-based approach supported the students in personalizing their learning. Students using mobile phones in a middle school who worked as mathematicians to explore authentic problems (Daher, 2010) resulted in the construction of useful knowledge in mathematics. Learning rhythmic gymnastics significantly improved for students using mobile learning due to a balance of flexible learning time and discussion, although instructors have experienced some difficulty in learning the new pedagogies and technology (Shi, Chen & Wang, 2017).

When using text-messaging in a secondary school on personal mobile phones (Faure & Orthober, 2011), the asynchronous nature of texting enabled the students to reflect more although some teachers were reluctant to use mobile phones. Others (Riconscente, 2013; Lan, et al, 2010) explored the use of a fractions game application on iPads to examine students' fractions knowledge and attitude or the use of tablet PC to learn computational estimation skills. In both cases the use of mobile technologies helped elementary school students develop their mathematical skills.

In a study that involved a cloud-based adaptive learning system that incorporated mobile devices in year eight science classroom, Nedungadi and Raman (2012) found that through formative assessment the system provided teachers with real time feedback about individual and group learning. The framework also included pedagogical recommendations to the teachers that were based on the users' knowledge levels and preferences. Similarly, a study of iPads for early years literacy and numeracy saw a significant increase in phonological awareness and mathematics performance compared with non-iPad using students, and credited the gains to ongoing, informal feedback from students (Reeves, Gunter, & Lacey, 2017). Specifically, students' informal feedback guided teachers in evaluating apps for instructional value and in the decision whether to continue or discontinue use.

In a study that introduced mobile technology in a hospital school setting (Maor & Mitchem, 2015), researchers found that the use of mobile technologies was critical in engaging secondary school hospitalized students in learning and keeping them up-to-date with their schoolwork. According to the teachers, the adaptation affordance of the mobile technology allowed them to adjust the technology to the vulnerable adolescents' specific emotional and physical conditions. According to the students, it also helped to maintain normalcy at a time of great disruption. Furthermore, in this study the mobile technology not only improved students' educational experience but also reduced social isolation and improve wellbeing.

However, the results of using mobile tools were not always positive. According to Fitzsimmons (2011) when the iPad was used as a teaching tool, teachers were required to invest considerably more time in talk related to classroom control and resource management and students' engagement was lower than for comparable tasks when the iPads were not used. In an empirical study (Kim, et al., 2010) that involved 160 students in urban slum and rural village communities in Mexico, students in the rural village benefitted more from the mobile technologies, but there was no evidence about the teachers' perceptions or preparation of the technology. In this rural community the rapid adoption of the mobile learning technology was driven by the students rather than the teachers.

These exemplar studies found that students' personalized and cooperative learning were facilitated through the use of mobile devices. These empirical research were conducted mainly in elementary and middle school, and therefore more research is needed at the secondary level to help teachers develop appropriate pedagogies and to create greater understanding on the m-learning potential and its impact on students learning, especially given that by the age of 15, according to the PISA survey, students already have an average of five years using mobile technology (OECD, 2015).

National Perspectives for Mobile Learning

Governments and education institutions are under increasing pressure to rationalize new programs financially and educationally (Warschauer, 2009; Perkins & Saltsman, 2010). In many countries, mobile learning is embedded in a broader digital inclusion agenda that is promoted to enable all citizens to fully participate in their communities, benefit from online services, and access learning opportunities that will prepare them for the future workforce. "Some 125 million school children around the world remain illiterate, even after four years of attendance – a waste of $129 billion a year" (United Nations, 2014, np). Worldwide, countries are committed to universal access to quality education as a foundation for vibrant economies and societies. Technology access for students, teachers, and families empowers anyone, anywhere with the opportunity to have a top-quality education, in part because its reach and scalability exceed the capacity of many countries to provide universal traditional schooling. For all citizens, access to the global digital society means economic, employment, and social opportunities. For governments, increasing digital inclusion accelerates employment by bringing training in reach of all citizens. Education is the most significant factor correlated with entrepreneurial growth (McKay, Williams, Atkinson & Levin, 2014). Digital access is used to bring young children learning opportunities that speed school readiness, reduce holiday learning slides, and close achievement gaps among groups of students. Access to digital tools and content affords expanded learning time beyond the school day (Cavanaugh, 2009), which increases school engagement and completion.

In addition to the economic benefits, digital inclusion makes possible an array of social benefits. Digitally-empowered teachers and students are being leveraged around the world to alleviate numerous educational problems, including crowded schools, shortages of secondary courses needed by remedial or accelerated students, lack of access to qualified teachers in a local school, students who need to learn at a pace or in a place different from a school classroom (Ferdig & Cavanaugh, 2011; Ferdig, Cavanaugh & Freidhoff, 2012), and students in remote areas such as the outback of Australia (Barbour, 2011). Where a national vision of social and economic benefits from mobile technology aims for a knowledge-intensive economy, a greater premium is placed on cognitive skills and on lifelong learning, adapting, and innovating. Knowledge-intensive activity generates growth and expands exports, and thus may be crucial to national prosperity. Knowledge-intensive activities require application of significant intellectual effort, idea generating, and problem solving of the type that require extensive time with the mindtools of technology (Mares, et al., 2013). These benefits result in many positive contributions to society. An OECD report (2010) links home computer use to academic success.

Further, the longer a child has an Internet-connected device at home, the stronger are the academic benefits, even stronger than school computer use: according to the Broadband Commission, a joint body of the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the International Telecommunication Union (ITU), every 10 percent increase in broadband penetration results in additional growth of 1.3 percent in national gross domestic product (GDP) (Broadband Commission, 2010).

Education Policy Perspectives on Mobile Learning

As digital inclusion is approached, academic gains are expected. Lessons may be learned from international high performing schools that are benchmarking based on international measures such as PISA as well as UNESCO measures like child well-being and economic competitiveness. This approach was used in an analysis that identified noteworthy examples of educational transformation (Hargreaves & Shirley, 2012). Factors contributing to these successes are summarized in Table 2. Many of these high-performing education systems have already integrated mobile learning into their visions for transformation.

Systems	**Policies and practices**
Finland	Investment in teacher quality, teachers as curriculum developers, communities of educators, autonomy of schools, community participation in education
Singapore	Teaching with technology, school autonomy, learning-centered teaching, iterative innovation, collaboration within and among schools as well as with policy and research agencies, alignment of education strategy with national economic needs, mobile learning days
Alberta, Canada	School innovation and teacher inquiry focused on learning, networks of schools, long term vision and planning, education culture of risk and trust
Ontario, Canada	Education for all policy with differentiation and strategies for learning of all students, professional learning communities, inclusive pedagogy, assistive technology, local authority with integrated strategy and shared accountability
California, USA	Leadership focused on equity, Innovation of school structures to increase engagement and differentiation, inquiry at school level, professionals as intellectuals.

Table 2. Policies and practices of high-performing education systems

In addition to countries already identified as high-performing, several countries are adopting mobile learning as one of the reform strategies in their focused drives to become high-performing. These countries include the United Arab Emirates, Qatar, Malaysia, Mexico, Thailand, Slovakia, and Japan.

Parents and government leaders understandably focus attention and resources on schooling that will prepare students with core cognitive skills needed for college, higher education, career, and civic participation. Thus, educational initiatives including mobile learning are expected to develop thinking and communication with literacy and numeracy. To answer the question, "In what ways have school mobile learning programs related to improved literacy and mathematics achievement?", we can begin with the most recent Programme for International Student Assessment (PISA) results and map the most-improved countries to their national mobile technology programs (OECD, 2013). Between 2000 and 2015, the following countries have recorded the highest increases in math, science and reading mean scores, although starting points varied, so growth potential was relative as shown in Table 3.

Rank in improvement 2000-2015	**Mathematics**	**Increase in points**	**Reading**	**Increase in points**	**Science**	**Increase in points**
1	Peru	95	Peru	71	Peru	64
2	Brazil	43	Albania	56	Albania	51
3	Luxembourg	40	Chile	49	Portugal	42
4	Chile	39	Luxembourg	40	Luxembourg	40
5	Portugal	38	Russia	33	Israel	33
6	Israel	37	Latvia	30	Chile	32
7	Poland	34	Portugal	28	Latvia	30
8	Italy	33	Israel	27	Russia	27
9	Albania	32	Poland	27	Brazil	26
10	Mexico	21	Indonesia	26	Germany	22

Table 3. 2000-2015 PISA improvements

Among the six countries with the greatest overall academic improvement over the past decade in Science, Mathematics and Reading, the following instituted national or large-scale mobile learning programs and key policy changes, as shown in Table 4.

Policies that high-performing and improving countries have in common support student-centered learning with the affordance of mobile environments, showing the need for holistic planning (OECD, 2013). The key policies included highly qualified teachers, longer school days, technology for all students, and expanding preschool/primary education. Specific policy changes enacted between 2000 and 2015 by the most improved countries included the improvement of data and information on learning accessible to schools, increased student-computer ratios, and increased teacher qualifications and professional development.

Country	Mobile learning program	Policy changes
Chile	Eduinnova	Integrated professional development to transform pedagogy
Peru	OLC-Peru, PCs for all students in 500 schools,	Focus on rural schools, emphasis on collaboration in teaching and learning
Portugal	Magellan, public private partnership	Math Action plan and Technology Action plan
Albania	ICT in education a main direction in National Strategy 2008-2013, bringing increased mobile technology and infrastructure to schools	School reorganization to student centered approaches
Luxembourg		Back to basics program, innovative teaching schools

Table 4. Mobile learning and policy change in most-improved PISA countries

Professional Development for Mobile Learning

Time spent in professional development, especially collaborative professional development, is one of the most effective differentiators of high performing schools (Jensen, Hunter, Sonnemann & Cooper, 2014). Internationally and in the US, student academic achievement is linked directly to the time their teachers spend in professional learning, especially collaborative learning. Countries with high PISA results tend to be countries with more time in the teaching day for professional learning (OECD, 2011; Darling-Hammond, Wei & Andree, 2010). A holistic ecosystem of curriculum and content, pedagogical and leadership approaches, and technology-empowered learning environments can bring the vision to life, and points to quality criteria. Indeed, more than access to the technology is needed for effective integration into learning; teachers must have support and time to learn in order to build their confidence and comfort with m-learning pedagogy (Liu, Ritzhaupt, Dawson & Barron, 2017). The following holistic framework (Table 5) has been found to be effective in large-scale mobile learning programs (Cavanaugh, Hargis, Soto & Kamali, 2013).

Research in professional development for mobile learning indicates that educators most value having their individual needs considered, attention to time demands for learning, acknowledgement of their anxieties, and ways to get information on their fundamental questions (Psiropoulos, et al., 2014). These results suggest that ongoing, job-embedded, peer-facilitated approaches to professional development are needed, in keeping with the 4Cs model that follows.

1. **Champions.** The foundation of sustainable professional development for school transformation is local champions who are already innovative teachers, who engage in training on adopted changes and engage in interactive discussions, small group work, and the creation of samples of effective teaching, and who facilitate learning among colleagues.
2. **Create.** Educators and support professionals should identify exemplary student work, media assets, lessons, and assessments to share and refine as "creative commons" property in the learning community.
3. **Communicate.** Using virtual environments along with onground approaches, champions, and leaders facilitate sharing of pedagogical success so it builds quickly and efficiently. These communities connect every teacher to high-impact, personalized, and collaborative, job-embedded learning in iterative cycles of lesson study, looking at student work, creating content, and inquiry into practice (Dawson, Cavanaugh, & Ritzhaupt, 2012).
4. **Celebrate.** A teacher peer-sharing event is an occasion for faculty to share their experiences about using the

Vision for holistic education transformation (Why)		
Pillar 1. Where	Pillar 2. What	Pillar 3. How
What are the elements of the learning environments that will transform education?	What curriculum and content will transform education?	What pedagogical and leadership approaches transform education?
Levels of technology adoption: SAMR model (2012) • Substitution • Augmentation • Modification • Redefinition	21st Century Learning Foundational Knowledge Meta-Knowledge Humanistic Knowledge (Mishra & Kereluik, 2011)	Technology, Pedagogy, and Content Knowledge (TPACK) (Koehler & Mishra, 2009) framework for technology integration
Quality indicators and measures for education transformation		

Table 5. Framework for holistic professional development

innovations in teaching and learning. Celebrations should be regular events designed to move the culture of innovation and transformation forward (Cavanaugh, Hargis, Munns, & Kamali, 2013).

Implications for Policy and Practice

To increase the likelihood of education benefits for mobile learning, the following recommendations for implementation are offered. Innovative and effective schools with the attributes needed to envision and enact a successful mobile learning program are associated with a clear and specific vision for education and the role of the school (Jensen & Sonnemann, 2014). These schools recognize the importance of getting buy-in for change from across the system and throughout the school. These schools view technology as one of the tools needed to accomplish their goals, employed to enhance teaching and student learning (Cavanaugh, Dawson, & Ritzhaupt, 2011).

Schools leaders should consider classroom, school, district, and home factors, including policies and conditions that may enable or inhibit program success. These may relate to physical space, security of information and equipment, availability of digital curricula and library materials, and teacher latitude in forms of learning assessments (Newmann & Newmann, 2014). Mobile learning provides a way to engage the broad school community including earlier connections for preservice teachers with schools, sustained collaborative learning among school leaders, and supporting wellbeing of educators who may feel isolated from colleagues (Acedo, 2014; Baran, 2014; Kokores, Johnstone, King & Jones, 2017).

They should also include families in planning so they have opportunities to experience technology-empowered learning, understand how children will be protected, know that the teacher is central to facilitating mobile learning, and become advocates for the richness that technology brings to the classroom. Providing as much access to the technology as possible for students and teachers increases the level of control of the learning process and to expand learning time, especially for students at risk of not completing school (Cavanaugh, Repetto, Wayer, 2013). Teachers are encouraged to place instructional focus on interactive and collaborative uses of the technology, such as interactive books for literature circles, student design projects involving capturing and working with media, and engaging apps for practicing skills for mastery as well as deep learning. Integrating technology with curriculum and assessment helps to achieve clear, measurable educational objectives. These collaborations can be increasingly global with new on-the-fly voice and text language translation technology, prompting research opportunities to examine development of authentic 21st century skills. Using technology in ways to show students the process of problem solving and have opportunities to use technology in problem solving develops higher order thinking skills (Ritzhaupt, Dawson, Cavanaugh, 2012). In addition, attention should be given in schools to the holistic effects of mobile learning on learning outcomes, learning experiences, and distraction (Cho & Littenberg-Tobias, 2016).

Implications for Research

With the advance of technology, there has also been an increase in discovering aspects of learning that can be challenged by the technology and in particular there is concern of whether the digital pedagogies enable the teachers to maximize learning using the emerging technologies. Some of the following questions are major foci for future research and educational practitioners: What are the gaps in m-learning research? How affordable is the introduction of mobile technologies in the current classroom environment? How sustainable is the impact of technology on learning? What is the best practice for Professional Development? and to what extent do teachers and students as end-users take a role in planning and implementing this new emerging field? Other questions related to Professional Development include: What is the role of digital pedagogies in helping with PD, and what is the role of the PD in enhancing the use of mobile technologies in the K-12 curriculum and in special needs settings? These questions require continuous research in the K-12 m-learning environment.

To address this concern, detailed knowledge is needed for leaders, policymakers, educators, instructional designers, and professional development providers.

- Communities can benefit from research-based models for bridging education divides in places where schooling is not available, not practical for all children, and not enough for adults needing new skills.
- Educators, content developers, and mobile learning product developers can apply refined, research-based guidance on the specific device configurations, features, instructional design approaches, and pedagogical practices that can be expected to be effective for specific learners and learning environments.
- Teacher educators and providers of educator professional learning should have access to evidence-based recommendations on how teachers can best develop their mobile teaching skills. For example, will they lead students better in mobile learning environments if they have had success learning in these environments? Can pre-service teacher programs embed student in K-12 mobile learning programs in support of this goal? In what ways can mobile learning propel new education approaches such as collaborative assessment, competency based learning, and new pedagogies for deep learning?
- Educators and leaders can benefit from research showing how mobile learning can serve student outcomes.

At the macro level, larger scale studies are needed at elementary and high school levels to identify the gaps in our knowledge about mobile learning. In particular, there is a need to identify challenges, limitations, and to document the success stories in schools and in the community. To do this, more authentic research methods that involve teachers in the data collection and analysis processes should yield more sustainable results for the future. This may involve research from different paradigms, such as design-based research, participatory action research, or virtual ethnography. On a micro level some research showed (Israel et al., 2013) that students collaboratively informed the design process, which enhanced their learning. Therefore students can engage not only as learners but also as collaborators and designers of the learning process in particular where elements of gamification can be introduced in ways that align K-12 learning environments with professional contexts.

Conclusion

There appears to be a slight shift towards personalized learning and more collaboration among students in the pedagogy used with mobile devices. It would be interesting to discover if this was a result of studies such as PISA that emphasize personal achievements that are then translated into national scores. Mobile tools are uniquely suited to increase collaboration thereby empowering students to personalize each others' learning experiences.

One of the conclusions from the emerging research is that the design of pedagogical models is essential for better adaptation of the mobile devices to maximize learning and to make the environments flexible and accessible anytime anywhere. In particular, these pedagogical models should be based on the needs that teachers and students have expressed regarding personalized and collaborative learning styles. Continuous improvement of professional development for teachers based on rigorous research as well as teachers' lived experiences will contribute to the design of digital pedagogical models.

In the future the aim will be to develop apps that enable teachers and students to move seamlessly from personalized environments to collaborative environments. Another goal will be to design features of assessment activities with the ability to consult with the teacher and to share the results with the students. These apps on mobile devices should provide mobility, flexibility, and creativity in learning.

In this paper we demonstrated the multidimensional use of mobile devices to enable m-learning environments to challenge students in their learning. Students who use m-learning as their learning hub are prepared to be independent learners who are accomplished in the 21st century skills needed in higher education and workplaces where they adopted them (Beheshti, Jambhekar & Deloney, 2010; Barber, Haque & Gardner, 2009; Scott, 2011; Penciuc, Abel & Van den Abeele, 2012). These tools support knowledge sharing in distributed teams of the type students will join in college and later in their careers (Sharp, Giuffrida & Melnick, 2012). With a diversity of involvement in m-learning from teachers, policy makers, researchers, technologists, and end users; the students for whom this learning experience is aimed, there should be a greater chance that their achievements will result in a successful and sustainable story.

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PART VIII

K-12 Online Learning Around the World

Introduction

Michael Barbour

In Chapter 3, Barbour introduced his chapter that outlined the similarities and differences between how we view K–12 distance, online, and blended learning in North America compared to the experience of our colleagues in international contexts. He concluded his introduction by stating that:

> the reality is that the vast majority of the scholarship that is being published focuses on the United States (and to a lesser extent North America), even though there is a great deal of K–12 online and blended learning occurring outside of the United States. (p. 23)

The reasons for this state of the field are numerous, unintentional, and complicated. However, the addition of this section to the *Handbook of Research on K–12 Online and Blended Learning* is a purposeful step to begin to address this deficit.

This is not to say that there is a complete void of knowledge within North America about the international context. Most North American scholars are familiar with the international surveys conducted by the International Association for K–12 Online Learning (iNACOL) (Barbour, Brown, Waters, Hoey, Hunt, Kennedy, Ounswork, Powell, & Trim, 2011; Barbour, Hasler Waters, & Hunt, 2011; Powell & Patrick, 2006) or the "A Transnational Appraisal of Virtual School and College Provision" (VISCED) initiative (Bacsich, Bristow, Camilleri, de Beeck, Pepler, & Phillips, 2012; Bacsich, Pepler, Phillips, Öström, & Reynolds, 2012). Similarly, there have been extensive studies published about K–12 distance and online learning in Canada – from the annual *State of the Nation: K–12 e-Learning in Canada* reports (Barbour & LaBonte, 2017) to the work of Elizabeth Murphy (e.g., Murphy & Coffin, 2003; Murphy & Rodriguez, 2009a, 2009b; Murphy, & Rodríguez-Manzanares, 2008a, 2008b, 2008c, 2008d, 2008e, 2009; Nippard & Murphy, 2007). Further, most North American scholars would also be familiar with the extensive body of literature published on K–12 distance, online, and blended learning in New Zealand (e.g., Barbour, 2011; Bennett & Barbour, 2012; Lai & Pratt, 2009; Powell & Barbour, 2011; Pullar & Brennan, 2008) – much of which has been presented at North American conferences and/or published in major distance education journals. Even the South Korean Cyber Home Learning System has been highly publicized in the conferences and journals of the Association for the Advancement of Computing in Education (see An, Seo, & Lee, 2012; Bae, Han, Lee, & Lee, 2008; Kang, Kim, Yoon, & Chung, 2017; Kim, Seo, & Song, 2010; Kwon, Kang, & Bhang, 2007; Lee, Yoon, & Lee, 2013). Further, in her book *Development and Management of Virtual Schools: Issues and Trends*, Cavanaugh (2004) included four international chapters that focused on K–12 distance and online learning initiatives in Australia (i.e., one chapter), Canada (i.e., two chapters), and Singapore (i.e., one chapter). Additionally, in their book *Online and Distance Education in Schools: Global Perspectives on Policy and Practice*, Clark and Barbour (2015) included individual case studies focused on K–12 distance, online, blended, and mobile learning in Australia, Canada, Nepal, South Korea, and the United Kingdom.

Internationally, there has been an explosion of K–12 online and blended learning activity in the last few years. For example, the iNACOL *Online and Blended Learning: A Survey of Policy and Practice Around the World*, reported that among 54 countries responding to a 2010 survey, 65% indicated that K–12 online and blended learning opportunities were available to at least some students (Barbour, Brown et al., 2011). This international survey also reported that China began its first online school in 1996 (Barbour, Hasler Waters, & Hunt, 2011). By 2010–2011, there were about 600,000 enrollments in 200 online schools in China. Developed nations reported the most extensive programs, while students in urban areas tended to have had higher rates of access across nations and regions. About 60% of countries responding reported government funding for K-12 online and blended learning, especially for infrastructure. However, schools in many nations had high levels of autonomy in how they implemented online and blended learning, and often undertook grassroots efforts to develop courses, programs, curricular, and other online resources. While only one in four responding nations reported specific training requirements for online teaching, 72% reported that online and blended learning teachers in their nation participated in professional development for online teaching. These are the kinds of illustrations that are needed to provide a better understanding of K-12 distance, online, and blended learning in international contexts. Unfortunately, the iNACOL surveys were conducted in 2006 and 2011 and have not been repeated since. The VISCED initiative was funded throughout 2011-12, but then ceased operations and has simply been left online as an archive that is not updated.[1] The addition of this section to the *Handbook of Research on K-12 Online and Blended Learning* will provide authors an opportunity to update on a regular basis the practical examples and research focused on K-12 distance, online, and/or blended learning in their country as each new edition is released.

Summary of Chapters

The purpose of this section of the *Handbook of Research on K-12 Online and Blended Learning* is to begin to address the state of K-12 distance, online, and blended learning practice and research in a series of different countries. This section of the handbook begins with LaBonte and Barbour (primary researchers for the *State of the Nation: K-12 e-Learning in Canada* reports) providing an overview of K-12 distance, online, and blended learning – or what they refer to as e-learning – in Canada. Using data and information collected from the past ten years that the *State of the Nation* report has been published, LaBonte and Barbour provide an interesting historical context, as well as a description of the current state of affairs on a province-by-province, territory-by-territory basis. One of the interesting aspects of the chapter is the illustration of how a variety of consortia in several different jurisdictions have evolved to support e-learning programs in that country – something that has been relatively uncommon in the United States beyond the VHS Collaborative (formerly the Virtual High School).

In the next chapter, Pratt describes the development of supplemental online learning programs that began more than two decades ago in New Zealand. While some of these online learning programs – or e-learning clusters as they are called – have been quite successful, many of them have struggled and/or ceased to exist. Pratt focuses much of her discussion on one of the most successful clusters, OtagoNet (now NetNZ). One of the advantages of this case study approach using OtagoNet is the fact that it has been one of the most researched of any of the e-learning clusters. This body of research allows Pratt to provide a well-referenced illustration of how one of these e-learning clusters was able to transition from a program originally designed to service rural secondary schools in one small portion of the country to merge with other clusters and become a national entity.

Powell and Barbour then examine the development of e-learning in Singapore. Prior to the publication of this chapter, the few sources of information about e-learning in Singapore were the chapter in Cavanaugh's *Development and Management of Virtual Schools: Issues and Trends* book by Hin and Subramanian (2004), which focused specifically on the ScienceNet initiative, and the general overview of online and blended learning provided in the iNACOL international survey (Rai, 2011). In this chapter, Powell and Barbour describe how Singapore is a country that has a highly-centralized national government, and through the use of centralized planning in the form of successive five-year master plans, the government was able to modernize and reform the way that education was supported and delivered. This case study is a familiar tale for many Asian nations. While Singapore is the focus of this particular chapter, the narrative that Powell and Barbour provide is quite similar to the narratives about China and Hong Kong from the 2011 iNACOL international survey (Barbour, Hasler Waters, & Hunt, 2011).

In the following chapter, Jakobsdóttir and Jóhannsdóttir describe another country that has a highly centralized national government, but that has a completely different narrative in terms of its development of K-12 distance, online, and blended

1. See http://www.virtualschoolsandcolleges.info/ and http://www.virtualschoolsandcolleges.eu/index.php/Main_Page and http://virtual-learning.referata.com/wiki/Main_Page

learning. The authors describe numerous grassroots initiatives in Iceland that often caught the attention of and support from the national government. Jakobsdóttir and Jóhannsdóttir indicate that these initiatives have eventually led to national projects that have sparked the growth and current status of K-12 distance, online, and blended learning in Iceland. This development is similar to the experiences of a country like Turkey (Barbour, Hasler Waters, & Hunt, 2011), and to a lesser extent a country like Australia (although in the case of Australia there has yet to be any systematic national policy or initiatives) (Barbour & Kennedy, 2014).

Finally, Biton, Fellus, Raviv, and Fellus provide a chapter focused on research and practice in Israel. The Israeli Virtual High School was originally created to provide students with opportunities to enroll in advanced mathematics and science courses. Over time it evolved to provide a more extensive and well rounded set of curricular offerings, while at the same time pushing the teachers involved with this largely supplemental program to change their pedagogy – both in the online environment and their traditional face-to-face classrooms.

Conclusion

In the first edition of the *Handbook of Research on K-12 Online and Blended Learning*, Ferdig and Kennedy (2014) indicated that they had at least three main goals for this handbook:

> 1. To continue to strengthen our field by providing clear evidence of what is known and what is yet to be known;
> 2. To provide an empirical resource for researchers (new and experienced) as well as parents, media, administrators, and policy officials; and
> 3. To set in motion a yearly close examination of our field. (p. viii)

This international section achieves the first two of these goals, and it is hoped that in subsequent editions that the third goal will be achieved. The five chapters in this section provide the reader with an understanding of how K-12 distance, online, and blended learning has developed in each jurisdiction. In some cases this development has been caused by grassroots movements, and in other instances it has been due to centralized planning. In some jurisdictions there are single, nationwide projects; and in other jurisdictions there have been numerous, sometimes overlapping local initiatives. However, in each case the reader is left with a greater understanding of what is known, and what is still unknown, about K-12 distance, online, and blended learning in that jurisdiction (i.e., Ferdig and Kennedy's first goal). Further, the reader has also been provided with the names of innovation programs and important documents that they are able to use as a reference point to begin their own exploration of that jurisdiction (i.e., Ferdig and Kennedy's second goal). Finally, by their inclusion in this edition of the *Handbook of Research on K-12 Online and Blended Learning*, the authors will be given the opportunity to provide regular updates on the state of the field in their country (i.e., Ferdig and Kennedy's third goal).

Beyond the opportunity provided to the authors of the five jurisdictions that have been included in this volume, there are exponential opportunities for this section to grow in future editions of the *Handbook of Research on K-12 Online and Blended Learning*. As was noted above, there have already been numerous examples from the English language literature of K-12 distance, online, and blended learning initiatives in nations such as Australia, South Korea, and Turkey. There have been isolated examples in the literature from countries like Brazil, Mexico, Nepal, South Africa, and the United Kingdom. Finally, based on the iNACOL international surveys and the VISCED initiative, we know that there have been K-12 distance, online, and blended learning projects in jurisdictions like China, Finland, Hong Kong, India, Ireland, Latvia, Netherlands, and Portugal – just to name a few. Each of these jurisdictions offer the potential for new and interesting national examinations that would 'strengthen the field by providing evidence of what is known and what is yet to be known' in that jurisdiction, as well as providing 'empirical resources from that jurisdiction for researchers, parents, media, administrators, and policy officials.' It is hoped that the version of the "International Section" in the second edition of the *Handbook of Research on K-12 Online and Blended Learning* is simply a starting point, and that future editions will solicit chapters from even more countries.

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An Overview of eLearning Organizations and Practices in Canada

Randy LaBonte & Michael Barbour

Abstract

This chapter provides an overview of the state of K-12 online, blended and distance education, or e-learning, in Canada. A summary of the history of K-12 e-learning and research is provided along with enrolment, current policy and legislation. A description of programs is provided along with an overview of practitioner-based organizations and consortia that have evolved to support e-learning programs in the country. A discussion of issues in K-12 e-learning and research are included and the chapter's conclusion calls for more research and sharing of innovative practices emerging in Canada.

Introduction

Practitioners and researchers involved in K-12 online and blended learning are likely familiar with the development of the field within the United States as most of what has been written about K-12 has focused on experiences in the United States. However, the development of similar programs in other countries tells an equally important, yet unique, story. Barbour (2014) pointed out that, while there were similarities in the development of online and blended programs internationally, policies, funding, and regulations were distinctive in other countries and there were clear differences in how programs are regulated and managed. For example, in Canada there is no federal responsibility for education as in the United States (other than for Canadian First Nations communities), as such, policy and legislation varies across the country.

Canada ranks highly among the nations of the world in educational spending per capita, but does not have a national policy for, or governing body with jurisdiction over, education across the country. Only the Indigenous and Northern Affairs Canada (2017) has responsibility for K-12 education across the country as it finances elementary and secondary education for First Nations, Métis and Inuit students and provides funding to post-secondary institutions for development of university-level courses for First Nation, Métis and Inuit students. Canada is a confederation of 10 provinces and three territories that have responsibility for education. As such, each province and territory has a Ministry of Education that assumes the responsibility for the elementary, secondary and post-secondary education and develops the policies, standards, and curriculum to support student learning within their province or territory.

Similarities in the educational structure exist between the 13 regions: funding is provided through provincial taxes, and every school in the province or territory receives the same basic per-student funding based upon enrolment – usually through a local education authority such as a school district and/or school board; the school year generally operates from September through June; most provinces have a system that runs from kindergarten to grade 12, other than the province of Québec, which has formal schooling from kindergarten to grade 11 with students optionally continuing their education through a Collège d'enseignement général et professionnel (CEGEP), which comprises an additional two years of general or three years of technical education before college or university. Several provinces also support separate public education systems for religious or language preferences. While the structural similarities exist, the individual Ministries develop their curriculum to respect the unique geography, history and culture of their regions. For more information on the structure of education system in Canada and the role the federal government plays through these national programs (see Barbour, 2005a).

Because of its vast geography and rural settings, Canada has had a rich history in the field of online and blended learning. Distance education has been used in Canada to serve students in rural and remote communities for close to one hundred years. British Columbia, one of the leading provinces in the field, began using correspondence education in 1919 (Stack, 1990), and introduced virtual schools in 1993 (Barbour & Stewart, 2009). Despite this long history, there has been little written about the development of distance, online and blended learning programs in Canada as federal funding for the development of research related to K-12 e-learning in Canada is limited or non-existent as education is a provincial jurisdiction. Moreover, Canadian higher education research has focused largely on post-secondary institutions, so K-12 online and blended learning programs have continued to develop quietly with little dissemination outside of the country, or even between individual provinces and territories. One publication has endeavoured to fill this gap, and for the purposes of this chapter e-learning research policy, legislation, and enrolment information has been drawn primarily from the annual *State of the Nation Report: K-12 e-Learning in Canada* (see Barbour & LaBonte, 2016 and http://k12sotn.ca).

K-12 E-Learning in Canada

By land mass Canada is the world's second largest country bordering three oceans and boasting the longest coastline in the world. It comprises almost half of the North America continent with ten provinces spanning its 5500-kilometre (i.e., 3400 mile) width, and three territories in the north of its 4600-kilometre (i.e., 2900 mile) north-south expanse. Like countries that cover a large geographic area but have a relatively small population, Canada has a long history of using distance education, and recently online and blended learning at the K-12 level.

In Canada, K-12 online and blended learning programs range from traditional distance education models, evolved from paper-based correspondence education, to learning exclusively online or through a blended model where some of the instruction occurs online and in a face-to-face environment. For the purposes of this chapter, the term "e-learning" was used to describe both distance education as well as online and blended learning. This definition was consistent with other Canadian organizations, including the Canadian Council on Learning (2009), which defined e-learning as:

> The implementation of computer technologies to education. E-learning can take many forms, whether it is used face-to-face in classrooms, as a share of required classroom activities or stroke work (e.g., online discussions), or to deliver a fully online course. E-learning can include distance education as well as traditional in-class instruction. (p. 4)

The definition was also consistent with the recently formed Canadian eLearning Network (CANeLearn – see http://CANeLearn.net), a partner of the annual *State of the Nation: K-12 E-Learning in Canada* report, which used the term e-learning to include all forms of education delivered remotely or at a distance to students (e.g., correspondence, audiographics/telematics, video conferencing and e-learning).[1] The definition was also consistent with other countries, for example the New Zealand Ministry of Education (2006) defined e-learning as "learning and teaching that is facilitated by or supported through the smart use of information and communication technologies" (p. 2).

At present, every Canadian province and territory has some form of online distance education, or e-learning, program. However, it is important to note that, unlike in the United States, the primary driver of K-12 e-learning in Canada is government, not independent corporations providing education services as charter schools. In Canada, corporations are largely contractors that provide content, technologies, and other services to government-run programs. There are few, if any, proponents of the application of free market principles to public education, particularly in K-12 e-learning as there is in the United States.

K-12 e-learning roots began 100 years ago when a correspondence school in Canada opened in 1919 in British Columbia with a student population of 86 students, growing to over 600 students by 1929 (Dunae, 2006). Almost six and one half decades later, the use of technology-supported online learning also got its start in British Columbia with the creation of New Directions in Distance Learning and the EBUS Academy, both in 1993 (Dallas, 1999). This was quickly followed by district-based online programs in Manitoba, Ontario, Alberta, and Newfoundland and Labrador (Barker & Wendel, 2001; Barker, Wendall & Richmond, 1999; Haughey & Fenwick, 1996; Stevens & Mulcahy, 1997).

1. See the "Defining E-Learning in Canada" section of Barbour & LaBonte [2015] for a comprehensive discussion of the term.

The first virtual school established in Canada was the Avon Maitland Distance Education Centre, organized by the Avon Maitland District School Board in Ontario in 1994-95 (Barker & Wendel, 2001) – although unlike British Columbia which later established a virtual school, Avon Maitland did not offer any courses until 1997-98. The first virtual schools to offer multiple courses were the Electronic Distance Education Network in Ontario and a school-based program operated by Garden Valley Collegiate in Manitoba during the 1995-96 school year (Barker, Wendall & Richmond, 1999). There were also several school district consortia that offered K-12 online learning programs in Alberta (Haughey & Fenwick, 1996), where from 1995 to 1999 there were 23 district-based online learning programs in operation (Muirhead, 1999). Over the next decade, Alberta continued developing public and private district and multi-district programs, while the district initiatives in Newfoundland and Labrador expanded into the current provincial virtual school (Barbour, 2005b).

K-12 E-Learning Research

Research literature on K-12 e-learning has been sparse with most focused on two provinces – Alberta, and Newfoundland and Labrador (Barbour & Stewart, 2008). While the Canadian Teachers Federation (2000) appeared to have provided the first published estimates K-12 e-learning participation levels in Canada, since 2008-09 the annual *State of the Nation: K-12 E-Learning in Canada* reports have provided estimates of the level of K-12 distance education, online and – now – blended learning in Canada (Barbour & LaBonte, 2016). Much of the data in this section was drawn from that report.

Canada continues to have one of the highest per capita student enrolment in e-learning courses and programs of any jurisdiction in the world, and was one of the first countries to use the Internet to deliver distance learning courses to students (Barbour & LaBonte, 2015). With approximately 5.1 million students enrolled in education programs in Canada in the 2015-16 school year, it was estimated that the number of students engaged in K-12 e-learning that year was 293,401, or 5.7% of the overall K-12 student population (Barbour & LaBonte, 2016). The highest level of activity in e-learning by raw numbers was in Ontario, but by proportion of students involved British Columbia continued to lead the country. Some jurisdictions that actively collect such data report over 12% of K-12 students learning online, and in British Columbia some estimates now put the level of involvement at over 20% of the student population.

Further, there were an additional 405,319 or 7.9% of students known to be engaged in blended learning, where at least part of instruction occurs in a classroom, part online at a distance to the teacher, both combined with some element of choice in learning for students (Horn & Staker, 2011). Means, Murphy, Bakia, and Jones (2010) conducted a meta-analysis of available research in blended learning and assert that blended learning environments demonstrated a higher level of effectiveness than fully online or fully face-to-face environments. In addition, they found that when online courses are either teacher-directed, or contain a great deal of peer-to-peer support, the effectiveness of the approach is greater than courses that use a purely independent study approach. Blended learning that combines the best elements of online and face-face instruction are likely to emerge as the predominant teaching model of the future in Canada.

Finally, there are gaps in how data is collected and reported across the country, so it is not inconceivable to estimate the level of active learning in online and blended environments across the country to be as high as one in four students engaged in some form of e-learning. A shift to blended learning can also be a catalyst for change as it encourages the use of Web technologies and enhances student collaboration (Watson, 2008). Blended learning holds a great deal of promise as part of the change and innovation agenda underway for K-12 education in Canada.

Cross Canada Provincial E-Learning Overviews

Delivery of e-learning varies from jurisdiction to jurisdiction in Canada. Across the country, correspondence education is asynchronous and limited to province-wide programs focused on learners that have dropped out of the traditional K-12 environment or K-12 students who are enrolled in elementary level distance programs (although there is a growing number of elementary-focused programs that are transitioning to an asynchronous, online environment). The small, often pilot, programs in the northern territories generally utilize some form of video conferencing within their e-learning delivery model. Most remaining e-learning programs across Canada are using either an asynchronous, online delivery medium (i.e., primarily used with distance education students) or a blended learning format (i.e., solely used with local students enrolled in brick-and-mortar settings).

Most e-learning programs in Atlantic Canada are delivered through an online learning medium. While Nova Scotia and New Brunswick utilize an asynchronous model of online delivery, Newfoundland and Labrador relies upon a primarily synchronous model of online instruction. In fact, according to Barbour (2013), beyond individual remediation and small group tutoring, and other than the "real-time blended" courses offered to Anglophone students in Québec as a part of Leading English Education and Resource Network (LEARN), the Centre for Distance Learning and Innovation (CDLI) in Newfoundland and Labrador was the only online learning program in North America that utilized a primarily synchronous model through a software-based virtual classroom environment, as well as individual site-based Polycom video units. Further, in both Newfoundland and Labrador and New Brunswick the asynchronous course content and learning management system from the Ministry-managed online learning program can also be used by classroom teachers for blended learning purposes; similar situations exist in Ontario and Manitoba.

An overview of each province is provided here as background to the discussion section that follows. The information has been drawn from the Barbour and LaBonte (2016) *State of the Nation: K-12 E-Learning in Canada* report.

Newfoundland Labrador

The CDLI is the sole provider of K-12 distance education, or e-learning, in the province. During the 2015-16 school year, there were 1105 students registered and 1715 course registrations in 38 different courses representing 103 different schools. E-learning at the K-12 level is delivered using a combination of synchronous and asynchronous tools, with synchronous instruction being the primary method.

Nova Scotia

There are two distance education, or e-learning, programs in the province. First, the Nova Scotia Virtual School (NSVS) provided online courses to approximately 1300 students from the seven English-speaking school boards and the Conseil scolaire acadien provincial during the 2015-16 school year. Second, the correspondence studies program provided courses to approximately 1200 students enrolled in courses through the correspondence study program. Close to half of these 1200 students attend a public school, while the other half are adult students, home-schooled students, or students living outside of Nova Scotia. Currently, work is ongoing to transition these correspondence courses to an online delivery format.

New Brunswick (also providing services to Prince Edward Island)

Both the Anglophone and Francophone sectors of the Department of Education and Early Childhood Development manage K-12 distance, or e-learning programs. These programs service secondary students in New Brunswick in either of the province's two official languages. During the 2015-16 school year, there were approximately 1800 students enrolled in the Anglophone program and 727 students enrolled in the Francophone program.

Québec

During the 2015-16 school year, there were four e-learning programs in the province of Québec. The largest program was the Société de formation à distance des commissions scolaires du Québec (SOFAD) that primarily develops and produces correspondence learning materials that school boards utilize in their own district-based programs. SOFAD also provides an e-learning platform (i.e., EduSOFAD) that offers many of the courses online for the students who prefer that option. SOFAD served 30,072 adult students (16 years or older) during the 2015-16 school year, including 3231 course enrolments in EduSOFAD). The Centre d'apprentissage en ligne de la CSBE is the e-learning program offered by the Beauce-Etchemin School Board and had 1041 students enrolled in 21 remedial and 10 full-time online courses. Finally, LEARN provided a variety of e-learning opportunities to approximately 9,400 English-language students from all nine English-speaking school boards in the province.

Ontario

Each of the 60 English-speaking and 12 French-speaking school boards offered some form of e-learning using the Ministry-sponsored learning management system combined with the online curricular materials provided by the Ministry or of their own development. Additionally, the Independent Learning Centre (ILC) continues to provide correspondence opportunities to adolescent and adult students throughout the province. Finally, there are as many as eight different private or independent K-12 e-learning programs. The last year the Ministry of Education provided data to researchers was for the 2013-14, when they reported that there were approximately 52,095 students taking e-learning courses (including summer school). Data from more than 20 school board programs over the past two years estimated approximately 60,000 students were taking e-learning courses and that those programs have experienced a 30% to 35% growth in enrolment over the past two years. Based on this information, it was estimated that there were approximately 67,000 students taking e-learning courses during the 2015-16 school year. It is also estimated the ILC had approximately 20,000 students enrolled in their correspondence courses. The most recent data available indicated there were approximately 7,500 students enrolled in private online schools. One of the more successful, Virtual High School, offered the full Ontario Secondary School Diploma to students within the province, nationally, and internationally and in the 2009-10 school year had over two thirds of the province's independent school enrolments (Bennett, 2016).

Manitoba

Manitoba Education and Training continued to support three distance learning options in 2015-16: Independent Study Option (ISO), Teacher Mediated Option (TMO) and Web-Based Course (WBC) Option. The ISO (i.e., print) continued to offer 52 courses in English and 11 courses in French for grades 9-12 students. The TMO, which is managed by rural school divisions through the TMO Consortium in partnership with Manitoba Education and Training, offered 19 English courses for grades 9-12 students. The WBC Option provided access to 43 courses in English and 4 courses in French. Each school division in the province has participated in one or more of the above distance education program options; however, participation varies from year to year depending on the changing needs of students and schools. The numbers outlined for the 2015–16 school year indicated 1596 students accounted for 2668 enrolments in the ISO, approximately 100 students from 23 different schools accounted for 421 enrolments in the TMO and 6500 student enrolments in the WBC Option. Overall, there were approximately 9589 e-learning enrolments in programs directly supported by Manitoba Education and Training, and students could be enrolled in more than one program.

Saskatchewan

During the 2015-16 school year, there were 13 school divisions and three other providers of distance education, or e-learning, based on the Saskatchewan Distance Learning Course Repository (i.e., a centralized online course directory that is coordinated by the Ministry of Education). The Ministry indicated that it only gathered data for students taking online distance education courses that count towards completion of a secondary diploma at the 10, 20, 30 levels (i.e., grades 10 to 12). During the 2015-16 school year, there were 9784 secondary course enrolments involving 5235 unique students and 6418 credits were earned. The Ministry also indicated there were students in kindergarten through grade 9 taking courses online through a variety of providers, but the Ministry did not collect data about their involvement. Based on the most recent responses to an annual individual program survey, 13 of the 16 e-learning programs reported approximately 11,000 students engaged in some form of e-learning.

Alberta

It is believed that approximately 20 school divisions in the province offer an assortment of e-learning, catering mostly to students in their own geographic jurisdiction. Some of these district-based programs manage students in other regions of the province, but at present there is only one single province-wide program (i.e., the Alberta Distance Learning Centre [ADLC]) that offers courses to over 44,000 students in the province. The Ministry reported that the provincial student information database indicated that there were 9,985 students enrolled in e-learning programs during the 2015-16 school year, but many school authorities currently do not code their students as e-learning students. Accordingly, the actual number of students engaged in some form of e-learning across all education authorities is unknown. Based on the most recent responses of an annual individual program survey from 11 of the e-learning programs, there were approximately 50,000 students engaged in some form of e-learning.

British Columbia

In 2015-16 there were 59 district-level public distributed learning schools (i.e., e-learning providers) and 16 independent (i.e., private) distributed learning schools that enrolled approximately 69,735 unique students in one or more courses. The Ministry of Education, through its Open School BC division, manages a central, province-wide listing of all courses provided by distributed learning schools, as well as provides content and online hosting services on a cost-recovery model to school districts lacking the capacity or desire to manage their own.

Yukon Territory

While continuing to sign memorandums of understanding with the existing partner school districts in British Columbia and Alberta, Yukon Education is increasing the scope of e-learning program delivery through the Aurora Virtual School (AVS). In 2015-16, AVS managed courses for 57 grade 8-12 students taking at least one of the 35 e-learning courses. Additionally, there were 55 full-time and 37 supplemental students enrolled in distributed learning programs from British Columbia.

Northwest Territories

At present, the Beaufort Delta Education Council eLearning Program, which the Department of Education, Culture and Employment had undertaken a pilot project with over the past few years, was the primary provider of e-learning in the Northwest Territories. During the 2015-16 school year, 51 students were enrolled in one or more of the eight courses it offered. The territorial government had made the development of and support for this pilot project a priority over the next four years. Additionally, there were still 31 students enrolled in distance learning courses offered through the ADLC.

Nunavut Territory

Nunavut does not have its own K-12 e-learning program, but the territory government has agreements with several programs from other provinces. For example, during the 2015-16 school year the ADLC indicated that there were 313 Nunavut students enrolled in courses they offered. This figure included students in both K-12 schools and other post-secondary settings. Additionally, students attending four schools in three communities could access an online version of the CISCO program delivered through Contact North, an Ontario-based program that offers academic and trade-based curriculum to students in K-12, adult basic education, and post-secondary settings. It is expected that the territory's participation in Contact North will expand to include six schools in five communities next year.

First Nations, Métis and Inuit

At present, there are a total of three K-12 e-learning programs designated as First Nations, Métis and/or Inuit programs. One of these is in Ontario (i.e., Keewaytinook Internet High School), one in Manitoba (i.e., Wapaskwa Virtual Collegiate), and one in Alberta (i.e., SCcyber E-learning Community). There are other First Nations, Métis and Inuit organizations that have been exploring the adoption of K-12 e-learning, however, for a variety of reasons – lack of bandwidth or connectivity, lack of community buy-in, lack of expertise for implementation and others – they have not yet established programs. It is also important to note that there have been several other First Nations, Métis and Inuit e-learning programs that have ceased operation in recent years (for many of the same reasons, as well as changes in federal regulations on the funding of First Nations, Métis and Inuit education).

E-Learning Policy, Funding and Regulation

The nature of regulation for e-learning programs varies across the country with some provinces having significant regulatory requirements in legislation and collective agreements (Barbour & LaBonte, 2016). The two most common ways that e-learning programs are regulated include no regulation at all (i.e., Newfoundland and Labrador, Québec, Saskatchewan, Alberta, and federally) or the use of policy handbooks (i.e., New Brunswick, Ontario, Manitoba, and Northwest Territories). Two provinces that are unique in their regulatory context are Nova Scotia, which is governed by provisions in the Nova Scotia Teachers Union collective agreement, and British Columbia, which has significant provisions for the operation of e-learning programs in the *School Act* and *Independent School Act* as well as in provincial policy. The nature of provincial, territorial, and federal (in the case of First Nations, Métis, and Inuit programs) regulation provides a framework for how programs operate.

How individual programs are funded is an example of one of the issues that would fall under the provincial regulatory frameworks. For example, the e-learning programs in the Atlantic Canadian provinces operate as an entity within their Ministries of Education and, as such, are funded as a part of the Ministry overall operations. Québec is unique within the Canadian context in that e-learning programs are funded through a variety of individual project sources. For example, the LEARN program (see http://www.learnquebec.ca/) is largely funded through the Canada-Québec Ententé on minority language education and second-language instruction, which is under the responsibility of the Ministère de l'Éducation, du Loisir et du Sport. British Columbia is also unique as e-learning programs are funded based on their direct enrolment (i.e., full-time equivalent student) in the same way that brick-and-mortar schools are funded. In the remaining provinces, e-learning programs are primarily managed by individual school districts and are funded internally within the district. In some provinces, the Ministry of Education provides support for some related e-learning activities (e.g., Ontario and Manitoba), in Alberta the Ministry funds a provincial e-learning program, while in other provinces the Ministry does not resource district-based programs at all (e.g., Saskatchewan and Alberta).

The overall regulatory framework, as well as the nature of funding, allows or limits the resources that e-learning programs can access. For example, in Ontario the Ministry of Education – through e-Learning Ontario (see http://www.edu.gov.on.ca/elearning/) – provides digital course content for complete courses, as well as a learning management system to deliver that content to students on, for district-based e-learning programs for both Anglophone and Francophone students. The responsibility for maintaining and updating these e-learning courses falls upon the Ministry and its team of subject matter experts. Newfoundland and Labrador, as another example, directly contracts with individual course designers to develop their asynchronous course content (see Barbour [2005c; 2007] for an overview of this process). In Manitoba, school divisions and schools develop their own e-learning programs and determine how to infuse technology into their classrooms to best suit the needs of their learners. As in Ontario, the Ministry provides teachers with access to the provincial learning management system and asynchronous course content. However, in Saskatchewan, Alberta and British Columbia, individual e-learning programs must allocate internal resources for the development of their own course content and pay license and/or service fees for a learning management system to support distribution of the courses (although in British Columbia, these programs do generate funding based on their level of enrolment).

The level and specific source of funding also permits e-learning programs varying abilities to provide educational services and programming. For example, through the Canada-Québec Ententé the LEARN program in Québec provides a virtual school for students attending any of the English school boards at no cost to the individual school board. In addition to the Ententé funding, LEARN also receives individual contracts from the Ministère de l'Éducation, du Loisir et du Sport that allows them to provide a provincial database of curated educational resources available to the English school boards to use in their own blended learning activities. In Alberta, the ADLC under its current two-year direct service contract with Alberta Education, continues its mandate to "fill the gaps" and provide educational services to Alberta students not serviced by the local education authorities. In short, most e-learning programs across Canada are either funded by the Ministry through local education authorities or school districts or the Ministry operates the e-learning program themselves. As such, the nature of services and programming is either focused on specific district or provincial needs, or limited due to allocation of funding for other district or provincial programs and mandates.

Similarly, the level and sources of funding also affect the nature of staffing. For example, in Newfoundland and Labrador teachers are directly seconded to the CDLI by the Ministry to teach online full-time. However, most of these teachers remain physically located in the schools they were seconded from to provide the CDLI a presence throughout the province. In Ontario, teachers in the district-based e-learning programs are also generally located in the schools where they are employed, but their e-learning teaching assignment is only a portion of their overall assignment (i.e., the teacher teaches some courses in the traditional classroom for their school, and one or more courses online for their district's e-learning program). On the other hand, many of the district-based e-learning programs in British Columbia had full-time e-learning teachers centrally located, however some e-learning programs have started to diffuse their e-learning teachers throughout schools in their district.

Interestingly, British Columbia is only one jurisdiction that includes any form of quality standards as a part of its regulatory regime (Winkelmans, 2010). Beyond this there are no Canadian-specific e-learning quality standards. Outside of the Canadian context, early K-12 e-learning initiatives, such as the Virtual High School Global Consortium (Yamashiro & Zucker, 1999) and Electronic Classroom of Tomorrow in the United States, developed their own standards to measure the quality of their online course content. Since these early e-learning programs, numerous organizations like the National Education Association (Fulton, 2002; National Education Association, n.d.) and the Southern Regional Education Board (Thomas, 1999; 2000; 2003) have also released "national standards" to measure the quality of online course content and/or online teaching. More recently, International Association for K-12 Online Learning (iNACOL) released their own "national standards" focused on online course design, online teaching, and online programs. It should be noted that none of the iNACOL standards had ever been validated from a research perspective (Adelstein & Barbour, 2016). In fact, to date one of the only research-based initiatives examining the quality of online course content has been the proprietary Quality Matters program (Shattuck, 2015; Shattuck, Zimmerman, & Adair, 2014).

Supporting E-Learning in Canada

Successful e-learning programs require initial investments in digital resources, instructional design for effective deployment of these resources, technological infrastructure for delivery, and finally a teacher skilled in the use of technology and online pedagogies to guide student engagement with digital learning technologies, resources and courses, peers, and teachers. On their own, most education authorities have struggled to adequately resource e-learning programs given their complexity and upfront resourcing costs for content and technology. As such, many provinces have seen the development of various consortia to address this issue.

Consortia form based on common interests and benefits that include, but are not limited to: advocacy; information sharing; joint purchasing; content development; and professional development (Muirhead, 1999). Adekanmbi (2010) described several models of consortia including an association model, the voluntary coming together of various organizations to form an association based on mutual needs, and a shared resource model where institutions with common problems and practices share resources including expertise, learning resources, and technology. For the most part, the provincial consortia that have formed would be closer to a shared resource model, whereas the newly created CANeLearn, which does not have resources of its own to broker, is an association model. In both instances, Adekanmbi went on to caution that collaborative models, such as a shared resource or association model, can quickly fall apart should there be any doubt or lack of clarity about its purpose or funding. Leadership plays an important role in maintaining any consortium, but in the case of an association model, reliance on donor funding has likely led to the dissolution of many education consortia. However, Baus and Ramsbottom (1999) suggested that while the survival and effectiveness of an academic consortium is a complex endeavour, it is one that if done effectively can reap significant benefits for the organizations involved.

One of the first documented consortium to form was in Alberta where duplication of efforts in the initial development of online learning in the province occurred (Muirhead, 1999). Muirhead noted that, "despite differences in how partnerships, consortia, and alliances are defined, all involve some common action by members which is intended to result in shared mutual benefits" (p. 3). Alberta went on to create a provincial consortium, the Alberta Online Consortium, which later dissolved – likely the result of one or more of Muirhead's 'essential ingredients' of trust, respect, and integrity missing.

Despite several provincial and territorial Ministries now investing in e-learning, either directly with their own programs or through centralized resource and technology strategies to support e-learning in their jurisdictions, there continues to be a need at the local education authority level for sharing new network technologies, resources, and training to support teachers in the development and deployment of e-learning strategies. As a result, several consortia have emerged across Canada to address specific needs for e-learning within provincial jurisdictions.

In British Columbia, one of the first e-learning consortia to form was the Consortium of Online Learning, or COOL School as they were better known as (LaBonte, 2005). COOL School started as a group of four school districts began by sharing a learning management system through their region's community college and co-created content for use with their growing number of students taking courses online. COOL School morphed into a province-wide organization known as BCEd Online that received a grant from the provincial Ministry of Education. Later, when the Ministry created its own independent organization to implement e-learning programs at the provincial level, the practitioners who had built the original COOL School consortium came together again to form the BC Learning Network (see http://bclearningnetwork.com/). The consortium has expanded to include 51 British Columbia school districts, the Yukon Territory's e-learning program and now one Alberta program as well. As such, they have renamed themselves the Western Canada Learning Network and are committed to supporting e-learning programs for both fully online and classroom-based blended learning.

Other consortia have emerged in Canada as e-learning programs continue to emerge and expand. In Alberta, despite the dissolution of the Alberta Online Consortium, two new groups have emerged in the e-learning space: the blendED Alberta group and the Alberta Moodle Hub. blendED Alberta started as a volunteer group of Alberta teachers and administrators that organize an annual symposium (see http://www.blendedalberta.ca/) to foster blended and online learning through structured dialogue and sharing. The group recently applied for, and received, Alberta provincial non-profit status (i.e., Alberta's Blended Learning Society) and received a grant from the Alberta Education Ministry (T. Reid, personal communication, March 24, 2017). The Moodle Hub is a group of educators, primarily from Alberta, who share courses built on the Moodle open source learning management system (LMS) platform (https://moodle.org/) and meet regularly to share strategies related to the deployment of courses on the LMS.

In Manitoba, there are three provincially funded e-learning options (ISO, TMO and WBC). The TMO is managed by rural school divisions through the TMO Consortium in partnership with Manitoba Education and Training. While each school division in the province has participated in one or more of the three e-learning program options, only the TMO fits the criteria as a consortium. In Saskatchewan, the provincial Ministry of Education no longer offers centralized e-learning programs, just a Distance Learning Course Repository. Based on the data published in the annual *State of the Nation* report (Barbour & LaBonte, 2016), there are 16 programs engaged in some form of e-learning. While there is informal sharing, and an annual "Distance Learning Conference" where educators leading and teaching in e-learning programs meet to share ideas, there is no formal consortium model in place in the province.

In Ontario three consortia emerged to support e-learning delivered through the publicly funded Ontario School Boards: the Ontario eLearning Consortium (OeLC), Ontario Catholic eLearning Consoritum (OCeLC), and the Consortium d'apprentissage virtuel de langue française de l'Ontario (CAVLFO). In Ontario, the Ministry of Education through its e-learning division eLearning Ontario (see http://www.edu.gov.on.ca/elearning/), provides supports and resources, teacher training, awareness building and resource development for Ontario School Boards providing e-learning options for students. eLearning Ontario supports include free access to provincially licensed courses on the *Desire2Learn/Brightspace* LMS (see https://www.d2l.com/) along with teacher support through its online community (see https://community.elearningontario.ca/), but stops short of e-learning implementation which is the responsibility of the Ontario School Boards. The three consortia were formed to support the equitable access to e-learning courses and services across their member school boards while avoiding the duplication of efforts. While eLearning Ontario provides the 'tools' for e-learning to occur, each consortium coordinates efforts to deliver e-learning among member boards in an equitable and cost-effective manner.

The OeLC (see http://www.oelc.ca/) is a grassroots partnership of 22 Ontario school boards that began in 2001 to collectively support the delivery of online secondary Ontario courses, to develop and share e-learning resources, tools and procedures, to perform quality assurance for e-learning, while supporting educators delivering e-learning, and to increase learning opportunities for students. The OeLC member Ontario School Boards have entered mutual agreements to open their e-learning courses to all students within the consortium member boards without a course fee. The OeLC tracks course enrolments for each member board, and strives to balance the number of courses students of one board are provided with the number provided by that board to students within other consortium member boards. Similarly, the OCeLC (see http://www.ocelc.org/) consists of 29 Catholic school boards across Ontario who have joined together to provide equity of access for Catholic secondary students to take secondary credits developed and taught by Catholic teachers. OCeLC members collaborate with the Ontario Ministry, as do OeLC members, to support implementation of e-learning and enhance learning opportunities through e-learning for Ontario students.

Finally, the Consortium d'apprentissage virtuel de langue française de l'Ontario (CAVLFO, see http://www.apprentissageenligne.org/) is a consortium of all 12 of the Francophone Ontario School Boards. CAVLFO serves as the central program for the boards responsible for the provision of online courses and guidance related to e-learning for the students within the twelve school boards. CAVLFO also works in partnership with the Ontario Ministry of Education through the Apprentissage assisté par la technologie Ontario, the French language counterpart of eLearning Ontario, to provide e-learning opportunities for Francophone students in the province. In addition, CAVLFO works directly with Francophone post-secondary institutions in Ontario and Canada as well as with other Francophone e-learning programs in other provinces in the support of their e-learning program. CAVLFO also offers services and support to adult Francophone learners seeking to obtain an adult high school graduation degree through e-learning (for a discussion of how e-learning services and programs support minority language students across Canada, see LaBonte and Barbour [in press]).

In Québec there are two provincially funded programs for e-learning, one for Francophone students, SOFAD that provides an e-learning platform that offers many of their correspondence courses online for students who are 16 years or older and prefer to work online, and LEARN that provides a variety of distance learning opportunities to approximately 9,400 English-language students from all nine English-speaking school boards in the province. There is also an e-learning program offered by the Centre d'apprentissage en ligne of the Beauce-Etchemin School Board. As all programs are provincially funded, while there is collaboration amongst the programs and local boards in Québec, there is no formal agreement among them or a consortia model like in other provinces.

Finally, the Ministries of Education in the Atlantic provinces and northern Canada territories all offer provincially funded and based e-learning programs. Accordingly, there are no formal consortium models in those provinces and territories, however there is sharing between and among some of the provinces. The Yukon Territory Ministry operates one e-learning program and is a member of British Columbia's BC Learning Network consortium, and the Northwest Territories partner with the ADLC in support of offering e-learning services to its students. In most provinces, there are also annual gatherings (i.e. conferences and symposiums) where educators come together to share and learn more about e-learning programs, services, and strategies. For the most part the provincial Ministries support these events through annual grants.

Canadian eLearning Network

With education a provincial responsibility, no national organization has acted to support the expanding online and blended learning practices and e-learning programs in Canada. National associations in Canada's education community are typically focused on representing or advocating for a specific group of educators (i.e., administrators, counsellors, teachers, etc.), curriculum (i.e., computer science, math, etc.), or educational issue (i.e., language, disabilities, dropouts, etc.). Over the past decade, leaders of e-learning programs across Canada began meeting at conferences and events, particularly the iNACOL's annual symposium (see https://www.inacol.org/symposium/) and began networking and sharing. It was decided to expand the networking and host events in Canada, rather than meeting in the United States. Existing organizations were researched using the Canadian Education Association's Canadian Education Directory for a list of Canadian organizations (which is no longer available online) to determine if any of them would be a fit for supporting e-learning leaders and programs. The search determined there was no national organization focused specifically on supporting emerging pedagogy in online and blended learning, and none were determined to be a suitable fit for the needs of the founding members so a new organization was created.

The new national consortium was launched in July 2013, CANeLearn, with a mission to "provide leadership that champions student success by supporting organizations and educators involved in online and blended learning through networking, collaboration, and research opportunities" (Canadian eLearning Network, 2016, p. 3). CANeLearn, registered under Corporations Canada as a Canadian not-for-profit corporation, is a network of online and blended programs from across Canada, with the purpose of supporting networking, collaboration, and sharing between and among e-learning programs by fostering professional learning events, communication, research on e-learning, policy and professional standards, and to promote online and blended learning in Canada. Figure 1 provides a visual representation of the network's activities and achievements from its launch to today.

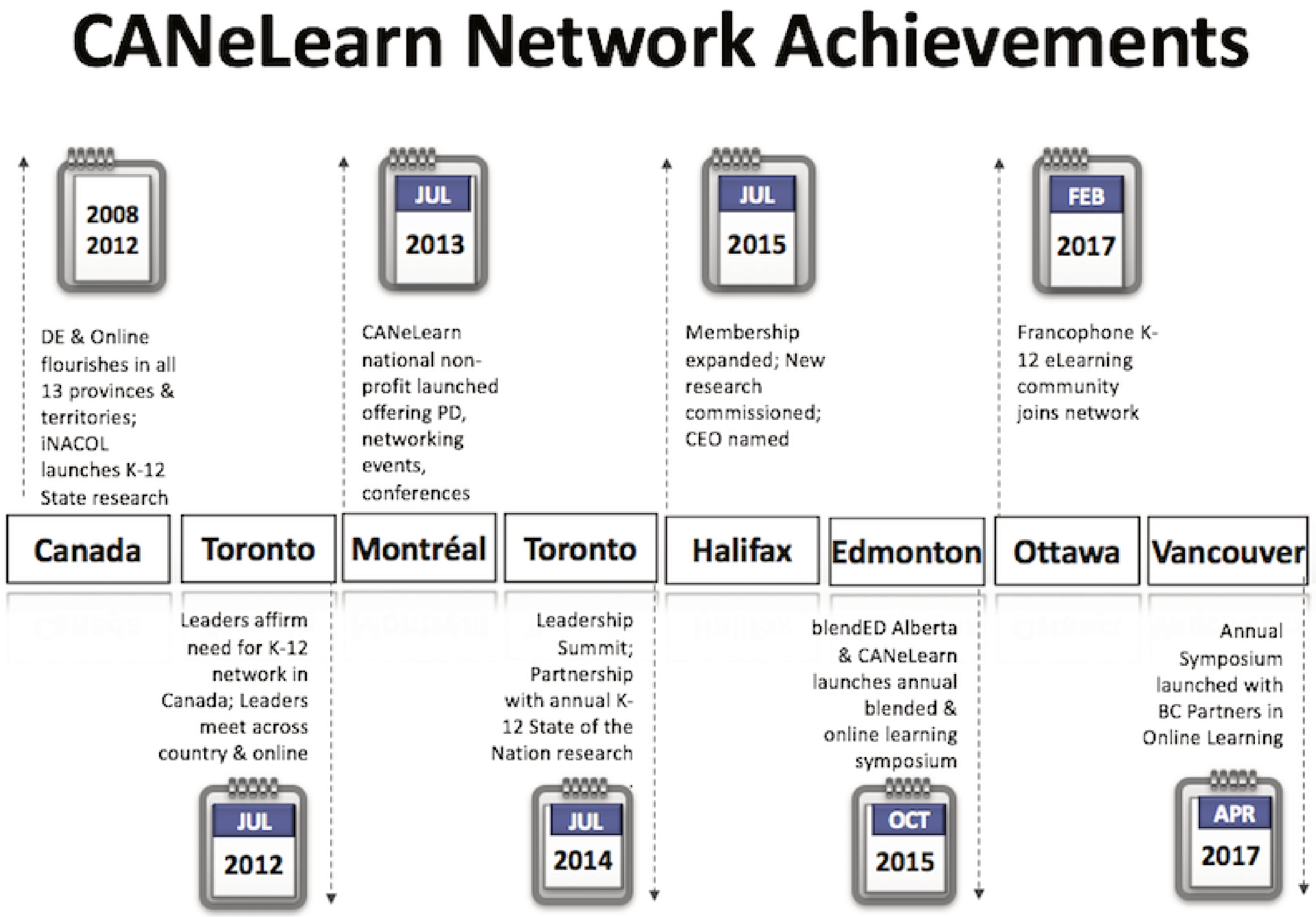

Figure 1. CANeLearn activities and achievements from 2008 to the present.

CANeLearn began growing as a network throughout 2014, expanding across the country as members met regionally at provincial events, as well as nationally every year in the summer. Meetings took place in Halifax, Toronto, Edmonton, Ottawa, and Vancouver. In 2015 the network expanded its research mandate beyond the annual *State of the Nation: K-12 e-Learning in Canada* to include commissioned research on digital assessment and minority language e-learning programs in Canada. That year CANeLearn worked with leaders in Alberta to help launch the annual blendED Alberta symposium. In 2017, the Francophone e-learning community expanded its membership and took a leadership role in the organization. Also in 2017 an agreement to host an annual symposium was formalized with the BC Partners in Online Learning.

Implications for Policy and Practice

With regulation for e-learning programs across the country varying from no regulation at all to regulation through policy handbooks, provisions in teacher collective agreements, or significant legislation and policy governing the operation of e-learning programs, the frameworks for how programs operate are significantly different across the country. Yet the programs operate in similar ways despite this. Most offer both synchronous (live, real-time) and asynchronous (individual, varied time) communications and interactions but with varying degrees of both. Most use some type of technology-based LMS, and all create digital learning resources that are often aggregated in their LMS. The need for educators skilled in the use of technology, the creation of digital learning content, and the application of online teaching pedagogies remain a constant for all jurisdictions and programs. However, as the overall regulatory framework affects the nature of funding, the resources that e-learning programs access varies and creates discrepancies among them regarding technologies, digital content, and teacher competency.

Some interesting lessons are emerging from the British Columbia experience. For example, the importance of policies that encourage online delivery is shown clearly in the sharp increase in enrolments that followed the policy changes to encourage student and parent choice by offering flexibility through distributed learning (i.e., e-learning) in the province. The enrolment changes in British Columbia also illuminate the importance of funding systems that encourage the operation of e-learning programs. Once the growth opportunities were clear to school boards and administrators, there was a rapid increase in the 'supply' of courses and services available to students. There are obvious implications for the support needed to develop, categorize, evaluate, and organize appropriate pedagogical content for delivery to students and teachers with British Columbia seeing many examples of duplication and overlap in local efforts to undertake these tasks.

In Newfoundland and Labrador, which in the past 25 years has faced a 50 percent decline in student enrolment – from 130,109 students in 1990 to 66,800 in 2016 (Mulcahy, 2017) – the CDLI was created and began offering e-learning courses in 2001-02. Prior to creation of the CDLI, the province faced persistent school closures – 281 in the same 25-year period of the rapid decline in student enrolment. The remaining small schools were in locations that made bussing students nearly impossible, so rather adopting a recommended policy of creating residential boarding schools for these students, the government created the CDLI to bring education to the students living in these remote communities through e-learning. Today the CDLI's staff comprised 46 including 29 e-teachers serving 1,105 students in 110 schools taking 42 high school courses. The CDLI's success has relied partly on policy decisions to employ teachers that have subject matter expertise and to offer synchronous, live exchanges between the e-teacher and online student.

There are also a growing number of education authorities that are adopting e-learning in an effort to break down classroom-based models of organization and governance, creating blended learning opportunities that offer both online and onsite learning access with student choice as an important component to the learning (Horn & Staker, 2011). As well, e-learning is also breaking down organizational barriers between K-12 and post-secondary education with several provinces already offering mixed-age classes with some students in grade 6 taking and passing grade 10 and 11 courses. The logical extension of this practice will be for students who are funded and managed as conventional secondary students to take a mix of secondary and post-secondary classes and many provinces are creating such programs or courses.

The e-learning environment enables quality control and improvement with educational audits and standards important foundations for improving quality. Courses are continuously improved and, because large groups of students can be aggregated from different areas of the province, teachers no longer need to teach multiple courses to obtain a full teaching load. In many rural communities, schools can remain open and students are not bussed kilometers away to meet with teachers and attend classes. Instead, the Internet is used as the network to connect students and teachers instantly, rather than students enduring lengthy physical travel over a rural road network.

As Canada does not coordinate e-learning or distance education policies and services nationally (Canadian Council of Learning, 2009) it is only through dialogue, initiative, partnership, and networking that sharing of ideas and resources between provinces and territories can occur. Organizations such as the Council for Ministers of Education in Canada (CMEC), and the Provincial Territorial Distance Education Association (PTDEA) – a committee originally reporting to the Council – provides one opportunity. However, the CANeLearn with its practitioner focus and base has an equally important role to play and is seen as an important vehicle for sharing among e-learning programs across the country.

Conclusion

Current research in electronic, online or distance learning in the K-12 sector is limited (Barbour & Kennedy, 2014; Barbour & Reeves, 2009; Cavanaugh, Barbour, & Clark, 2009, Patrick & Powell, 2009). According to Cavanaugh et al. (2009), the current research in K-12 had focused on defining distance learning and its current strengths and weaknesses. However, many K-12 classrooms, both online and onsite (i.e., traditional school-based classrooms), are incorporating technology-supported open learning options and resources and are not part of this research.

While blended learning is used extensively in many educational contexts (Picciano, Seaman, Shea, & Swan, 2012; Staker et al., 2011), research in blended learning environments is lagging far behind its practical applications (Drysdale, Graham, Halverson, & Spring, 2013; Means, Toyama, Murphy, Bakia, & Jones, 2010). In short, there is a clear need for further research in K-12 online and blended learning in general. Specific to Canada, fostering research of Canadian practice is key for growing its network of practitioners as this research will inform practice within the country as well as internationally. Both the CMEC in Canada, and its PTDEA committee and the newly-formed CANeLearn, with its practitioner focus and base, have important roles to play in the sharing and understanding of e-learning practice in Canada. Given Canada's rich experience in online and distance learning, an investment in Canadian-based research would be wise. CMEC can be an important part of informing provincial policy and legislation, while a national organization such as CANeLearn could foster, support, communicate and share such research in a manner that reaches local practitioners, not just academic journals.

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K-12 Online and Blended Learning in Aotearoa New Zealand

Keryn Pratt

Abstract

New Zealand schools use supplementary online learning approaches whereby students take classes from other schools using videoconferencing, the Internet, and other technologies. Particularly common in rural secondary schools, online blended learning and research regarding this have been conducted for over 15 years. This chapter presents an overview of this research, highlighting the impact it has had, and the implications for policies it practices. It then identifies areas where future research is needed.

Keywords: online, blended, videoconference, secondary, personalised, learning, New Zealand

Introduction

Aotearoa, or New Zealand, is a small country, located in the Tasman Sea. Its nearest neighbour is Australia, approximately 900 miles away. It comprises two main islands and a number of smaller ones. Its population of just under 4.7 million is largely based on the smaller of the main islands, the North Island, with around one-third of New Zealanders living in its largest city of Auckland. Only around one-quarter of New Zealand's population live on the South Island. Overall, then, New Zealand is a sparsely populated country with, on average, 41.0 people per square mile (compared to the United States at 85 people per square mile; http://wikipedia.org), and many areas with far fewer people per square mile. New Zealand's topography is also varied, with mountain ranges and lakes in both islands meaning sometimes even apparently short distances can take a long time to travel via road. It has three official languages, Māori (i.e., the language of the indigenous people of New Zealand), English, and New Zealand Sign Language. Although English is the most commonly spoken language, it is common to incorporate key words and phrases in Māori, such as in the name of the country, *Aotearoa* into everyday speech.

Children in New Zealand are required to attend school, or register as being home-schooled, from the age of six. Most start school, however, on the first day they are able to, the day they turn five. Students are generally required to attend school until the age of 16, although most continue until they are at least 17, and have gained a formal qualification. As Table 1 shows, compulsory schooling in New Zealand comprises of primary (also known as contributing primary), intermediate and secondary (also known as high school) levels.

Table 1. Comparison of school levels in New Zealand and the United States

	New Zealand		United States	
Age	Year	Level	Grade	Level
0-4			Nursery/PreK	
4-5			Pre-K	
5-6	0/1	Primary	Kindergarten	
6-7	2		1	Elementary
7-8	3		2	
8-9	4		3	
9-10	5		4	
10-11	6		5	
11-12	7	Intermediate	6	Junior High
12-13	8		7	
13-14	9	Secondary	8	
14-15	10		9	High School: Freshman
15-16	11		10	HS Sophomore
16-17	12		11	HS Junior
17-18	13		12	HS Senior

However, not all areas, particularly areas of less population, have separate intermediate schools. A number of primary schools incorporate the intermediate level students and are known as 'full primary' schools, meaning they comprise students from Year 0 to Year 8; that is, they incorporate the intermediate years. In other areas, the intermediate years are part of the secondary level, with these schools known as Year 7 to Year 13 schools. In addition, a final classification of schools – area schools – exists in areas with very small populations. These schools comprise students from all year levels. There are also a small number of composite schools, which comprise another combination of year levels. The Junior High model also occurs in small numbers, generally where one designated Year 7 to Year 13 secondary school has split their levels into a Year 7 to Year 10 Junior High School and a Year 9 to Year 13 Senior High School. See Table 2 below.

Table 2. Age and year level of students attending each of the types of school in New Zealand

Age	Year	Contrib-uting Primary	Full Primary	Inter-mediate	High School/ Secondary (7-13)	High School/ Secondary (9-13)	Area School (1-13)	Composite school (any combination)
5-6	0/1							
6-7	2							
7-8	3							
8-9	4							
9-10	5							
10-11	6							
11-12	7							
12-13	8							
13-14	9							
14-15	10							
15-16	11							
16-17	12							
17-18	13							

There was a substantial change to the nature of schooling in New Zealand in 1989, when 'Tomorrow's Schools' was introduced (for further detail of New Zealand's educational system, see Powell, 2011). This initiative saw the governance of schools devolved to the schools themselves. Each school elected a Board of Trustees, who was responsible for drafting school policies, directing curriculum, and allocating funding, within broad guidelines (Wylie, 1990). This move was intended to allow schools to better respond to the needs of their students. While all schools are required to teach to the New Zealand curriculum, under this learner-centred, personalised approach, schools are encouraged to identify how they can do so while meeting the needs of their students. This is possible as the curriculum document is very broad; rather than being a prescriptive document, "its principal function is to set the direction for student learning and to provide guidance for schools as they design and review their curriculum" (Ministry of Education, 2010, p. 6). As such, it comprises a vision, principles, values, and key competencies (i.e., thinking, using language, symbols, and texts, managing self, relating to others, participating and contributing). It also identifies eight learning areas (i.e., English, the arts, health and physical education, learning languages, mathematics and statistics, science, social sciences, and technology), noting, however, that these do not need to be taught independently. Additional information is provided about each learning area, with this phrased in terms of what students will be able to do and/or understand.

The use of information and communication technology (ICT) has been encouraged within New Zealand schools for some time. Before discussing this, however, it should be noted that within the New Zealand context, the term e-learning is used to describe the use of ICT to support or enhance learning; this is different from online learning, where ICT is used as a mode of delivery (e.g., see Powell & Barbour, 2011). New Zealand's response to the availability of tools that could be used for e-Learning meant that the International Association for K-12 for Online Learning's study "determined that the country of New Zealand had implemented some of the most innovative ideas in this field" (Powell, 2011, p. 1). The first strategy for the use of ICT in schools (i.e., e-learning) appeared in 1998 (see Barbour et al., 2011; Powell, 2011); while the 2010 Curriculum document (Ministry of Education, 2010), talked specifically about the role ICT could play both in terms of e-learning but also in opening "up new and different ways of learning" (p. 36). For more details of the development of e-learning policies in New Zealand, see Powell (2011) and Powell and Barbour (2012).

Around the time e-learning was becoming an expected part of teaching and learning in New Zealand schools, schools were being challenged to rethink the nature of what they did (Hipkins, 2004). Particularly at the secondary school level, they were asked to address the needs of diverse students to prepare them for further study in a range of topics, and for work (Alton-Lee, 2003). Thus, schools were not only required to provide core subjects (e.g., English, statistics, calculus, history, geography, physics, biology, and chemistry) but also alternatives that would meet the needs of their students (e.g., tourism, electronics, languages). This was particularly difficult for small (sometimes as few as 40 Year 9 to Year 13 students), usually rural, schools. They already had non-specialist teachers teaching senior classes; now they were being asked to increase their range of options further, with the potential for the need to offer different classes each year.

Secondary schools had been augmenting their offerings with distance education provided through *Te Aho o Te Kura Pounamu* (i.e., The Correspondence School, commonly known as *Te Kura*) since 1928 (*Te Kura*, n.d.), particularly small, mostly rural, schools (Stevens, 2005). This model of distance education was seen as less than ideal by a number of schools, as even in the early 2000s, most of its lessons were delivered in a paper-based format, with information mailed back and forth between the teacher and the student (see Barbour, 2014). A number of teachers and students were concerned with this approach, reporting that students were not performing to their expected levels (Lai & Pratt, 2004). Secondary schools in one region, Canterbury, augmented this by successfully using audio conferencing to provide an alternative approach to distance education in 1994 with the creation of CantaTech (later to become CantaNet). In the far north of New Zealand, an e-learning cluster, *Kaupapa Ara Whakawhiti Matauranga* (KAWM) began using videoconferencing to enhance opportunities for Māori students, or students learning Māori (Roberts, 2009). The group with perhaps the most impact, however, was the group of rural schools in Otago (known then as OtagoNet). They decided to use synchronous videoconferencing, supported by various online technologies and text-based resources, to deliver classes from one school to several other schools in the region (for details of this model, see Lai & Pratt, 2004; Pratt & Pullar, 2013). This approach has now been extended through New Zealand, and a national brokerage service, the Virtual Learning Network (VLN) (see http://www.vln.school.nz), was established in 2003. Currently there are at least 13 active clusters, involving more than 200 schools, tertiary organisations, and private providers (Powell & Patrick, 2006; Pratt & Pullar, 2013). At least one-fifth of secondary schools in New Zealand had students involved in at least one course in 2011 (see http://www.vln.school.nz/groupcms/view/29716/contacts-to-clusters-individual-schools-via-the-learning-exchange). Over the years since this initial challenge, New Zealand schools continued to be challenged to support their students to be lifelong learners, and to provide them with personalised learning experiences (21st Century Learning Reference Group, 2014).

New Zealand primary schools are also implementing online learning, but to a lesser degree. It is largely delivered through the VLN Primary, a collaborative community of around 90 schools (Williamson-Leadley & Pratt, 2017). They work together to provide enhanced opportunities through the use of online learning (see http://www.vln.school.nz/groupcms/view/32433/our-schools). To date, little systematic research has been conducted with these schools, although the research that has been done has highlighted the positive experiences for students.

As noted previously, though, the vast majority of research has been conducted on the online learning experiences of students who are also taking in-person classes. What is also apparent from a survey of the research available is that although online learning has been established in New Zealand for over a decade, there is a paucity of research, particularly in terms of published articles. Much of what has been published has been in the form of reports and/or conference proceedings, although there are a growing number of articles. It is also clear that the majority of research has been done by a small group of researchers, and has involved either a small number of participants or a single or small number of clusters. In particular, much of the research focuses on the original cluster, OtagoNet (for a summary of research conducted with this cluster, see Pratt & Pullar, 2013), and its current iteration, NetNZ (which is a result of a merger between OtagoNet and CantaNet). This focus is perhaps not surprising, as it is the origin of the model most commonly adopted; it has also worked with researchers since before its inception. As the original OtagoNet report (Lai & Pratt, 2004) explained, researchers with expertise in the area of distance learning at the university level were asked to work with the teachers to develop what would become the OtagoNet model. Other research focuses on work done with other specific clusters, including FarNet (e.g., Alexander-Bennett, 2016; Bennett & Barbour, 2012; Rivers & Rivers, 2004) and KAWM (Waiti, 2005). There is also a small amount of research focusing on blended learning involving students in traditional classes who are expected to incorporate some form of online learning as part of their classroom experience (Dewstow & Wright, 2005; Zaka, 2013). The limited amount of research on this may be due to the overlap between this and e-learning, which – as explained previously – is an expected part of the New Zealand schooling experience.

Having presented readers with information regarding the context within which online and blended learning occurs in New Zealand, the remainder of this chapter will focus on presenting a synthesis of research in the area. I will then explore the implications of these before identifying areas in which future research is needed.

Research Synthesis

In this section key findings from the research conducted with regards online and blended learning in secondary schools will be explored. Three key themes were identified: the experience, comprising the structure of the cluster and the teaching and learning models used; practical issues, and the effectiveness of the approach.

The Experience

In New Zealand, online learning is largely delivered via a supplementary model. Students remained based in their traditional brick-and-mortar schools, but choose to take some classes via other means, and from other providers. As well as taking online classes delivered by teachers at other schools, students may be taking online classes from higher or vocational education providers, or be involved in workplace learning (Barbour & Wenmoth, 2013; Pratt, Pullar, & Trewern, 2011; Pratt & Trewern, 2011). Schools around New Zealand are grouped into clusters, usually based on geographical location, although others, such as KAWM are based on other foci. Each cluster functions as a learning community, with professional development and other forms of support coming from within the cluster (e.g., Lai & Pratt, 2005). The preference is also for students to remain within their cluster, although they do take classes from outside them on an as needed basis. The funding for each student is given to the home school, with clusters then determining how delivering schools will be funded. Initially an informal reciprocal model was used, but this is increasingly becoming more formalised (see http://netnz.org) (Lai & Pratt, 2004). Both models have some issues, particularly if subjects are being delivered from outside the cluster (Brook & Gasson, 2007).

As the numbers of clusters grew, the *Learning Communities Online (LCO) Handbook* was developed with a focus of developing these online communities (Wenmoth, Reisch, Walsh-Pasco, Roberts, Smith, & Bennett, 2011). It provides guidance to those involved in online learning, and comprises a matrix where each cell includes information about the principles behind the content, actions that need taken, and resources. Unfortunately, however, it has been noted that "while the leadership of the cluster may use the *LCO Handbook*, many of the leaders in the member schools were not even aware of its existence" (Barbour, 2011, p. 5). This has resulted in this document having a limited effect.

Online students are supported by their online teacher (i.e., the eTeacher) and at least one teacher at their home school (see Davis, Eickelmann, & Zaka [2013] for further discussion of the roles). Each home school must have a designated person who is responsible for the students from their school who are taking online classes, and liaises with the various eTeachers to ensure everything is proceeding as it should. Students may also be supported by other teachers at their home school; often a teacher is available during their timetabled non videoconference class hours for general academic support, while a teacher who has knowledge of the subject they are studying may also be available for additional support. Each cluster also has a managing body, usually comprising an ePrincipal supported by one or more others.

Online learning classes typical comprise a synchronous web-based videoconference session of one hour, supported by timetabled class hours to make up the same number of 'in class' hours as their in person classes (see Lai & Pratt, 2009; Pratt & Pullar, 2013). While New Zealand online teachers are using a wide variety of teaching and learning approaches within this broad structure, in many cases technology is being used to allow teachers and students to replicate in person practices. As Lin and Bolstad (2010) explained, "while [online] students were more likely to use ICT for their virtual rather than their conventional classes, the technology was mainly used to deliver or retrieve information" (p. 5). Similarly, in a discussion of teaching and learning in the FarNet cluster, teachers commented that they "underused many methods of communication (particularly Web 2.0 tools)" (Barbour & Bennett, 2013, p. 19). As such, the current use is often in the form of Substitution or Augmentation, rather than to transform it, through Modification or Redefinition (i.e., the SAMR model) (see Cavanaugh, Hargis, Kamali, & Soto, 2013; Puentedura, 2009).

There appear to be a number of reasons for the lack of transformation in teaching and learning occurring in the online environment. Most of the online learning occurs in the senior secondary school, when students complete external exams at the end of each academic year. As one teacher commented "we're teaching kids to pass exams… therefore often it's a very intense time… there's not a lot of time to mess around" (Lin & Bolstad, 2010, p. 5). This comment, however, hints at a deeper issue; that using ICT is seen as 'messing around' rather than being a worthwhile investment of time to enhance learning outcomes (see also 21st Century Learning Reference Group, 2014). This issue is not restricted to the teachers, with some who had tried to use more collaborative and innovated approaches finding that students often responded with "tepid enthusiasm or digital silences" (Lin & Bolstad, 2010, p. 5). As is the case with e-learning more generally, it seems there is some way to go before teachers and students recognise that different approaches to teaching and learning, utilising ICT, can be not only as but rather more effective.

Pockets of innovation are, however, reported in the literature. The majority of the online teachers in the NetNZ cluster recognised that teaching online was different to teaching in person (Lai, 2017; Lai & Pratt, 2004), and agreed that they had a focus on developing self-regulated learners, while around half that they wanted to develop knowledge creators (Lai, 2017). As such, they most commonly used an enquiry approach to learning, utilising knowledge-building models. Despite this, around half the online teachers are still unsure over the ability of online learning to provide for more flexible learning environments. There has certainly been development in this area over time, however. Initially, teachers reported reverting to a transmission model of teaching and learning, which they no longer used in their in-person classes. They felt that they had to use the one-hour of contact time to deliver the information, and struggled with having to stay in one place (Lai & Pratt, 2004). As they became more comfortable using the technology, however, they became more comfortable using the out-of-class times to deliver content, and the in-class times to check students' understanding and discuss issues, in line with what is now known as the 'flipped classroom' approach.

A small number of New Zealand studies have explicitly focused on blended learning in line with the international definition; that is, where students are expected to participate in online learning as part of their in-person classes. These described two different models; one in which an outside 'expert' provided additional comment and responses via an asynchronous discussion board (Dewstow & Wright, 2005); and one in which a school had students participating in online learning both as a supplement to their in-person classes and as part of them.

Practicalities

The nature of schooling in New Zealand created two immediate practical issues for the supplemental model of online learning being used. As each school functions independently, they determine their own start and finish times for both school and classes and run their own timetables, which do not always correspond to the days of the week (e.g., they may have a six-day timetable). This makes it difficult when students are taking classes from other schools. Generally, the agreement is that videoconference classes start on the hour, and these are to take priority over in person classes. As such, students are expected to excuse themselves from whatever class they were in and attend their videoconference class. For this to work, students need to remember to go to their videoconference class, and their home school teachers need to be happy to release them. In practice, this is not always the case. Students have reported that some of their home school teachers have been unhappy to release them, unwilling to provide access to work for them to catch up, and have scheduled tests for the day on which their videoconference was scheduled (Lai & Pratt, 2005; 2009).

A key issue that initially impacted on the delivery of online classes was the technology being used. At the time of OtagoNet's inception, the infrastructure to deliver classes using videoconferencing was not in place; the remote locations and surrounding topography meant getting broadband to the schools was both expensive and difficult (Lai & Pratt, 2004). When classes were first delivered, a number of schools were using a frame relay system, which proved to not have sufficient capacity to cope. In addition, the technology was new to all those using it, and there was limited technical support available for students and teachers. Although both the technology and infrastructure have developed considerably, technical issues are still a problem; teachers and students want to do increasingly complex activities. As schools have to fund all resources for this out of their existing operational grants, schools need to consider cost when choosing what they will use. The *Google* suite of tools is commonly used, but problems are still reported with issues with connectivity and other questions regarding functionality.

Less of a problem now than when videoconferencing was used is the room in which this occurs. Originally, schools were recommended to have a room set up with the specialised equipment, and appropriate sound and light control (Lai & Pratt, 2004). The advent of desktop videoconferencing means this is not as critical, although it is still important that students and teachers have an appropriate space from which to participate in their videoconferencing.

Effectiveness

As seems to be the case with any educational intervention, initial research focused on whether it was as effective as what was previously used. In this case, though, the first comparison was between online learning and the *Te Kura* model of distance learning currently being implemented, with subsequent comparisons being made with in person models. The initial feedback suggested that the experience was generally positive. It was seen as achieving its aim of providing students with increased subjects options delivered in a manner that was more satisfactory than that used by *Te Kura* at the time (Lai & Pratt, 2004). However, it was not perceived to be as good as in person classes, with the amount of interaction being a key area identified for improvement (Lai & Pratt, 2009).

Over time, perceptions seem to have changed, with students more content to take an online course. The format of the class very rarely affected students' choices of subjects to take (Pratt et al., 2011). Indeed, when asked about the format of their classes, most students were unable to differentiate between based on mode, focusing instead on whether they were lecture style, involved group work etc. Although most students reported still preferring to always having a teacher, they did not think the format would impact on achievement. Any impact, they generally suggested, would be due to their lack of commitment and motivation, rather than on the format per se.

A common theme in the international literature regarding online learning has been the need for students to be self-motivated, able to manage their time, and learn independently (e.g., Rice, 2006; Roblyer & Marshall, 2003). Within New Zealand, however, this perception is changing; with many teachers believing that all students could succeed under the right conditions. While having their skills was seen as a benefit, it was not seen that they were necessary for students to engage in online learning. Indeed, some teachers expressed concern regarding the level of 'gatekeeping' that occurred at some schools, where students were not given the opportunity to undertake online learning during to the perception that they would be able to cope. In addition, although students and teachers both believed that participating in blended learning would and did enhance their learning and study skills, particularly in areas such as independent learning, motivation, and time management, this did not always seem to be the case (Pratt et al., 2011).

What seems, in the New Zealand online learning environment and approach at least, to make a difference to students' levels of success was the support they received, both from their eTeacher and within their home school. In general, it seems that online students require more support than in person students (Lai, 2017). In addition, students at different schools appeared to have very different experiences, with the level of support varying hugely (Pratt et al., 2011). Those who received quality support had a much more positive attitude towards learning independently. While schools with online students have agreed to support them, the degree to which this occurs varies. Some teachers with support roles are given insufficient workload for them to do so effectively, while the resources available in some schools is less than ideal.

As well as requiring support in the areas of teaching and learning, these online students needed support in logistical and practical areas, as well as social and psychological support, referred to as 'deep support' (Pratt, 2014). Adding to the complexity of this issue is that students are not always are of what support is available, despite the best issues of teachers, and do not always ask for help when it is needed. Why this is the case is not clear, although it may be due to students' view of themselves as dependent learners (Bolstad & Lin, 2009).

Although there is much talk of twenty-first century learners as preferring student-centred environments, where they can learn much more independently, New Zealand students do not always seem ready for them. In the first year of implementing online learning, a number of teachers were stunned – and somewhat horrified – to discover that their students had been dutifully attending the videoconference lessons but doing no work in between. There was a learning journey for students as well as teachers, as they became used to this new environment. This is no longer the issue it was originally, although it might be, at least in part, to students being more commonly and more closely supervised during these scheduled non-contact times. The importance of these non-contact times cannot be overstated; when the student is seeing a teacher for one hour per week, having scheduled non-contact class times for three or four hours, and otherwise working in their own time, it is essential that this time is productive. In some schools, there is a dedicated space for students during these non-contact times, staffed by teachers who are tasked with ensuring students are working, and helping as needed (Barbour, Davis, & Wenmoth, 2013; Barbour, Davis, & Wenmoth, 2016; Pratt & Pullar, 2013).

Although much of the work in supporting the student is the responsibility of the home school, the delivering school shares in this. The eTeacher needs to ensure that they communicate regularly with those facilitating online learning in the home school, to ensure they know what is expected of the student, what resources they need, and whether or not the student is learning as expected. They also need to ensure that they use a pedagogy appropriate to this form of learning, recognising the needs of online learners and making best use of the available technology (Brook & Gasson, 2007; Lai & Pratt, 2009; Pratt & Pullar, 2013). A key aspect to ensuring students succeed is building a good relationship with them. This is more difficult in an online environment, but remains an essential part of teaching and learning (Lai & Pratt, 2004). Within New Zealand teachers have used a variety of methods to build relationships. The most effective has been to have an in-person meeting, but this is not always possible, in which case ensuring that time at the start of each year is spent developing relationships between students and teacher, and within the class itself (Brook & Gasson, 2007; Lai & Pratt, 2004; Pratt & Pullar, 2013). In addition to these challenges, online teachers need to be prepared and organised well in advance of their online lessons to ensure material is available for the distance learners.

Impact and Implications for Policy and Practice

In many ways, the overarching issue that the current research shows has impacted on all aspects of the online learning experience is the commitment of those involved. The model currently being implemented in New Zealand involves two schools, with differing rules, structures, assessment policies, and timetables, and multiple people (see Table 3 for an overview of who is involved and their roles).

Table 3. People and tasks involved in online learning

	Home school	Delivering school
People directly involved	mTeacher (mentor Teacher, to be available for general academic support during non-videoconference sessions) and/or eDean (to support student, and to liaise with eTeacher) Student	eTeacher (needs to understand needs/context of student, and how to effectively deliver content, and liaise with mTeacher/eDean, to ensure the student is supported appropriately)
People indirectly involved	Principal (who determines space, resources, workload for people directly involved) Students' other teachers (as student may need released from their class to attend videoconference) Peers Parents Cluster principal and other leaders (who work to ensure everything is as it should be, and that all those involved have the support and/or professional development required)	Principal (who determines space, resources, workload for people directly involved)
Issues to be considered	Suitable space for synchronous videoconference Suitable space for non-contact timetable study times Suitable equipment for videoconference Suitable equipment (including any necessary textbooks) for subject Efficient procedures for sharing material (e.g., distribution and collection of tests)	Ensuring home school has appropriate equipment, and that student has access to it Efficient procedures for sharing material (e.g., distribution and collection of tests)

As shown from the research discussed previously, in order for students to have a problem-free and effective experience, each of these needs to be considered and addressed. In addition to the ways the wider group influences the experiences of those involved in online learning, so is online learning influencing those involved in in person classes. A number of the teachers involved in online learning have commented that their experiences in the online classroom have impacted on the pedagogy they used in their traditional classrooms (e.g., Barbour, 2011). In addition, some of the schools that changed spaces to provide for the needs of online students are now reflecting on and adjusting the physical space provided for their in-person students (Barbour et al., 2013; 2016).

The large number of students involved in online classes alongside their in-person classes, and the impact that support has on their success, highlights the need for schools to understand how to support these students effectively. This is complicated as each cluster is organised differently, and each school has its own processes. If, however, this form of blended learning is to achieve its goal of providing personalised learning opportunities for all students, the support for students needs taken seriously, and funding for time for staff and resources for students need to be made available.

Sitting alongside the need for effective support is the need for teachers to know how to teach effectively in this particular online model, and for students to know, or be support to learn, how to learn effectively in this environment. Currently clusters are generally providing their own professional development; while this is usually seen as helpful, it would seem that more is needed. In addition, there is currently very little awareness of online learning in New Zealand's initial teacher education programme, with pre-service teachers given little if any experience in or knowledge of what is happening in this area (Williamson-Leadley & Pratt, 2017). If online and all forms of blended learning are to grow, more emphasis is needed in our initial teacher education programmes.

Currently, online learning has developed from the bottom up. While this form of development has benefits, it also has drawbacks. Each cluster works largely in isolation. While this isolation has enhanced opportunities for innovation, it also means they run the risk of repeating mistakes that others have already made and learned from (Barbour, 2011; Barbour et al., 2013; 2016). The differing structures of clusters also mean that students taking online classes from multiple providers face different systems and expectations. The grassroots nature of this development has also meant there is little national policy or funding for it, as seen in issues around funding students. This may change with a recent amendment and proposed amendment to the *Education Act*. The *Education Amendment Act* (2013) allowed partnership schools, or *Kura hourua* to join the education landscape in New Zealand (see http://www.education.govt.nz/ministry-of-education/legislation/education-amendment-act-2013/). While these schools have to teach to the New Zealand curriculum, like other schools, they can adapt it to the needs of their students. As these schools are generally run by organisations or companies, they can have very different interpretations of the curriculum. These schools also have different requirements in terms of employing registered teachers (Berg, Gunn, Hill, & Haigh 2017). In 2017, it was proposed that this be extended to include online schools, known as Communities of Online Learning (CoOLs). Whether or not this will happen is now uncertain, as a change of government in 2017 has led to an uncertain future for Partnership Schools. What this amendment did highlight, however, was the level of lack of understanding of online learning in the wider community, and what was already being done. To a lesser degree lack of understanding was highlighted in research conducted with existing initial teacher educators, some of whom expressed similar concerns regarding the possibility of online learning.

Implications for Research

As noted at the beginning of the chapter, putting together this synthesis has highlighted the lack of research in this area, and the limited insight we have into what is happening in the field of online and blended learning in New Zealand. More research is needed both within these areas as they are defined within New Zealand, and in the area of blended learning as it is defined elsewhere. As most of the research has focused on one or two clusters, we need a better understanding of what is happening in the all clusters (Barbour & Bennett, 2013) and how clusters can work effectively together (Barbour & Wenmoth, 2013). As part of this, we need to ensure that we understand the perceptions of all those involved, including those at the periphery such as peers and parents, and gain an understanding of not only what is working but also what is not. In addition to gaining information about perceptions, conducting observations of lessons and artefact analysis will add depth and rigour to our current understanding. As part of this extension of our understanding, more research needs to happen within the primary context, to understand what is happening there, and what is and is not working. The importance of providing support to students has been identified; however, further work is needed to untangle the complexities and identify what is needed in which situations for individual students to succeed. In addition, research that explores the needs of priority students (i.e., those who have not traditionally experienced success) is required (Tiakiwai & Tiakiwai, 2010). In particular, research is needed to understand how online learning can effectively be used to support our Māori students, and te reo (Māori language) in particular (Jeurissen, 2015).

Research into online and blended learning in primary and secondary schools is less established than that of higher education (Louwrens & Hartnett, 2015). To date research in New Zealand has been largely descriptive, and little work around theories has been included. Zaka (2013) took an ecological view of the online learning communities in New Zealand (see also Davis, Eickelmann, & Zaka, 2013), while Barbour and colleagues (2013) explored it from a network perspective, but much more is needed. In contrast with primary and secondary schools, there are a number of models, conceptual framework and theories in higher education. Rather than simply discarding these as not being applicable, I would suggest research be conducted to see the degree to which work done in the higher education section is transferable to the primary and secondary sectors.

Conclusion

While online and blended learning is relatively well established in New Zealand research and policy is less well developed. While the teachers who are implementing online learning are doing a good job, they need support to help them identify best practices within the New Zealand context. They also need support from policy makers to ensure they are able to implement these best practices. It is clear that currently research has not kept up with the developing field of online learning, and a more systematic research programme needs to be instigated. Sitting alongside this is the need to ensure that all those with a connection to teaching and learning in primary and secondary schools, including parents and initial teacher education providers, understand the advantages online learning can offer to students, teachers, and schools. They also need to be equipped with sufficient knowledge to make good decisions about which, if any, online and blended learning opportunities they take up.

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A Case Study of E-Learning Initiatives in Singapore's Secondary Schools

Allison Powell & Michael Barbour

Abstract

There is a shift occurring in education systems around the world, which could change the face of education as we have known it through blended and online learning. The purpose of this chapter is to describe the current e-learning initiatives and proejcts for students in secondary schools in Singapore. An overview of the Singpoare education system, along with a more in depth look at the current e-Learning initiatives and how they evolved are shared. Finally, a specific look at how e-learning has been implemented within Singapore's secondary schools is described. The research in this chapter looked at both the policy and practices happening within Singapore's education system.

Introduction

E-learning is a powerful instructional strategy because it transcends the boundaries of traditional classroom instruction. In fact, it creates virtual schools that allow learning to occur at the student's initiative – any time, any place. E-learning also holds promise for promoting equity by providing students with access to courses that otherwise might not be available, such as accelerated courses in remote rural areas. (Blomeyer, 2002, p. 1)

E-learning offers opportunities and possibilities that were largely unknown to educators over a decade or so ago. According to Watson (2008),

> E-learning has the capacity to grow, and the early results demonstrate the benefits of students and parents being given the choice of a variety of learning options, from fully online courses at a distance, to classroom-based courses, with blended learning options in between. (p. 10)

A disruption to education systems in countries across the world, e-learning is allowing for interactive and accessible environments for students to learn at their own pace, no matter their neighborhood or income level.

In 2006, the International Association for K-12 for Online Learning (iNACOL) surveyed several countries and highlighted the most up to date information about "current initiatives, funding, student populations, content development and quality control, professional development, and current trends and obstacles" in the area of K-12 e-learning (Powell & Patrick, 2006, p. 3). At the time, Singapore was at the high end of the scale for implementing e-learning initiatives in their K-12 schools based on the results of this survey. "As of November 2006, all (100%) of secondary schools and junior colleges and 134 (85%) primary schools (grades 1-6) are using a learning management system for teaching and learning" (p. 19). According to Vreeland, Dana, Hurwitz, Just, and Shinn (1990), "because of the country's miniscule size and its insularity, there are few aspects of social life that are not directly touched by bureaucratic actions and influences" (p. 77), including education, allowing for the quick implementation and buy-in of the entire country to implement a countrywide e-learning initiative.

Singapore has a "strong and robust education system that has been a key source of competitive strength" for the country (iN2015 Education and Learning Sub-Committee, 2006, p. 9). It was evident from the iNACOL study, and the little research available about the country's education system, that their circumstances differed, and that not every country can achieve what Singapore has done with K-12 education. However, it might be possible to learn some basic ideas from process and experiences of a nation like Singapore. We can learn both the positives and negatives aspects of processes for implementing successful e-learning programs within other jurisdictions in order to build new and grow current e-learning programs around the world in different environments.

In this chapter, we begin by providing some background to Singapore as a country, followed by a brief overview of the Singapore education system – with a focus on initiatives designed to increase information and communication technologies – for those readers that may not be familiar. This overview is followed by a specific description of developments related to e-learning in the country, most of which have been tied to one of three 'Masterplans for Information and Communication Technologies in Education' (Huat, n.d.). Finally, we close with a discussion of the significance of this particular illustration as an example of how a national government can be a catalyst for educational change through the lens of e-learning.

Background to Understanding Singapore

The Republic of Singapore is a city-state located at the southern tip of the Malay Peninsula, about 85 miles north of the Equator. It consists of the diamond-shaped Singapore Island and some 60 small islets. The main island occupies all but about 18 square miles of this combined area. The main island is separated from Peninsular Malaysia to the north by the Johr Strait, a narrow channel that is more than half a mile long. The southern limits of the state run through Singapore Strait, where outliers of the Riau-Lingga Archipelago – which form a part of Indonesia – extend to within 10 miles of the main island (Singapore, 2008). Singapore is one the largest port in Southeast Asia and is one of the busiest in the world.

There are several versions of how the name Singapore or Singapura (meaning "Lion City") became the name of the island, ranging from Rajendera who first raided the island giving it the name to the Srivijayan prince Sri Tri Buana who was said to have glimpsed a tiger (mistaken it for a lion) and thus called the settlement Singapura (Singapore, 2008). It originally served as an outpost for the Sumatran empire of Srivijaya based on Japanese inscriptions and Chinese records dating to the end of the 14th century. The British East India Company bought the 267 square miles of swamp and rain forest that make up Singapore from the Malaysian Sultan of Johore in 1819, and "in 1824, Singapore's status as a British possession was formalized" (Singapore Ministry of Information, Communications and the Arts, 2008, para. 3). One hundred and thirty-five years later, in 1959, a new constitution was passed and Singapore became a self-governing state with control over all domestic affairs (Turnbull, 1989).

An estimated 5.6 million people now live on the island and surrounding sixty smaller islands (Singapore Department of Statistics, 2017), which make up the country of Singapore. Singapore has four official languages: Chinese, Malay, Tamil (Indian), and English. In 1956, a policy was adopted to give equal official weight to all four languages and provide bilingual education for all Singapore children. However, English was the language of government and the armed forces and, in 1987, English was officially adopted as the first language in schools (Turnbull, 1989). English is now the most commonly spoken language in Singapore, as it is needed to conduct the majority of business transactions; however, Malay remains the official national language (Wikipedia.org, 2007). At the time of Singapore's independence the ethnic make-up of society could be described as a Chinese majority, who dominated the government and politics. Malays worked in civil service careers and Indians often worked as laborers and shopkeepers (Milligan, 2004). Since Singapore's independence the country's struggle has been

> to establish a balance between national integration with a common identity and the opportunity for the different ethnic groups to maintain their individual heritage. Education, particularly at the primary and secondary levels, is regarded in this context as an essential vehicle to achieve harmony and separate ethnic identities. (SarDesai, 2001, p. 1202)

Overview of the Singapore Education System

Because Singapore is a small island with no natural resources, her only resources are her people.

> The wealth of a nation lies in its people – their commitment to country and community, their willingness to strive and persevere, their ability to think, achieve, and excel. Our future depends on our continually renewing and regenerating our leadership and citizenry, building upon the experience of the past, learning from the circumstances of the present, and preparing for the challenges of the future. How we bring up our young at home and teach them in school will shape Singapore in the next generation. (Singapore Ministry of Education, 2007, para. 3)

Singapore has always taken the value of education seriously and its new reforms have done well as, "the Singapore education system has been referred to as being one of the most successful educational systems in the world" (Kong, 2017, para. 2).

According to Ng (2008), "the intangibles such as an international mind-set, a strong work ethic, business creativity, and national teamwork become even more important determinants of the quality of the workforce and the development of the country" (p. 56). The focus on the quality of workforce as a mean of development necessitated the mindset that "the quality of education took on a new significance in the 1990s as never before" (p. 56). With the rapid advances in technology and the transition to a knowledge-based economy, values in Singapore and around the globe have shifted "away from production toward innovation and creativity" (Goh & Gopinathan, 2008, p. 29). The faster the economy changed, the more peoples lives changed, they had busier lives, with less time for family, friends, and their community, but they had better economic and social gains. These changes led to the need to redesign Singapore's education system to meet the needs of the new century. Parents became more involved in the re-working of the education system, which went from the efficiency-driven education to more of an ability-driven system.

Students in Singapore were performing well on international math and science exams. "The 1995 research compared mathematics and science test scores of 13-year-olds in 41 countries. The international average score was 500. At the top of the list was Singapore, with 643" (Goh & Gopinathan, 2008, p. 30), which they again repeated in 2003. They believed it was their process of streaming students, which allowed teachers to focus on teaching all students, rather than just to the average.

In June 1997, the shift to an ability-driven education system was strategically introduced to Singaporean's in the Ministry of Education's new vision, *Thinking Schools, Learning Nation*. This new vision "was introduced to encourage creative thinking, more varied curriculum and improvement to teachers' education" (Lee, 2008, p. 14). Prior to the release of the Ministry's new vision, "the entire education system was reviewed, from pre-school education to university admission criteria and curriculum," (Gopinathan, 2001, p. 11) and for the first time, the vision was "for a total learning environment, including students, teachers, parents, workers, companies, community organizations and the government" (Goh, 1997 as cited by Zhao et al., 2011, p. 117). This was not the Ministry of Education's vision, it was "a formula to enable Singapore to compete and stay ahead. *Thinking Schools* intended to ensure schools met future challenges while *Learning Nation* aimed at promoting a culture of continual learning beyond the school environment" (Gopinathan, 2001, p. 11).

The focus was on holistic education and the new need was to develop the whole child and to recognize and develop their different talents, abilities and skills. This new ability-driven curriculum allowed for experimentation and innovation and allowed for schools to try new things that may or may not work. The new, "ideal student would be literate; numerate; information technology-enabled; able to collate, synthesise; analyse and apply knowledge to solve problems; capable of being creative and innovative; not risk-averse; be able to work both independently and in groups; and be a life long learner" (Gopinathan, 2001, p.11). The curriculum for a secondary school student now offers a wide variety of courses to meet the individual needs as illustrated in the graphic created by the Singapore Ministry of Education in Figure 1.

Thinking Schools, Learning Nation focused on four areas of reform: "emphasis on critical and creative thinking, the use of information technology in education, national education (i.e., citizenship education) and administrative excellence" (Gopinathan, 2001, p. 12). Students were engaged in inquiry-based learning and project work was introduced and now required as part of college admissions. The cluster school concept of groups of independent and autonomous schools sharing resources and working together under a superintendent expanded. Teachers were now entitled to a minimum of

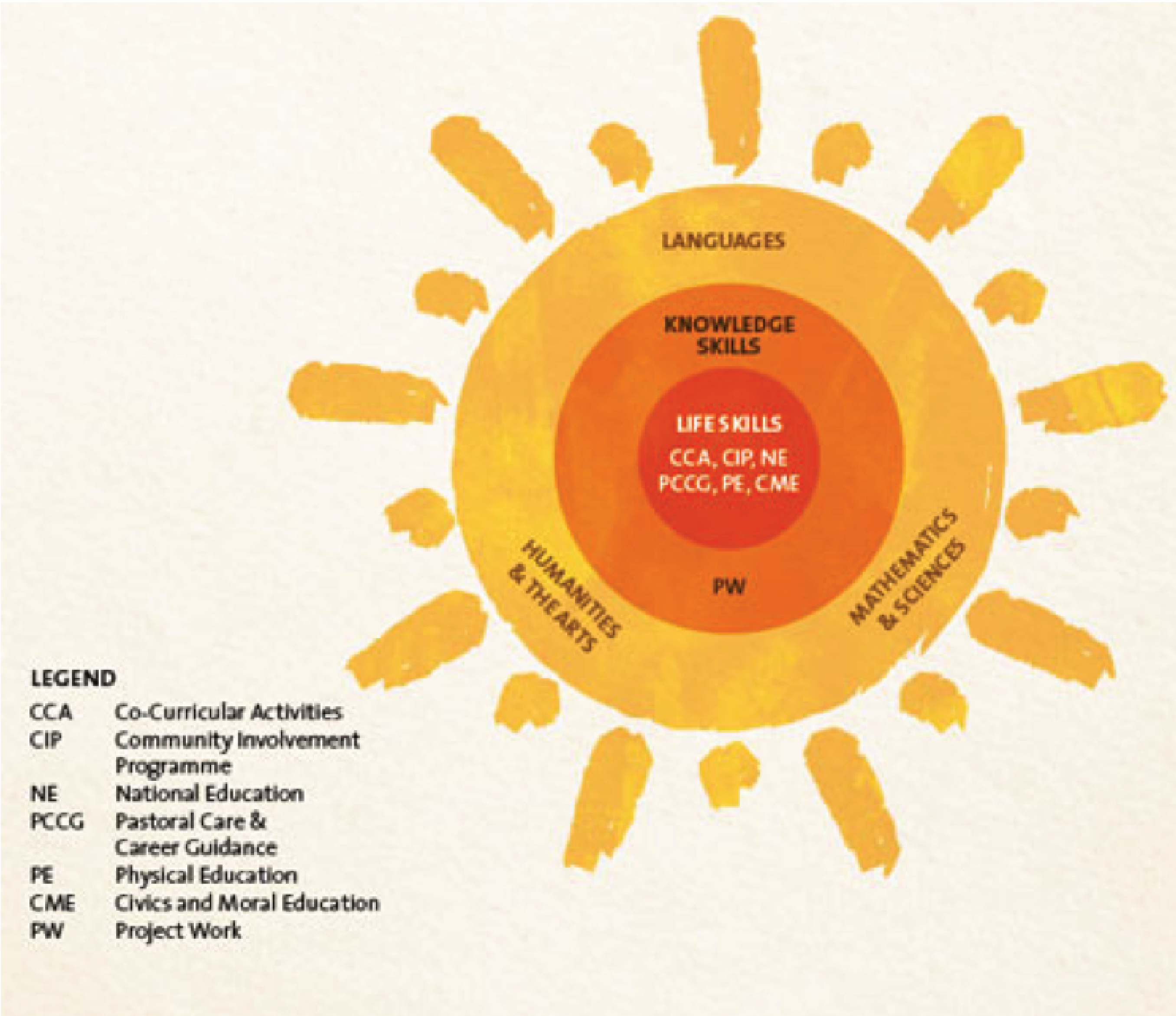

Figure 1. Singapore Curriculum and Skills (Singapore Ministry of Education, 2008a)

100 hours a year in professional development, to keep them up to date, and were encouraged to do some of this training outside of the field. Students were taught to think and question and to be creative and take risks, while the teachers' role changed to be more of a guide on the side. (Gopinathan, 2001; Ng, 2008).

The new ability-driven education gives all children in Singapore ten years of education, which offers a national curriculum and a wide variety of choices and flexibility, depending on the individual student's skills, talents, and abilities. This includes six years of required primary education. Students begin school at age six, with a few starting a couple of years earlier in preschool and kindergarten. Children study math, science, and social studies, as well as arts and crafts, physical education, and music. Language is the most important subject. All students are required to learn English as well as another one of the official languages (e.g., Chinese, Malay, or Tamil), depending on their family's heritage.

Assessment is important in *Thinking Schools, Learning Nation*, with "major national examinations at the end of the primary, secondary, and junior college years" (Goh & Gopinathan, 2008, p. 30). After students take the primary school leaving examination at the completion of year six at the primary level, they will attend four to five years of secondary school and depending which stream they enter, will follow a different curriculum stream. Students are placed in the special, express, normal (i.e., academic) or normal (i.e., technical) course according to how they perform on the primary school leaving examination. Figure 2 from the Singapore Ministry of Education, shows the multiple paths a student can take to fulfill their education in the country. "This new approach is to organize [students] around intelligence, instead of around mechanical functions or processes" as in previous versions of streaming landscapes (Liang & Ng, 2008, p. 110).

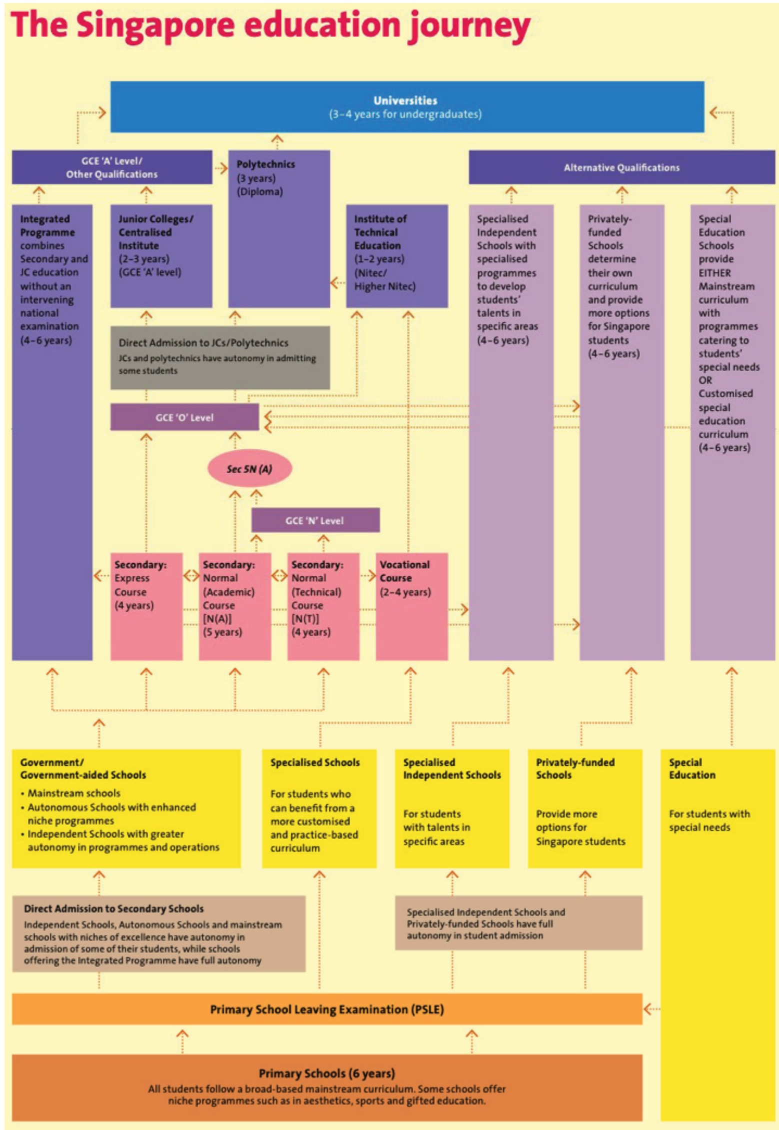

Figure 2. The Singapore Education Landscape (Singapore Ministry of Education, 2008b)

In addition to the changes in the streaming options students have to complete their education, the role of the teacher changed in the Singapore education system. Singapore provides their teachers with a generous compensation package to recruit and retain teachers in their system. Teachers are now entitled to 100 hours of fully paid professional development each year that can be done in the education field or other areas of their choice that may enhance their teaching (Goh & Gopinathan, 2008). Both teachers and leaders are encouraged to learn new skills and gain new knowledge by taking sabbaticals.

With all of the new changes to the education system and the new philosophy of teaching, the teachers needed these new skills as well. As a follow up to the *Thinking Schools, Learning Nation* vision, Prime Minister Lee called for teachers to 'Teach Less, Learn More' in a speech in 2004. This new initiative called for more "experiential discovery, engaged learning, differentiated teaching, the learning of life-long skills, and the building of character through innovative and effective teaching approaches and strategies" (National Library Board, 2008, p. 1). All teachers would be trained in collaborative learning strategies, using strategies to promote creative thinking and team work, would be introduced to the new curriculum and also the use of new technologies for teaching and learning.

"International competition has been the driving force of Singapore's economic development strategy since 1965" (Ng, 2008, p. 65). The people of Singapore have valued education over the last 50 years. They see it as an investment rather than consumption as other governments around the world. "Huge sums continue to be spent on school rebuilding and upgrading IT infrastructure, teacher training, and teacher professional development" (Goh & Gopinathan, 2008, p. 16). Singapore is well positioned to its goals to continuously update the knowledge and skills of her population. An emphasis continues to be placed on the subjects of mathematics, science, and technology, but the humanities and other extra curricular areas are still kept as a priority in the curriculum.

E-Learning in Singapore

Singapore has the fourth highest percentage rate of Internet users in Asia per their population – 82 percent of all citizens use the Internet (Internet World Stats, 2015). In Singapore, people who do not know how to use computers usually have a difficult time functioning in their society because so many transactions depend on computer skills. Singapore is also rapidly moving from a manufacturing and services based economy to a global, knowledge-based economy. The Science Hub is very similar to the well known United States' Silicon Valley. New and innovative products are created here, and scientists study the latest technology.

Singapore's 10-year *iN2015 Masterplan* was put into place to enable the country to be where it is today. Its goal was "to transform Singapore into a global city which exploits the potential of infocomm to add value to the economy and society" (Koh & Lee, 2008, p. 87). The *iN2015 plan* covered all aspects of the country, including government and schools. It was said by the committee who created the plan that infocomm enables "access to the latest knowledge and new learning resources; making learning come to life with multimedia and interactive elements; and creating an environment in which independent and life-long learning can take place" (p. 88). The goals related to education in the *iN2015 plan* were to create a new learner-centric environment, to build a new nationwide infrastructure connecting schools, and to make Singapore the model for the innovative use of information and communication technologies in education and learning.

Schools have also embraced the use of technology in the nation's classrooms. "Information and communication technologies competencies are incorporated in school curricula and as resources for teaching and learning" (Ai-girl, 2004, p. 105). Before *Thinking Schools, Learning Nation*, information and communication technologies was already being implemented in pilot projects across the country. Schools began using technology in the 1970s. However, "it was not until the early 1980s that the Ministry of Education made concerted efforts, through a series of projects, to enhance their application in every area from communication to administration to teaching" (Koh & Lee, 2008, p. 16). Computer appreciation clubs were introduced in secondary schools and at the junior college level the first computer science course was introduced. The Ministry of Education also started the *School Link Project*, which connected all 360 schools on the island together and to the Ministry and could be used for administration and communication needs.

From 1990-1996, technology was implemented in a variety of ways through some pilots in selected schools. The *Professional Computing Support Program* was developed to begin equipping teachers with the knowledge and skills of using technology and software for teaching and learning. Within these six years, two courses were implemented in secondary schools focusing on technology use in the workplace and providing basic computer skills, which required the Ministry of Education to put a computer lab in every secondary school (Koh & Lee, 2008).

The four information and communication technologies related projects were focused on computer-assisted instruction in mathematics classrooms. This software supplemented math textbooks and focused on drill and practice and problem solving skills, and it provided immediate feedback to the student. The *Internet in Schools Project* was a mentor-based project that provided technical support in using the Internet for schools. Principals were also brought together at this time to be "made aware of the critical issues when linking their school to the Internet through sharing sessions and discussion panels conducted by Internet pioneers (Koh & Lee, 2008, p. 19). The final piece of this pilot was setting up the *MirrorS* site, which was rich education content that both teachers and students could access from school or home. Primary Schools participating in the *Accelerating the Use of Information and Communication Technologies in Primary Schools Programme* used information and communication technologies in their classrooms to teach on average 10% of the curriculum using CD-Roms and software. The *Students' and Teachers' Workbench* took the two science courses at the secondary level and developed a content repository of resources for them. Up until this point, the Internet use in schools had been reserved for administration and teachers. This final project helped create the first phase of Singapore's *Masterplan for Information and Communication Technologies (ICT)* (Koh & Lee, 2008).

As part of the Ministry of Education's *Thinking Schools, Learning Nation* vision in 1997, a *Masterplan for ICT* was also introduced. "The underlying philosophy of the *Masterplans* is that education should continually anticipate the needs of the future and prepare pupils to meet those needs" (Singapore Ministry of Education, 2009, para. 9). Not only did the plan want to provide broader access to instructional technology to a larger base of students, it was "hoped that the new 'learning connection' to be provided will assist students in developing the perspectives required to work and live in an increasingly borderless world (Towndrow, 2001, p. 24). The *Masterplan* would be implemented into the education system in three phases: *Masterplan I* from 1997-2002 (Singapore Ministry of Education, 2010-2015a), *Masterplan II* from 2003-2008 (Singapore Ministry of Education, 2010-2015b), and *Masterplan III* from 2009-2014 (Singapore Ministry of Education, 2010-2015c).

S$2 billion was invested in the first *Masterplan* "to introduce information and communication technologies in schools and to have pupils spend 30 percent of curriculum time learning with, or through, computers" (Goh & Gopinathan, 2008, p. 33). The investment of "funds were designated to purchase computers, full networking of the schools, physical renovations, software and courseware, and teacher training" (SeokHoon, 2003, p.284). An additional S$6 million per year was to be used to replace and maintain hardware, training teachers, and to develop new digital resources for schools. In the first *Masterplan*, information and communication technologies would be integrated in to all aspects of the education system including the "curriculum, assessment, pedagogy, professional training, and culture" (Goh & Gopinathan, 2008, p. 33) in order to fulfill the vision of *Thinking Schools, Learning Nation*.

The key information from the Ministry of Education was integration, they did not want the computers to replace the teacher, but it was to be used as a tool to support teaching and learning. In the first phase of the plan, "the objective of integrating information technology into the curriculum is to promote independent learning and critical thinking, what seems to be a central preoccupation is computer competence, rather than the use of information technology as a critical skill" (Koh, 2004, p. 339). Students were to learn the basic skills of using a computer, such as word processing, designing web pages, searching the Internet, etc. rather than developing their "understanding of information technology as a critical social practice" (p. 339).

With the introduction of the first plan, the Educational Technology Division of the Ministry of Education was created in order to take the lead on the implementation of the Masterplan. The EdTech Development, Infocomm Technology Training, and Media branch and Infrastructure Support branches made up this new division. This EdTech branch was responsible for researching and recommending new advances and innovations in education technology that could be integrated into Singapore's curriculum. The role of the Infocomm Technology Training branch was to implement the technology in the schools and assist teachers in using it in their classrooms. The final Media & Infrastructure Support branch was responsible for the planning of the physical infrastructure of the technology (Koh & Lee, 2008). This division worked together and secured outside partnerships within the Ministry of Education and in the corporate world to design, develop and implement the nation's *Masterplan for ICT* (Singapore Ministry of Education, 2010-2015a).

The first *Masterplan* identified four goals of the education system in order to successfully implement the plan, which included:

- curriculum and assessment.
- content and learning resources,
- physical and technological infrastructure, and
- human resources development (Koh & Lee, 2008, p. 31).

The curriculum had previously focused on teachers dispensing information to students to memorize, where the new shift was in evaluation, application, and synthesis of information. The Ministry of Education recognized a need to not just pile these new skills on top of the curriculum that was already there, and reduced the curriculum by 25% to allow for the integration of information and communication technologies skills. Also, "150 out of 162 syllabi were revised to align them with the objectives of the *Masterplan for ICT* in education and other key Ministry of Education initiatives for enhancing learning" (p. 32).

The new ability to use information and communication technologies tools in education provided the ability with students and teachers to collaborate with other students and teachers from around the world as well as providing them access to experts and new learning environments that students might otherwise have ever seen. The Southeast Asian Ministers of Education Organisation countries, United Kingdom, Chile, Canada, Finland, and Japan set up memorandum of understandings for collaborating on projects throughout the school year (Koh & Lee, 2008). Field experts in science and math also worked with students via the Internet by providing knowledge and access to tools from their field that schools may not have access to.

Content and learning resources were also created by the memorandum of understanding and its corporate partners for teachers and students across the country as part of the first *Masterplan*. A central clearinghouse of recommended software and the Internet Resource Website, which recommended websites for teachers, were created for teachers to easily find and integrate new technologies into their curriculum. The Educational Software Procurement Scheme was developed to assist schools in obtaining these recommended software and other resources at an "average of 30-40% lower than the retail price" (Koh & Lee, 2008, p. 37).

The physical and technical infrastructure was a necessity for implementing the *Masterplan for ICT* in education. The two areas of focus for this goal of the plan were to provide:

- "students with access to infocomm in all learning areas in the school; and
- a school-wide network to link all schools through the Wide Area Network, to be eventually connected to Singapore ONE, enabling high speed delivery of multimedia services on an island-wide basis" (Koh & Lee, 2008, p. 42).

Schools were provided with standards for the infrastructure, but it was up to them what they would purchase and when, as long as the standards were met by 2002. The standards included "a pupil-to-computer ratio of 6.6:1 in primary schools, and a ratio of 5:1 for secondary schools and junior colleges. Teachers were equipped with notebooks, and the ratio of teachers to notebooks is 2:1" (Soh, 2001, p. 22).

Every school was also provided with their own school-wide network and were linked to the Wide Area Network. "Singapore ranked second in the world, after Finland, for the availability of Internet access in schools" (Koh & Lee, 2008, p. 44) in the *Global Competitiveness Report 2001-2002* based on the connectedness provided by the high-speed backbone of Singapore ONE. With all of the schools connected, communication and access to data was seamless through email and school Intranets and the Internet.

The final goal of the first *Masterplan* was in the training of leadership and the teachers. This had to be done not only at the Ministry of Education and school level, but in higher education as well. Teachers were to be trained in basic skills of information and communication technologues and how they could be used in the classroom with students. "Every in-service teacher in primary and secondary schools went through 30 hours of core training" (Koh & Lee, 2008, p. 47). Training was done face-to-face and was subject-based for secondary teachers and more general for the primary school teachers. Like the full implementation of the plan, training was done in three phases and a total of 24,000 teachers were phased over the five-year implementation of the first *Masterplan*. Sixty additional teachers who were strong in pedagogy and showed a high level of interest in technology were identified and given additional training to become Senior Infocomm Technology Instructors who trained the remaining teachers in schools across the country. Continuous training was offered both in online face-to-face courses to provide ongoing support for the teachers.

Pre-service teachers also needed to be trained on the vision of the Ministry of Education and how to implement it in the schools. The teacher training university (i.e., the National Institute of Education) aligned their programs with the *Masterplan* to prepare all of the incoming teachers. The school hired an outside vendor to do the initial 12-hour training and teachers also held online discussions on what they had learned in these lessons and in their practicum teaching experiences in the schools. More advanced courses were later developed by the university and master degree programs were created in information and communication technologies to encourage in-service teachers to learn more about how to use information and communication technologies in their classrooms.

Singapore considered the first *Masterplan* implementation to be a success in laying a foundation for the future. Students were surveyed and it was found that they felt prepared and had the skills to develop information and communication technologies-based projects. All schools had been provided with the infrastructure to support information and communication technologies in the schools and teachers had acquired the necessary knowledge and skills to implement information and communication technologies into their curriculum (Koh & Lee, 2008). The experiences from the *Masterplan I for ICT* in education provided new models and direction for the next phase, the implementation of *Masterplan II*.

After the end of the first *Masterplan*, "Singapore had been able to take full advantage of the information revolution due to its advanced computer, Internet and Social structures" (SeokHoon, 2003, p. 284). The first phase of the *Masterplan* was successful in that because of the small size of the country, it was easy to communicate its vision to the schools and it was fiscally aware and used its resources wisely. The foundation had been laid and the infrastructure and basic information and communication technologies skills and how to integrate them into the curriculum were taught to teachers. From 2003 – 2008, *Masterplan II* was implemented. It was "designed to build on the many achievements of Masterplan 1 and take information and communication technologies integration in the education system to an even higher level" (Koh & Lee, 2008, p. 59).

The second phase of the plan would be for schools and teachers to achieve the baseline of ICT in schools, to provide teachers with additional resources to be innovative, to use information and communication technologies to help differentiate instruction, and to prepare students with the 21st century skills needed to be a productive citizen of Singapore. "The second *Masterplan* had the following six outcomes.

- Students use information and communication technologies effectively for active learning.
- Teachers use information and communication technologies effectively for professional and personal growth.
- Connections between curriculum, instruction and assessment are enhanced using information and communication technologies.
- Schools have the capacity and capability to use information and communication technologies for school improvement.
- There is active research in information and communication technologies in education.
- There is an infrastructure that supports widespread and effective use of information and communication technologies." (Koh & Lee, 2008, pp. 60-61)

In order to achieve these outcomes five areas were identified to implement *Masterplan II*: 1) curriculum and assessment, 2) professional development, 3) capacity and capability building, 4) research and development, and 5) infrastructure and support.

At the start of the *Masterplan II* (Singapore Ministry of Education, 2010-2015b), the Ministry of Education's Educational Technology Division's role changed to become "the champion and catalyst in using technology to enhance educational processes and to establish Singapore as the leading centre for information and communication technologies in education"

(Koh & Lee, 2008, p. 61). This division was re-structured to two branches, one focusing on researching and identifying new technologies and pedagogies and the other focusing more on professional development and building schools' capacity to integrate technology into the curriculum. The division continued to build and foster relationships with other divisions within the Ministry of Education and community.

New technologies and resources were developed to strengthen information and communication technologies integration into the curriculum and assessments. In 2005, basic information and communication technologies skills standards were developed for primary, secondary, and junior colleges to provide benchmarks to ensure students mastered the information and communication technologies skills needed to prepare them for their future. The Ministry of Education implemented the standards in two phases, starting with primary schools in 2007 and secondary schools and junior colleges in 2008 (Koh & Lee, 2008). The standards ranged from students learning basic word processing and multimedia tools to using more complicated technologies such as data-loggers to collect data for various subjects. Strategies and ideas for teaching these skills were integrated into textbooks and learning guides were also developed for teachers.

A shift from CD-Rom based content to digital resources was seen in *Masterplan II* to provide anytime, anywhere access for students and teachers. "In 2003, Ministry of Education implemented the *Rich Digital Media Content* project to pilot test the development of such resources" (Koh & Lee, 2008, p. 65). The Ministry of Education developed and contracted vendors to build these resources initially, but then led workshops for teachers on how to create and share their own learning objects. All of these resources were uploaded into Singapore's *edu.MALL* portal for teachers to easily search, access and customize resources and learning to meet the needs of their individual students.

Professional development continued to play an essential role in the implementation of the country's *Masterplan*. School leaders and teachers continued to be at various skill levels in their knowledge and ability to implement information and communication technologies. "Mass customization of programmes was adopted to cater to the differing needs of teachers, such as skills to integrate the baseline use of information and communication technologies (e.g., use of Internet), or higher levels of information and communication technologies use (e.g., use of discussion forums)" (Koh & Lee, 2008, p. 66). Professional development was delivered in a variety of ways including face-to-face workshops, online courses, lectures, camps, etc. and was customized to meet the individual teacher's needs either through one time workshops, conferences, just-in-time training, university degree programs, and through ongoing trainings.

Training "focused on the value-added use of information and communication technologies in the teaching and learning process, instructional design for resource development as well as the planning, monitoring, and reviewing of department information and communication technologies programmes" (Koh & Lee, 2008, p. 67). Teachers are given time to take courses, plan and design lessons, and to collaborate with other teachers. Communities of Practice were encouraged to start after face-to-face trainings in order to foster the relationships built in the course and to continue the sharing of resources and ideas beyond the training. *Professional Development Guides* were developed by the Ministry of Education to assist teachers in identifying the skills they need to integrate information and communication technologies and to help them in planning their own professional development program to obtain that knowledge. In 2006, the *One-stop Learning and Resource Portal* was created "to consolidate efforts by different parties in Ministry of Education to promote learning and professional development, minimize duplication of such efforts and resources utilized, and maximise return on investment" (p. 67). The Ministry of Education's investment in professional development and support of their teachers shows they understand how important the teacher is in implementing their vision of an information and communication technologies literate population.

The infrastructure implementation and technical support was all overseen by the Ministry of Education in the first phase of the plan. Schools had the flexibility to choose and purchase the hardware and software to meet the needs of their students. "With schools at different levels of information and communication technologies implementation and given greater autonomy, they needed support which was provided by information and communication technologies consultancy teams formed in 2004" (Koh & Lee, 2008, p. 69). The goal of these teams was to help schools build capacity in planning and using information and communication technologies in education. The teams were made up of both education and technological professionals to assist schools in a variety of ways such as experimenting and integrating new technologies, learning environments and pedagogies to promote information and communication technologies literacy.

Within phase two implementation, schools were now required to self-assess their own information and communication technologies practices. The Ministry of Education developed the *Benchmarking Your Information Technology Practices for Excellence in Schools (BY(i)TES)* assessment to help schools review and improve on their implementation of information and communication technologies. The form was revised several times with the input of the schools and narrowed down to three domains: 1) leadership and culture, 2) student use, and 3) teacher use (Koh & Lee, 2008). The self-assessment tool provided schools with a roadmap to assess the strengths and weakness of their plan and allowed them to create a plan to make their programs better.

In 2003, a Research and Development branch was formed within the Educational Technology Division of the Ministry of Education and in 2005, the National Institute for Education created the Learning Sciences Labs. These groups were designed to experiment with emerging technologies and pedagogies and to make recommendations to schools and teachers on what and how to implement them in order to meet the needs of each student. Action research and experimentation of these new findings was also encouraged at the school level as well for the first time in a new group of 'Incubator schools.' This program started with one primary and one secondary school to experiment with Tablet PCs and new environments for teaching. By 2008, 68 schools had become incubator schools, or *LEAD ICT* (as the program was later renamed), and "could focus on either research in the use of emerging information and communication technologies-based pedagogies such as studying the effect of multimedia use in the teaching of Chinese language, or practice-based efforts such as use of video and podcasting by students for language learning and use of data loggers to study the effects of environmental destruction" (Koh & Lee, 2008, p. 72). These schools were closely watched for what was working that could be implemented in other schools and what types of technologies were not appropriate for educational usage.

The final area of focus on the implementation of *Masterplan II* was on the enhancement of the infrastructure and support. The first plan provided schools with a basic infrastructure, but the second plan focused on providing schools "with an enhanced information and communication technologies infrastructure that could facilitate different modes of lesson delivery of and support varied learning, that is, one that could support an undisrupted delivery of powerful multimedia and full interactivity of instructional content" (Koh & Lee, 2008, p. 73). The continued support for this new ubiquitous learning environment was essential. Baseline bandwidth of 5 Megabits per second was provided to schools, with the eventual goal of connecting all schools at 1 Gigabit per second or more. Computer ratios for students went down to 6.5:1 for primary schools and 4:1 for secondary schools and a new focus of providing computer and Internet access for high need students began. "In 2006, 12% of households with school-going children did not have access to an Internet-read personal computing device" (p. 75). The Infocomm Development Authority of Singapore collaborated with their industry partners to offer more than 19,000 families Internet ready computers and unlimited broadband access for less than S$300.

The need for support continued to grow. Each school was still provided with an on-site technology assistant and access to the central technology help desk, through funding from the Ministry of Education. In addition to this support, the "Ministry also provided an option for schools to purchase additional technical services form a list of Professional Support Services" with their ICT funds (Koh & Lee, 2008, p. 75).

> In 2008, schools received additional funding for an Information and Communication Technologies Executive as part of their Information and Communication Technologies Grant and have the autonomy to decide on whether to use the funds to engage ICT Executives for their schools, or on other information and communication technologies services. (p. 75)

This executive's role is to provide technical support and professional services for planning and implementation of information and communication technologies in the schools.

As the implementation of phase two of the *Masterplan* ended, a few achievements were noted. Students and teachers were surveyed and feel they are competent in basic information and communication technologies skills and are able to use the

Internet and email and two-thirds of teachers feel comfortable supplementing the curriculum and their teaching with ICT tools. 80% of schools have met the *Masterplan II* outcomes and 15% have exceeded them (Koh & Lee, 2008, p. 77). "The ultimate goal of the second *Masterplan* is not about the use of technology, but rather about changing the culture of the classroom and school to support and motivate thinking and independent learning among young students" (SeokHoon, 2003, p. 287). As this goal has not yet fully been reached, the continued efforts, participation, and collaboration by teachers, principals, and Ministry of Education are continuously working to make this a reality with the recent creation of a third *Masterplan*.

Masterplan III had the goal to continue the implementation of ICT in education from 2009-2014 (Singapore Ministry of Education, 2010-2015c). The third *Masterplan* continued the vision of the first two phases of the plan of equipping students with 21st century skills to succeed in a knowledge-based economy. Looi and Xie (2014) stated that, "the broad strategies of the third Masterplan for ICT in education are:

- to strengthen integration of information and communication technologies into curriculum, pedagogy and assessment to enhance learning and develop competencies for the 21st century;
- to provide differentiated professional development that is more practice-based and models how information and communication technologies can be effectively used to help students learn better;
- to improve the sharing of best practices and successful innovations; and
- to enhance information and communication technologies provisions in schools to support the implementation of *Masterplan III*" (p. 88).

The Ministry of Education is continuing to focus on the areas of curriculum and assessment, professional development of its leaders and teachers, research and development, and the continuous upgrade and implementation of new technology infrastructures in schools.

As part of *Masterplan III,* the Singapore Ministry of Education extended the information and communication technologies deeper into the curriculum and pedagogy by providing richer opportunities for students to use the technology to communicate and collaborate and for researching, analyzing and synthesizing information (Tan Seng, Chen, Teo Kheng, Koh, Chai, & Lee, 2010). Web 2.0 tools also allowed both students and teachers to create content for the Internet. Their infrastructure goal was to provide every student with a notebook computer and they gave schools faster Internet connections in order to allow each student to meet their curriculum goals.

More teachers were trained as 'ICT specialist teachers' and trained teachers across the country on new instructional practices focused on integrating educational technology tools to increase student learning and engagement. The Ministry also continued to grow their *LEAD@ICTSchools* and *FutureSchools@Singapore* programs that began during the previous two phases of the Masterplan, which allowed schools to try more experimental technologies and pedagogies with students. As part of *Masterplan III*, the Ministry continued supporting and expanding their network of educational labs, which allowed for the prototyping of educational innovations across the country. The promising practices that were developed within these labs were shared with other schools across the country and also served as training opportunities for pre- and in-service teachers across Singapore. Singapore still has a national curriculum and examinations, but the schools are gaining more and more freedom in using and developing their own resources for educating students in a variety of ways to meet each child's different needs.

e-Learning in Singapore's Secondary Schools

With the investment in an infrastructure, training, and support for Singapore's schools, e-learning is a natural fit in the education system. With the autonomy for schools to decide how they want to implement the use of information and communication technologies for teaching and learning, several have chosen online and blended learning approaches.

> According to Dr Koh Thiam Seng, Director of Educational Technology Division, "With iN2015's push for ubiquitous computing, broadband access and 1:1 computing will become commonplace and pervasive in Singapore.

> The future of learning and education is going to be browser-based, multi-device and mobile… I expect that learning will be accessible anywhere, anytime, and through any device. (Koh & Lee, 2008, p. 88)

The Ministry of Education's vision is that "schools will become highly connected learning hubs which will seamlessly tap external resources, specialized knowledge and expertise from different agencies, organizations and communities at the local and international levels" (p. 89). All of these things lend well to the expansion of online and blended learning environments in Singapore's schools.

Further, according to the updated version of the iNACOL international survey that was conducted in 2011,

> Singapore developed the Ministry of Education Baseline [ICT] standards to provide a scaffold for schools to plan and implement online and blended learning programs. Funding in Singapore provides local schools the ability to develop online and blended learning programs for all subjects, with the intent of improving students' ability to research, analyze, and publish information using a variety of media. (Barbour et al., 2011, pp. 11-12)

The infrastructure and content has been implemented and developed for primary and secondary schools and junior colleges through the *Masterplans for ICT* in education. "As of November 2006, all (i.e., 100%) of secondary schools and junior colleges and 134 (i.e., 85%) of primary schools (i.e., grades 1-6) are using an LMS for teaching and learning" (Powell & Patrick, 2006, p. 18). The Ministry of Education has also developed and purchased several digital content resources that are located in their web-based portal, *edu.MALL* that was created out of the *Masterplans*. As part of the professional development in the first two phases of the *Masterplan*, teachers were trained to integrate these resources into their teaching as well as taught how to build and share their own resources, in which they have uploaded and shared over 12,000 digital resources from May 2005 – November 2006.

The schools that are offering online courses to their students are focusing on the core subject areas using curriculum that is provided by curriculum design companies or their own teachers, or they are using a combination of both. The schools providing full online courses offer them during the school day in the school computer lab (Powell & Patrick, 2006). The Ministry of Education wants to take education into the next generation of technologies and pedagogical practices by prototyping and studying educational gaming, virtual worlds for learning such as *Second Life* and by studying today's students to gain a better appreciation of how to develop content to engage them in learning.

Blended learning environments, which are becoming more popular around the world, is the majority of the way online learning opportunities are providing for students in Singapore. "Singapore reported that pure online learning is not a priority since the city is small and well connected. However, blended learning is used as a complement to classroom learning" (Barbour et al., 2011, p. 13). The schools mix online curriculum with face-to-face instruction. "However, students in some schools can purchase a personal subscription to the content in order to access the content from home" (Powell & Patrick, 2006, p. 18). The majority of the students who purchase this personal subscription use the money they get from the 'Edusave Grant' offered by the government.

The most innovative idea gleaned from iNACOL's international survey was the idea of e-learning week.

> A number of schools in Singapore have adopted e-Learning week, where students do not attend school but stay at home working on lessons and assignments delivered through the learning management system. During this week, teachers facilitate the learning and provide feedback via email and other electronic means. (Powell & Patrick, 2006, p. 19)

E-learning week started with one secondary school and junior college in 2005, and has now expanded to multiple secondary schools, junior colleges. The idea was taken from Raffles Institute, who has been doing e-learning week since 1999. In 2006, the idea of e-learning week had become so popular they phased it out and is now integrated into the curriculum on a full-time basis.

According to the Ministry of Education's response to the iNACOL international survey, e-learning enables teachers "to incorporate technology into learning and is a creative avenue for students to express themselves" (Powell & Patrick, 2006, p. 19). Students can work on difficult concepts at their own pace, using a variety of methods and tools and can communicate and learn from their peers in online discussion forums. The teachers' biggest challenge in using online learning has been "the time spent on designing e-learning packages" (p. 19). However, when asked, the students found the online content engaging and enjoyable making it worthwhile to the teacher.

Generally, private companies develop the learning management system and content for schools and provide it to them on a subscription basis; however, a few students at the Chinese High School "produced *Electronic Link Forum*, a communications software that includes e-mail, group messaging, file sharing, and other features. The boys drew up a business plan and are now negotiating with the Education Ministry, which may buy the software, according to school officials" (Borja, 2004, p. 33). This is just one of example of what can happen when information and communication technologies and project work are combined. Currently, most education is learning about something and the Ministry of Education says, "in the future, it would be equally important for students to experience "learning to be" entrepreneurs, designers and programmers through participation in the niche communities" (Koh & Lee, 2008, p. 91), which is exactly what these students were able to experience.

Partnerships have been essential to the implementation of the Masterplans and have grown into other projects. "The Information Technology Standards Committee, an industry partnership supported by SPRING Singapore, and Infocomm Development Authority of Singapore have developed a Specification for e-Learning Framework" (Powell & Patrick, 2006, p. 21), which provides standards for e-learning, including approaches to developing courseware for different environments. The partnership is also in the process of developing *Content Exchange Metadata Standards* and *Taxonomy Standards* for education in hopes that everyone, commercial and the Ministry of Education, will use the same language for the development of content in order to easily distribute and exchange the resources.

The country has developed the *edu.MALL* to host a variety of digital content. Content within this clearinghouse will have to meet all of the standards in order to be shared across the country. "Singapore is currently looking into a framework for the development of digital content, including e-learning resources. It will provide a set of guidelines to facilitate and ensure the development of quality digital content by commercial vendors" (Powell & Patrick, 2006, p. 21). Teacher resources are also provided within *edu.MALL*. Teachers can locate pedagogically sound resources for their on demand learning needs. Teachers also conduct learning activities using online tools. Online teaching skills are required as part of the professional development program for educators. Courses are provided by the National Institute of Education or professional development organizations. However, there is no prescribed set of qualifications or training that a teacher must engage in to teach online (Barbour et al., 2011).

Costs of training teachers, upgrading and implementing new technologies, and on going subscription costs are the main obstacles in implementing online learning for all students (Powell & Patrick, 2006). As stated earlier, low-income families are provided low-cost computers with unlimited broadband Internet access, so access to the technology is not an obstacle for Singapore, unlike in most countries that participated in the international survey. Other technologies, such as "Tablet PC's, data loggers and handhelds with wireless connectivity" have also been implemented to change the experience of how students learn (p. 22), also making the transition to learning online and in a blended environment much easier.

"Online learning is increasingly adopted by schools as part of their learning process. Project work and the shift to a more learner-centered approach have encouraged independent learning among students" (Powell & Patrick, 2006, p. 22). With the implementation of the Learning Digital Exchange – a national learning content network that allows seamless access and sharing of teaching and learning repositories related to education for all learners – (IMDA, 2016) in the third *Masterplan*, online learning is only expected to expand in Singapore. Other approaches the Ministry of Education is considering to expand online learning include the use of an open source learning management system, incorporating a learning activity management system into the schools' learning management system, the development of a learning object repository, edumall 2.0, which provides teachers with resources, learning ideas and approaches from varied providers and may potentially even be made accessible to every student in Singapore.

Online learning is a key initiative in Singapore's education system. It is continuing to advance and students are using Web 2.0 tools, digital content, virtual worlds, and mobile devices to access content through the Internet. Singapore sees *the FutureSchools* as the schools that will be the frontrunners in the expansion of these new technologies and how they can be infused into the curriculum.

> [Within] the *iN2015*'s vision of ubiquitous computing, and the use of IDM [Interactive and Digital Media] in the future, it is imperative for schools and teachers to re-conceive how learning can be more inclusive of students' experience, interests and passions which occur outside the school environment, and more importantly, to reconnect learning within the broader learning ecosystem. (Koh & Lee, 2008, p. 93)

Blended and online learning environments are tools that allow teachers to easily differentiate learning in order to provide a customized learning experience to ensure students are engaged in learning.

Significance of this Illustration

According to an Organisation for Economic Co-operation and Development study in May 2015, Singapore is home of the world's best education system. "Education is highly valued, and produces strong outcomes, at least partly because the public at large has understood that the country must live by its knowledge and skills, and that these depend on the quality of education (Hanushek & Woessmann, 2015, p. 14). Over the past 15 years, the Singapore Ministry of Education has invested a lot of time and resources in order to thoughtfully implement the use of technology in their schools, and the rest of the world can learn a lot from their implementation.

The Ministry invested heavily in the infrastructure and professional development across the country, early in their ICT *Masterplans*, to ensure the technology was accessible and teachers understood how to both use it and teach with it to ensure student success. They were not just implementing technology for technology's sake, which we have seen happen without success all over the world. Singapore has a focus on student learning and innovation and has put a lot of thought into implementation that is seeing positive results.

Singapore has a centralized education system, with a national curriculum, which is different than many other countries. However, they have allowed schools to be innovative with their information and communication technologies implementations. Several schools have piloted different innovations over time to discover challenges and successes. The Ministry started small with a few schools and have invested in many more schools since *Masterplan I* to continue to innovate in different ways by using technology as an educational tool.

While Singapore is a small country and the government has much control over what happens with education, they way they have planned and implemented information and communication technologies over the past 15 years is a model for other countries and schools, no matter their size or government control. First, they developed a plan with all stakeholders (i.e., infrastructure, training, communications, government, school leadership, families, etc.), and then communicated it to the community. Next, they invested in the plan (i.e., building the infrastructure, worked with Colleges of Education and schools to develop new professional development and training programs for pre-service and in-service teachers). Then, they started small with the implementation, working with schools and teachers who were ready and excited to get started in a variety of ways, slowly expanding the pilots across the country, learning from one another. Throughout the implementation, they have also been observing and researching what is happening in these schools and updating their plans for the future, while sharing their successes with the rest of the world; providing us with a great case study to learn from.

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The Development of Online and Blended Learning in Primary and Secondary Education in Iceland

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Abstract

In the early nineties, a grassroots movement of educators in rural districts initiated a nationwide network and connected most Icelandic schools to the Internet. The development of online and blended learning at the compulsory level involved: language-related projects; projects in rural schools; and efforts to increase course selection through collaboration between schools and access to upper secondary level courses. At the upper secondary level, in 1994 to 2005, pioneering distance programs started in a few schools. In the following years, blended and online learning developed to various extent in all schools with the aid of Learning Management Systems (LMSs). Results from a 2010 evaluation study involving three main distance education providers are outlined and an overview of selected cases provided which shed light on recent development. It is concluded that there is a need for stronger policies and support from authorities regarding the development of distance, online learning and blended learning at the primary and secondary level in Iceland.

Introduction

Iceland is a volcanic island in the Northern Atlantic ocean and was first settled in the ninth century. It was under Norwegian and later Danish rule from 1262 to 1918, but became a republic in 1944. It is one of the Nordic countries and maintains close ties and cooperation with them; for example, at the government level through the Nordic Council. Iceland is not in the European Union but is in the European Economic Area (EEA). The country ranks high in economic, political and social stability and equality ("Iceland," 2017). Currently about one third of a million people live in Iceland, the majority in or close to the capital area of Reykjavík but others in small towns, villages or rural areas distributed around the country's 103,000 km^2 (ca. 40,000 sq. miles). The population density is only about 3.2/km^2 (8.3/sq. mi).

Iceland was isolated through the centuries with a homogeneous population due to its remote location, harsh climate, and lack of natural resources for boat building. The country was very poor with its economy based on farming but its affluence grew with the fishing industry during the last century as well as an economic boost during the second world war. In recent years, tourism has surpassed fisheries as the main source of income for the country and Iceland has become far more multi-cultural which has resulted in a varied language background of the population. The official language is Icelandic but from 1997 to 2016 the number of children having another mother tongue than Icelandic steadily rose from 377 (0.9%) to 4148 (9.3%) with more than 50 language backgrounds involved (Statistics Iceland, 2017a). The largest foreign language group has been Polish, with more than one third of the children in 2016 (1,467) of Polish origin.

In the following sections we will provide a short introduction to Iceland's education system followed by a comprehensive overview of distance and blended learning in compulsory and upper secondary education in Iceland. At the compulsory level we describe distance learning projects related to language learning and rural school collaboration, as well as development in blended learning. At the upper secondary level, we describe the pioneering schools providing online and distance learning, look at the development of the use of LMSs in blended learning and provide insights in the recent developments describing selected cases.

Overview of Iceland's Education System

In this section, we will give an overview of compulsory education in Iceland, which involves education at the primary and lower secondary level, and then we will describe education at the upper secondary level which is non-compulsory.

Iceland's Compulsory Education

Compulsory education in Iceland can be described as a single structure education with no transition between primary education and lower secondary education, and with general education provided in common for all pupils (Commission/EACEA/Eurydice, 2016a). These include grades 1 to 10 with children 6 to 16 year old (Commission/EACEA/Eurydice, 2016b).

The Icelandic Ministry of Education, Science, and Culture issues the main curricula of both compulsory schools and upper secondary schools and is responsible for the operation of the latter schools while education at the compulsory level is provided by the municipalities/local communities. In 2015, there were 168 compulsory schools in Iceland (94% of them public) with ca. 44,000 learners (Statistics Iceland, 2017a). About 28,000 (i.e., 63%) of those lived in the capital area but the rest were spread sparsely throughout the country. The number of learners in each school ranged from 4 to 861 and the average number of learners per school was 260. During the past decades people have been moving from rural areas to the capital region where schools tend to be much larger, resulting in the closing down or merging of rural schools at the compulsory level.

Iceland's Upper Secondary Education

Education at the upper secondary level in Iceland is divided in general education for matriculation exam, vocational-industrial education, and professional education for master craftsmanship. The upper secondary schools may be divided in junior colleges (i.e., grammar schools) providing general education and comprehensive schools which offer both general and vocational programs. Traditionally, there were separate industrial-vocational schools but many of them are now merged in the comprehensive schools. In 2008, several industrial-vocational schools in the capital area, were merged to become The Technical College. In addition, there are many vocational schools with programs for specific trades and careers (they are not counted among the conventional upper secondary schools below). The length of the studies in vocational education varies from one to four-year study. The general upper secondary education is planned in continuation of the compulsory education (i.e., age 6–15) with pupils entering upper secondary schools at 16 years old. They used to be organized as four years of study for the matriculation exam, but that was recently changed to three years. Students in the vocational programs tend to be older than in the general programs (Statistics Iceland, 2017b).

There are currently 30 high schools/junior colleges in the country (i.e., not counting special schools at that school level, e.g. in arts or horticulture). The age of a "regular" student is 16-20. Approximately half of those schools offer vocational-industrial programs. Seventeen schools are in the countryside (i.e., 57%) and 13 in the capital area of Reykjavík (i.e., 43%).

Most of these upper secondary schools are public schools run by the state or in collaboration of the state and the municipalities. The Technical College in Reykjavík offering industrial-vocational education and different specialized programs is privately run by the employers' organizations SA – Business Iceland. Included there is The School of Master Craftsmanship for those who have completed a journeyman's examination in a certified trade and are generally working as trade craftsmen while finishing their studies. Many of the programs offered by The Technical College would qualify as tertiary education. Another, privately-run school is Keilir Academy, founded in 2007. It offers vocational and academic programs, mostly at the tertiary level, many of which are organized as blended learning, or flipped learning, with considerable use of computer technology. Keilir also offers a program for preliminary university studies, which has been an important provider of online studies for finishing the equivalence of matriculation exams enabling older students to enter the university (Keilir, n.d.).

Most upper secondary schools in Iceland (~80%) organize their education in a unit credit system (i.e., module/course-based) where students follow courses prescribed in the relevant programs rather than following age-based cohorts. In the case students fail in a course, they need to repeat that course. The flexibility of the unit credit system makes it feasible for the schools to open access to their courses online and for credit recovery.

Distance and Blended Learning

With the advent of the Internet in the early nineties, online learning became a feasible formal education option for students in rural districts. Around 1990, a grassroots movement of small schools in sparsely populated districts had started to build up Internet connections which grew quickly. In 1992 it became a formalized nationwide network called Ísmennt or The Icelandic Educational Network (SKÝ – Skýrslutæknifélag Íslands, 2017; Wilde, 2011). The small countryside schools aimed to increase collaboration and enhance teachers' professional practice. By the spring of 1993, 80% of all schools in the country had been linked to the Internet through the network (Jónasson, 2001). The network became an important supporter as well as promoter of distance learning at all school levels in the country initiating or supporting pioneer projects in online education. The network was also an important supporter of Iceland University of Education, which started its distance education program for compulsory school teachers in 1993 to address a lack of certified teachers in rural schools (Jóhannsdóttir, 2010).

In this section we will describe how distance and blended learning developed both at the compulsory level and at the upper secondary level.

The Compulsory Level (i.e., Primary and Lower Secondary)

According to the Icelandic curriculum guide from 2011, the main objectives of distance and flexible education at compulsory school should be to provide pupils, no matter their location or educational achievement, the opportunity to take additional electives or advanced courses without extra fees (Icelandic Ministry of Education and Culture, 2014, p. 80). Given the background of Iceland as described above, the development of distance education and blended learning at the compulsory level can mainly be divided in two: (1) Language related; and (2) efforts involving distance learning in small rural schools through online collaboration and/or video conferencing. In this section we will provide a description of two language-related cases and three cases involving rural schools. Additionally, there have been some efforts to offer other blended learning opportunities, for example in the Reykjavík municipality. Furthermore, students at the lower secondary level have been able to sign up for courses (i.e., advance placement) at the upper secondary level (Jakobsdóttir & Jóhannsdóttir, 2010), especially in Icelandic, English, Danish, or Mathematic

The Language Centre

In 1971 opportunities to study Norwegian or Swedish instead of Danish were provided due to many returning expatriates who had worked or studied in those countries and were returning back to Iceland with children wanting to continue with those languages rather than to study Danish. These children were relatively few and distributed around the country so it was hard, especially for small rural schools to provide that instruction. To address this issue, in 2001, Reykjavík Education authorities decided to found The Language Centre which started operating in 2002 (Tungumálaverið, 2013). It currently provides advice and assistance to schools and districts throughout the country; in-school classes (i.e., web-facilitated) in Norwegian, Polish, and Swedish to students in Reykjavík; and on-line classes in Norwegian, Polish, and Swedish for students within and outside the metropolitan area for students in grades 9 and 10. In 2015-2016 there were 182 children from the countryside and 210 from Reykjavík. The students access the online class during the time in their own school, when their classmates are studying Danish, or from home. Students communicate with their teachers online, do projects and take tests online. Parts of projects involving oral practice of the language can be completed via phone or online conversations.

Learner autonomy has been encouraged from the start of the school (Ragnarsdóttir, 1999; Ragnarsdóttir, 2002) but other emphasis include a communicative approach, project and theme-based learning, personalized learning, and portfolio assessment. Teachers and students in The Language Centre have participated in collaborative projects with other teacher and student groups across the Nordic countries, for example via Norden Online. The learning environment and tools of The Language Centre have changed through the years and in 2016 it included, for example, *Moodle*, *Quia*, *Google*, *Screencast-o-matic*, *Facebook*, *iMovie*, *pbwiki*, *MS Powerpoint*, and *SoundCloud* (Ragnarsdóttir, 2016).

IceKids (Íslenskuskólinn á Netinu)

The aim of IceKids was to create a web-based platform and a school community for young expatriate Icelanders to keep up their mother tongue through courses, games, and community in a safe online environment (Macdonald, 2008). It was initiated by the University of Iceland and used Netskólinn (i.e., The Net school) as the LMS. The IceKids project was one of a number of Icelandic cases studied in an OECD/OERI project in 2008 involving the development of digital resources in the Nordic countries. All activities and content (games, newsletters for parents, courses, tests, discussions) using the learning management system were developed by the teacher working closely with a programmer – a former teacher – who was paid a small amount to turn the ideas into working reality (Macdonald, 2008, p. 20). The innovation was essentially a grassroots effort. Other stakeholders were the ministry of education, Icelandic families living abroad and a number of sponsors. There was an absence of engagement and therefore ownership from schools, companies and the foreign ministry, not having been involved from the outset when the project was ministry of education funded. Eventually funding issues closed the project (Macdonald, 2008).

Strandir

In the school year 1999 to 2000 a project was started to connect a small school in a remote rural area in the Westfjords of Iceland (i.e., Broddanes School) to a larger school (in Hólmavík) 37km away. This development project was inspired by two early projects in other countries with distance education at the primary/lower secondary level: The Finnish Kilpisjärvi project and the Alaskan project On the Wings of Tomorrow. For several years there had been fewer than 10 students at the Broddanes School and the aim of the project was to explore whether distance learning through video conferencing (i.e., connected classrooms) could improve work and study in such a small school at the compulsory level by increasing learning opportunities and variety. The aim was also to strengthen students' social position and facilitate their interaction with peers in neighbor schools and reduce teachers' isolation and improve their work conditions with better opportunities for interaction with colleagues. The school administrators and teachers at the school collected data during the project and did action research (Sigþórsson, 2000, 2003). The University of Akureyri Research Centre evaluated the project (Sigþórsson, 2000) collecting data from administrators and teachers (i.e., meetings via video conferencing and on site), from students in grades 4, 5/6, and 9 (i.e., interviews and surveys), and parents (i.e., surveys). There were 5 students in these grades who participated in Broddanes and 44 in Hólmavík. The main conclusions of the evaluation study indicated that distance education of this sort was technically and pedagogically viable and in various ways could strengthen work and study in small schools and include social benefits. This appeared more true for students in the older grades and for students that were more independent and self-confident. Students and parents tended to be happy with the experience but there were some technical difficulties and it proved hard for the teachers to divide their attention between their class in Hólmavík and the distance student(s) at Broddanes. The experiment did not save any money for the schools involved but they continued to collaborate via distance to some extent after the project for a few years without outside support but then discontinued, and Broddanes school later closed.

VestBarð

In 2003 to 2006 a similar project was started with collaboration of schools in a different area of the Westfjords of Iceland (Thorsteinsson, Ingason, & Thórsteinsdóttir, 2006). There were difficulties for the schools involved to attract licensed teachers and travel in winter on mountainous roads was difficult. Two schools participated in the project, one with 100 students (at Patreksfjord) but the other with about 90 students distributed in three locations (i.e., about 50 in Tálknafjord, 20 in Bíldudalur, and 20 in Birkimelur). Students' social connections increased and they felt they were a part of a larger whole with less conflict between areas. The participation appeared to increase learners' independence in their studies. Teaching methods became more varied, and there was more communication between teachers who were also gaining skills in computer use and the use of software which could be of use in teaching. Learning performance appeared similar to performance in traditional learning and it was thought that students would be better prepared to utilize distance learning opportunities at the upper secondary school level in the future. There were opportunities to take advantage of teachers' special expertise across schools without travel cost. While technical difficulties came up, they were managed effectively, and overall the experiment was thought to have gone rather well and as a result a new project – SnæVest – started with the same schools in the Westfjords that were to collaborate with schools in towns and villages in the Snæfellsnes peninsula.

SnæVest

The main aim of the SnæVest project was to strengthen the countryside schools involved with blended learning (Jóhannsdóttir & Jakobsdóttir, 2011). In the beginning of the project there was the same need as in the VestBarð project, that is a lack of teachers. However, in 2008 an economic crisis rocked Iceland and had a large effect on the project. Prices for new video conference equipment and laptop computers for students in the participating schools sky rocketed. It became easier during the project period to get qualified teachers in the rural schools, so the need to get teachers all but vanished. Technical problems also came up when trying to connect more than two schools via video conferencing. However the subjects Danish and Physics were taught from the Patreksfjord school to schools in Tálknafjord and in Snæfellsnes and administrators and teachers thought that had gone well. Students had been pleased and the projects online learning materials developed had been useful. However, it appeared difficult for other schools to access and/or reuse the materials from the LMS, Netskólinn. The extensive collaboration between the schools to develop varied teaching methods and blended learning had not gone as planned although there was interest for a continuation of the project. The evaluation revealed the vulnerability of a project of this kind to outside effects including technology pricing and teacher availability. It was suggested that a nationwide collaboration with an online school might be a way to go, open to any school at the compulsory level in need of teaching or interested in collaborative projects with their student groups. Also it was suggested to look at open source solutions in relation to learning materials and LMS's.

Blended learning – Reykjavík schools

An experiment was done in 2002 to 2004 using WebCT (Jónsdóttir, 2003) where three and later four Reykjavík schools collaborated providing students in grades 8 to 10 access to online courses (i.e., electives) across the schools, for example in mathematics and creative writing. In 2006 Reykjavík City provided access to Blackboard for all schools at the compulsory level in the city. The use was very limited (Thorkelsdóttir, 2015) but in 2011 it was decided to switch to Moodle and later it was decided to open access to the web for all schools in Iceland. Teachers and schools have been able to set up courses and also to share learning materials in a special open educational resource category.

Examples of schools and teachers developing blended and online learning in recent years include Hólabrekku School where learning materials in Danish have been developed and students in grades 8 to 10 work more independently on projects and exercises in Moodle during the school time at home or outside the classroom (Thorkelsdóttir, 2015). Also learning materials on ICT in teaching and learning for teachers have been available for self-study and professional development. One development project involved an action research study by a teacher in Reykjavík teaching social science at the lower secondary level using blended learning in Moodle for his students in Voga School but later he provided online access to those materials and taught students in a rural school using the same materials (Tómasson, 2015) at a distance. His conclusions were that Moodle was very applicable for both blended learning and distance learning at this school level.

Pupils at the compulsory level taking courses at the upper secondary level

In an evaluation study of distance education at the upper secondary level in 2010 it was revealed that many students at the compulsory level were taking distance education courses (Jakobsdóttir & Jóhannsdóttir, 2010). About 8% of the 3228 distance education students registered with the three largest distance education providers were 15 or younger (i.e., from the lower secondary level). About 70% of those reported in a survey that the main reason they registered for a distance education course at the upper secondary level was to get ahead in their studies. The schools tended to be pleased with these students because they had low dropout rate compared, for example, with students self-blending courses in the 16-20 year age group.

Upper Secondary Schools/Junior Colleges

In this section an overview will be provided of online and blended learning at the upper secondary/junior college level in Icelandic schools. First we will describe the early development between in 1994 to 2005 where a few schools took the initiative to provide access to their courses online. Then we will describe the period 2005 to 2009 when all of the schools started employing LMS's and to develop blended or online learning to various extent. We will then describe the results of an evaluation study done in 2010 on the three leading distance education providers at the time. Finally an overview will be given of the development from 2010 with selected cases.

The first distance education programs 1994 to 2005

Online distance education has been offered as an alternative form for learning at the upper secondary level since the early nineties. In 1994, Akureyri Comprehensive College (VMA), located in the main town in North Iceland, became a pioneer in offering online courses at the upper secondary level. It was initiated by a teacher who had been one of the most active members of the Ísmennt grassroots network of teachers. Most of the traditional courses offered in the school could be accessed online with the same requirement and credits as the regular courses. All teaching was done via email with no face-to-face sessions. The program was meant to make access to formal education at the upper secondary level available for people in sparsely populated districts and to enhance equity in access to upper secondary education in Iceland (Ágústson, 1999; Matthíasdóttir & Hermannsson, 2003a). The industrial-vocational programs have also offered most of the general academic courses online with face-to-face sessions in practical subjects. An important addition to the VMA is The School of Master Craftsmanship, which is offered as an online distance option with several face-to-face sessions during weekends or evenings. VMA was for about eight years the largest provider of distance education at the secondary level in Iceland with several hundred distance students studying online. Women and people living in areas nearby the school formed the majority of the student group, however students living all around Iceland and abroad were enrolled (Matthíasdóttir & Hermannsson, 2003a). Increasing demand for online distance learning made upper secondary schools in Reykjavík soon follow suit. Planning and educational policy from the Ministry of Education, Science, and Culture in 2001 and 2005 also called for an increase in online and blended learning and that students would be able to study when it suited them regardless of residence/location.

In 2001, another school at the upper secondary level started to develop distance learning programs, that is the Comprehensive College at Ármúli (FÁ) located in Reykjavík (Matthíasdóttir & Hermannsson, 2003b). In 2005 another Reykjavík school followed suit, The Commercial College of Iceland (VÍ).

Research on blended and distance learning 2005 to 2009

A series of research studies on distance and blended learning were done during this time and data collected from all schools at the upper secondary level in Iceland (not counting special schools at that school level, e.g. in arts or horticulture). The data were collected in 2005 and 2006 from administrators (phone interviews) at 29 schools, and in 2009 from 31 schools (same 29 plus two newly established schools). In addition, in 2007, 25 teachers and 53 students from six schools were interviewed, most of them by phone (Jakobsdóttir, 2008, 2009; Jakobsdóttir & Guðmundsdóttir, 2010a; Jakobsdóttir, Jónsson, Elfarsdóttir, & Jóhannesdóttir, 2007).

Using the data from the administrators, the schools were classified into five main groups in terms of prominence of distance education and blended learning in the schools. Figure 1 shows how the schools were classified based on the interviews with school administrators in 2005, 2006 and 2009 (Jakobsdóttir, 2009).

The five groups displayed in Figure 1 are described as follows:

- Group 1 –Schools in this group with strong distance education stems (i.e., with large groups of students registered in distance education, and the distance education program even about equal to the regular program). Variable to what extent the distance education and the regular program was blended or separated.
- Group 2 – Sizable distance education programs, but lower rate of students than in group 1. Or small program apparently growing at a very fast rate (i.e., more top-down).
- Group 3 – Regular school program, but distance education started in some ways for groups or courses and/or

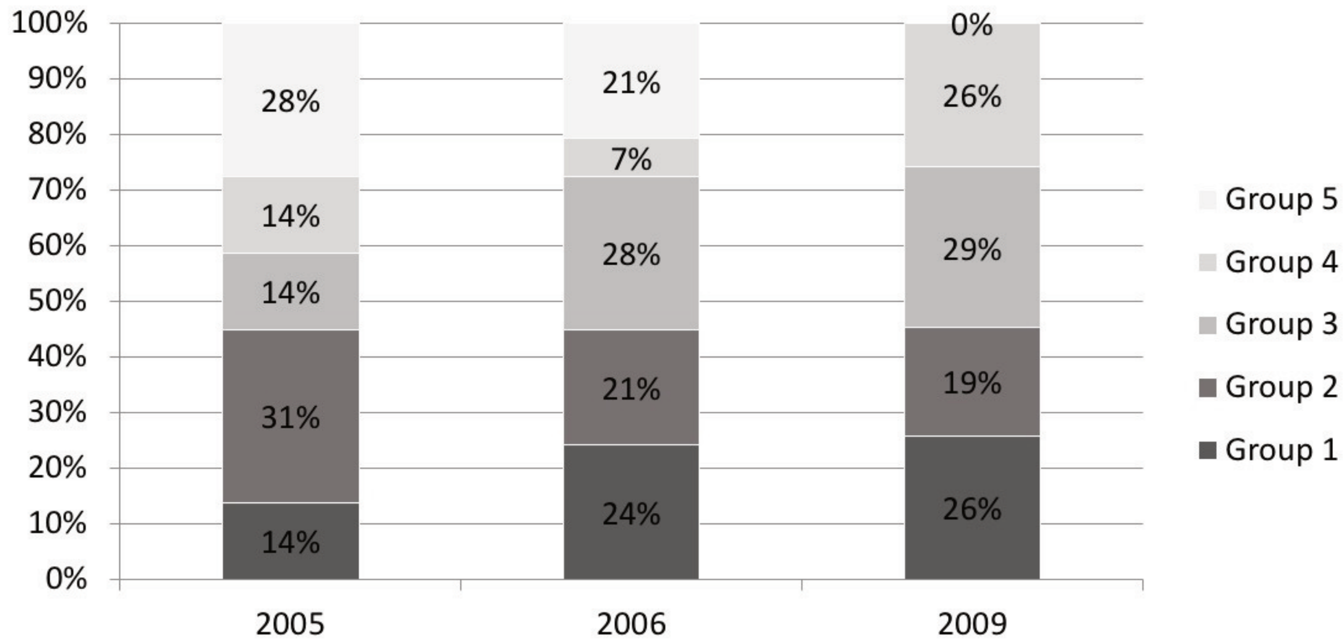

Figure 1. Classification of upper secondary schools based on prominence of distance education/blended learning in the schools (Jakobsdóttir, 2009).

time. Some schools started to use LMS highly and experiment with shorter school days or fewer regular classes as a result.

- Group 4 – Use of LMS's or intranet in high use in schools in this group by most teachers/student but attendance, length of school day, and schedule unchanged.
- Group 5 – LMS's or intranet in use in most or all schools but not as widespread as in group 4.

As can be seen in Figure 1, some trends were evident regarding distance education and uses of LMS's in the schools from 2005 to 2009. For example, the number of schools categorized in group 1 (i.e., strong/prominent distance education programs) doubled from four to eight, whereas at the the other end of the spectrum, there were eight schools in 2005 in group 5 with no distance education learners and/or without an LMS, which dropped to none in 2009. In 2005, there were seven to eight schools (i.e., about one quarter of the schools) without an LMS, whereas all used one in 2009.

Among the schools, there was a clear trend regarding the use of open source software (i.e., *Moodle*) as an LMS in favor of foreign commercial software (*Blackboard/WebCT* and *Angel*). In 2006 reasons administrators gave for the choice of LMS included the language (i.e., Icelandic), access and user-friendly interface, development and adaptation, connection with other systems, cost, timing/history (i.e., best system when chosen), experience, and ideology (i.e., open source). However, after the economic crash in Iceland in 2008, the cost factor appeared to be much more prominent. Figure 2 shows the trends of the types of LMS's in the schools involved (Jakobsdóttir & Guðmundsdóttir, 2010a).

The administrators interviewed in 2005, 2006, and 2009 tended to be pleased with the use of the LMS's. They thought that the use improved information flow between teachers and student, both in distance eduaction and regular programs, and made access to information about courses and teaching much easier.

Students at the upper secondary level in Iceland in 2007 studying via distance and/or with the support of an LMS tended to be content in their studies (Jakobsdóttir, 2008). Distance learners had chosen that type of study for various reasons. Some craved access to education in locations where there was no high school. Many emphasized the flexibility in location and time and a preference for studying online and/or using an LMS. New groups of distance learners emphasized benefits having to do with convenience and comfort rather than needs and necessity. However, some students reported that studying at a distance was more impersonal than studying in a regular program, there was not enough contact with

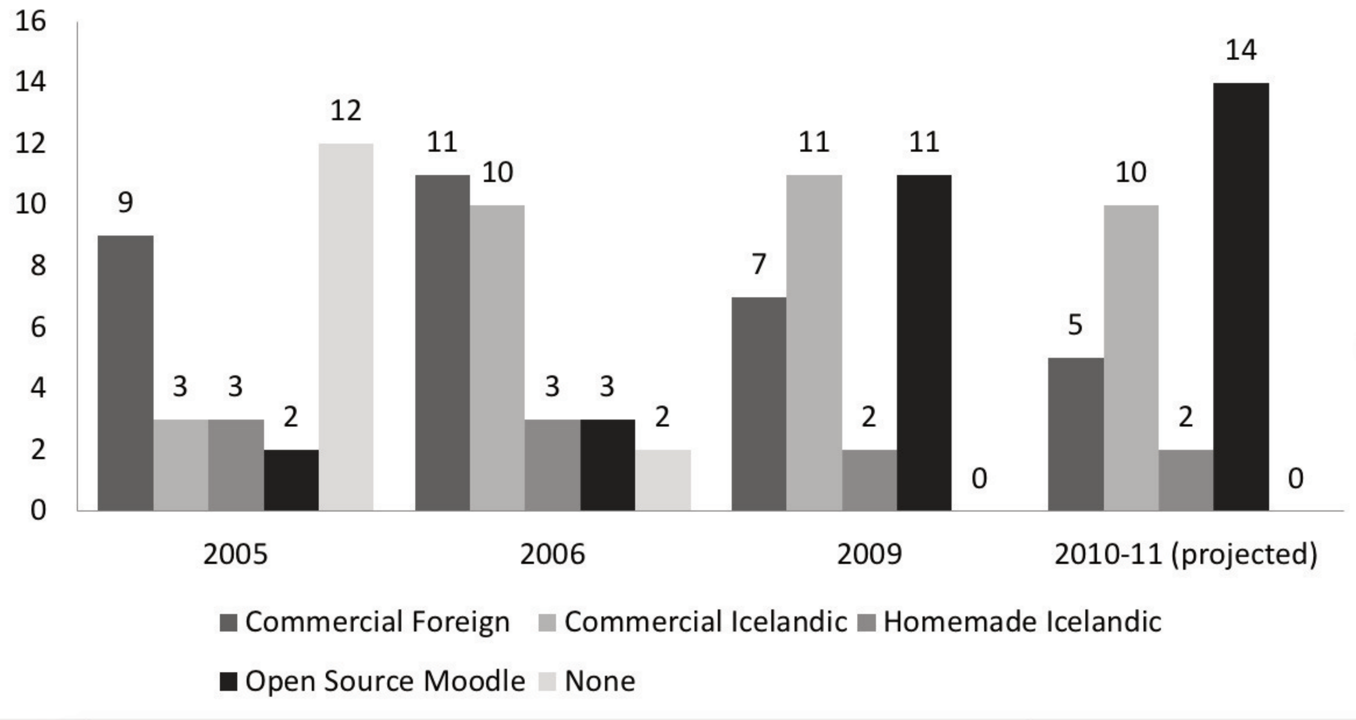

Figure 2. Types of learning management systems in schools at the upper secondary level (Jakobsdóttir & Guðmundsdóttir, 2010b).

teachers or students, and there was more need for self-discipline. Some students also thought that the LMS's could be used more effectively.

Teachers interviewed in 2007 felt that there were several benefits associated with distance education (Jakobsdóttir & Guðmundsdóttir, 2010a, 2010b). These included increased opportunities for small schools in rural areas, increased flexibility to coordinate residence, family, work and study. Students learned new practices and there was increased freedom for teachers and labour saving in the long run. On the other hand, drawbacks included increased workload for teachers (at least in the beginning) and isolation; insufficient teacher-student interaction and student-student interaction. Some maintained that distance learning was not for all schools or learners and that there might be greater risk of student cheating and dropout. Distance education required self-control and maturity. In addition technical problems were mentioned.

Among conclusions reached from these studies were that education at the upper secondary level in Iceland had tended to be compartmentalized. Going online might make it more so, and in some schools there might be a trend towards "independent study" with isolation of both students and teachers. It was felt that higher focus was needed in distance education on social elements, online community building, and effects of the use of LMS's needed more attention (Jakobsdóttir, 2008).

Evaluation study of the three main distance providers in 2010

In 2010, FÁ, VÍ, and VMA were the largest online distance education providers at the upper secondary school level with about three quarters of all distance education students (Jóhannesdóttir, 2010). The number of distance education students registered in these three schools was 3223 students, 66% female and 34% male. FÁ had general study programs for matriculation exams and vocational programs for healthcare professionals (ca 30% of the student population). The aim was to make as many of their general courses and specialized academic courses for the health care programs accessible online. VÍ had general programs for matriculation exams and all of their courses were offered both as an online and campus-based option. In both schools, distance courses were available also during the summer.

In 2010, the Ministry of Culture and Education launched an evaluation audit of the status and quality of the distance learning in these three schools (Jakobsdóttir & Jóhannsdóttir, 2010, 2011). They were all dual mode with online courses and on-site courses taught separately. The distance courses were to be equivalent to the on-site courses and often the same teacher taught both forms. The distance courses were planned entirely online without face-to-face sessions. In most of the upper secondary schools offering general academic courses online there were no obligatory face-to-face meetings, however, students might be invited to the schools for consultation or study counselling if they so wished to. To ensure the quality of the distance program, the distance students were evaluated in the same way as the regular students by taking the same final exam.

The mean age group was 20-30 years old but the age range was big from 15 to over 50. The distance students were living all around Iceland as well as abroad and were registered in most of the schools at the upper secondary level in the country, not just the three main providers. Many of the students were living in districts in Iceland that did not have upper secondary school in the neighborhood.

Reasons for choosing to study online varied with age (Jakobsdóttir & Jóhannsdóttir, 2011). The youngest group (15 or younger) had mostly one reason for signing up for DE courses. They wanted advance credits from the upper secondary level so they could perhaps go quicker through that school level later on. For the next two age groups (16-20; 21-25) the reasons were more varied but the main one was that they needed credits (for their diploma). These would include students who had failed a course in their day school, could not fit the course into their schedule or the course was not available at their school in the semester they needed it. The age group 21-25 needed the credits even more urgently – having been delayed in finishing their diploma and trying to catch up. Convenience and flexibility in time was high on their list and a reason to be able to work with their study was prominent. That reason was the main reason for the next two age groups: 57% of respondents 26-40 chose it and 66% of the people 41-50. These age groups had very varied reasons for enrolling in the distance education programs, especially the people in the 26-40 age group who needed a lot of flexibility while juggling work, study and family trying to get necessary credits. A prominent reason with that age group was being able to stay home with family/children which is not surprising given that this is the main child bearing age. Finally, the oldest age group (51+) appeared thirstier for knowledge that the others. About 80% of the oldest group listed a reason for their DE studies that they wanted to add to their knowledge although many also listed work with study, convenience and flexibility.

Attrition rate of distance education students in the three schools evaluated in 2010 was mainly measured by the percentage of enrolled students that showed up for the final exam or handed in the assignments required for assessment. The dropout rate was from approximately 27 to 40%.

The evaluation study revealed that the majority of the distance students thought they had a great need for distance learning, thought it was convenient to study online and that their educational outcomes were similar in distance and regular programs. Teachers tended to agree. Administrators, teachers, and students thought the quality of the programs comparable in many ways although students tended to think that teaching and communication with teachers was better in regular programs and communication with co-learners much better. An examination of the teaching methods in the distance programs showed that there were usually little or no requirements for student communications and collaboration. The LMS's were well used to organize the distance courses. Access to learning resources was provided, and students tended to have opportunities for self-tests and exercises but application of multi-media was not common.

Development of online and blended learning from 2010

In 2014, 4012 students were enrolled in distance learning in upper secondary schools in Iceland, which was a drop of 600 fewer than in 2010. There were 30 schools at the upper secondary level and 18 of them had distance learners enrolled (i.e., 60%) (Statistics Iceland, 2017c). Only 17% of the grade based schools had distance students/program but 71% of the unit credit based schools.

Vocational education was usually offered as a blend of online and face-to-face sessions. Industrial-vocational studies including programs such as marine engineering, boatmasters' education, and education for health care and social workers were offered in online courses with periodical face-to-face meetings. Apprenticeship was as a rule an important part of this kind of education and needed to be completed on-site (Jóhannesdóttir, 2010). Based on the schools' websites and recent yearly reports, five schools in the capital area offered such programs, and nine schools in the countryside had formed a coalition to make industrial-vocational programs available for people living in rural areas (Fjarmenntaskólinn, 2017). In the countryside, some upper secondary schools allowed pupils to enroll in blended learning organized for pupils to be able to stay at home while completing upper secondary education. In their hometown, they had access to a learning center where there were facilities for supporting their learning including a good Internet connection and a teacher or a mentor. In the learning centers pupils were connected to the school via Internet enabling them to participate in classroom teaching via video-conferencing or equivalent computer programs. Most of the learning resources were provided with an LMS so that pupils could work on their assignments in the learning centres. In general pupils attended classes in the learning center three weeks and were then expected to meet up for face-to-face sessions in the school for one week per month where they are provided with housing in dormitories. During these weeks, besides the academic school work, social events were planned for the distance students to mingle with the on-site students. Three schools in the countryside had offered this form of blended learning for 5-45 students per year (Jóhannsdóttir, 2017b).

The three schools that were the biggest distance education providers in 2010 are still among the largest providers while other schools have been increasing their distance students' enrolment. In the following sections, we will give an overview of selected cases, which shed light on the development of online and blended learning from 2010 at the upper secondary level in other schools entering the distance education scene in Iceland.

The Technical College. In 2014 the Technical College in Reykjavík offering industrial-vocational programs, had become the second biggest distance education provider, enrolling 645 distance students. In 2009–2010, The Technical College was already an important provider of distance programs, being in the fourth place after the three mentioned earlier. The college is made of 14 schools (or departments) with different industrial-vocational education of which seven offer blended learning. In the spring term 2016, the highest number of their distance students were enrolled in the School of Master Craftsmanship which is offered as evening school and/or distance learning courses with several face-to-face sessions. Other programs at The Technical College include boatmasters, construction, electro-technology, technology, information technology, and mechanical studies. The school serves a different population of students than general upper secondary schools with males between the ages of 32 and 36 being their largest subgroup of distance learners (Jónasson, Jónsdóttir, Ólafsdóttir, & Guðmundsdóttir, 2016).

Borgarholt Comprehensive School. Another upper secondary school in Reykjavík is Borgarholt Comprehensive school (BHS), which offers vocational programs as a blend of online and face-to-face sessions organized for students 18 years and older. The schedule takes into account that the students are working alongside their studies. Programs offered are: social service program for social assistants and school assistants, industrial metal work, practical multimedia, and automotive industry (Borgarholtsskóli, n.d.). In 2014, 230 students were enrolled in these programs as distance/blended learners (Statistics Iceland, 2017c).

Keilir Academy. In 2014, the numbers from Statistic Iceland show that Keilir Academy had become among the most important providers of online and blended learning at the upper secondary school level with large growth in enrollment. Two programs were offered as a blend of online and face-to-face meetings at Keilir, including preliminary university studies and sports training. Preliminary university studies was a popular program offered both as fulltime studies and part time for students who are in the labour market. Keilir has been in the forefront of using flipped teaching, varied assessment methods are emphasized and the attrition rate is almost 100% (Keilir, 2017).

Egilsstaðir Upper secondary school. In 2014, Egilsstaðir Upper secondary school (ME), had become an important provider of distance education in addition to the formerly mentioned institutions. ME is situated in East-Iceland offering general academic programs for both online and traditional learners. These programs have shown increased enrollments in online courses with students taking and average of one to three courses online each year (Guðmundsson & Þorsteinsson, 2016). Usually the upper secondary schools organize the school year in two 15 weeks semesters, the fall and spring semesters. In ME, each semester is divided in two shorter terms which gives the pupils the possibility to focus on fewer subjects and finish their credit units in 7 weeks. This is part of the attraction of the distance courses in ME. Different from the biggest providers of online courses, the VÍ and FÁ in Reykjavík, in ME distance students are enrolled in the same courses as the regular students with access to an LMS where resources and teaching are provided for both groups. The reasons for this arrangement is that with smaller cohorts of regular students the group sizes were getting too small and in order to make it feasible to run all courses needed for finishing final exams, distance students were invited to enroll to make the groups bigger. Thus, enrollment of distance students has helped the small rural school to sustain its operation, in spite of fewer regular students. The attrition rate in ME has been similar to the bigger schools and in the years 2011-2016 the mean rate has been 71% of enrolled students that have signed up for final tests of which 85% have passed (Guðmundsson & Þorsteinsson, 2016). Records are kept of where in Iceland the distance students live while enrolled in the online courses. In the school year 2016–2017, 20% lived in East Iceland where the school is situated, 14% lived in Western part of Iceland, 13% in South and South West Iceland and the biggest group, 48% lived in Reykjavík and neighborhoods; 3% of students were living abroad. The majority of distance students were females (ca. 60%).

Tröllaskagi upper secondary school. In recent years, another small rural school entered the market of providers of distance education at the upper secondary level. The Tröllaskagi Upper secondary school (MTR) is situated in North Iceland. The school was established in 2010 and is the most recent upper secondary school in Iceland. The school has attracted attention for innovative approach to teaching with intensive use of ICT and for networking on local, national and international levels (Jóhannsdóttir, 2017a). All courses are set up in an LMS where learning resources are available and assignments submitted. Students are expected to bring laptops to classes and be prepared for working on their assignments online. Following the school policy, formative assessment is the norm and there are no final exams. Students are expected to submit diversified assignments each week and teachers are to give weekly feedback taking into account competence criteria set up for each subject. Teachers work according to the learner centered pedagogy on which the school culture is based. Similar to ME, the majority of the distance students enrolled in MTR live in the capital area.

Already when the MTR upper secondary school was established a matter of concern was being able to offer the necessary provision of courses due to small student cohorts living in the area. Addressing that problem, a contract was made with VÍ, one of the big providers of distance education in Reykjavík. Access to the online courses in VÍ was opened for all students at MTR. Many other upper secondary schools in rural areas were facing the same problem which later led to a collaboration among them and the Distance College entered the scene of online provision in Iceland.

The Distance College – a network of upper secondary schools in the countryside. Diminishing cohorts of students in the rural communities, made it feasible for the smaller schools to exchange students and teachers, for being able to offer quality courses in all subjects taught by specialized teachers, and economic class size. Some of the schools had collaborated on projects for enriching the educational offerings in the countryside which in 2013 led to formation of the Distance College (Fjarmenntaskólinn, 2017), grassroots initiated collaboration of 13 rural upper secondary schools, most of them enrolling from 100–300 students while two of them are enrolling more than 500 students. The participating schools are committed to open their general education courses for online students from other schools in the network. Shorter vocational programs are offered periodically by two to four schools collaborating on each project. Professional collaboration of principals and vice-principals take place on a regular basis and a part time project manager has been hired for coordinating the work.

The circumstances that initiated the Distance College Network were diminishing population in the rural communities together with the decision of national authorities that the upper secondary schools that used to be four years for achieving matriculation exam should be shortened to three years. This situation has threatened the existence of some of the small schools. In order to survive the schools needed to prove that they had a capacity to offer a qualitatively recognized education for the rural youth at a reasonable cost. This called for schools in similar situation to work together. The Internet was the tool that made the networking feasible and visions for the importance of local schools among the school staff stimulated the formation of the network.

The prerequisite for participating in the exchange of students and teachers in the Distance College is a knowledge of the use of ICT for distance teaching and learning. However, in this respect the school practice in each school is different. While some schools, like MTR, are recently founded and use ICT widely for their teaching and learning and teachers are accustomed to collaboration, others still use traditional teaching methods with teachers independently teaching in their classrooms. Some schools had offered distance learning on a general market before they entered the Distance College Network while others had very little or no experience of teaching online (Jóhannsdóttir, 2017b).

In the autumn 2016, three years from the foundation of the network, the exchange of distance students is different in the participating schools. The schools that accept the most distance students enroll 20 to 40 distance students from other schools in the network, while others don't enroll any from other schools. Some of the schools that did not offer distance learning before, have taken the opportunity to develop their know-how in online course offerings and have managed to attract numerous distance learners from all over the country, like the ME in the East and MTR in the North mentioned above. Two more schools have managed to add 50-100 distance students to their regular student group (ca. 100-200 students). In these schools, the distance students' enrollment has been crucial for the school's' operation, both financially, and professionally. Other schools have planned for and advertised distance learning courses without success. Interviews with school authorities show that three issues needed to be in place in order to attract distance students: knowledge in use of ICT for online teaching, coordinated rules for the practice of teachers teaching online and collaboration of teachers and willingness to share expertise. The schools which had succeeded in attracting distance students were all concerned to use formative assessment and based their teaching on learner centered pedagogy and were committed to take care of individual learners by personal communication online (Jóhannsdóttir, 2017b).

Some of the schools have a tradition of providing industrial-vocational education and for them the benefit of the Distance College's network is to be able to form a temporary collaboration of three to four schools for providing vocational programs when there are too few students in each school. In these cases, the Distance College functions as a platform for forming smaller networks within the overall collaboration when needed. The small industrial-vocational schools also collaborate with the bigger schools in Reykjavík (e.g., the Technical College for boatmasters education, which is in high demand in the fishing towns in the coastline regions around Iceland). Education for health care services and school assistants is also a high area of need and the collaboration of several schools makes it possible to gather sufficiently large groups to be able to offer learners access to a blend of online courses and work-based sessions provided in collaboration with hospitals and schools in the smaller towns around Iceland. These arrangements call for a different kind of collaboration than the exchange of students in academic courses as distance learners. Some of the schools are focusing on either form and several are involved in both forms.

The network is important for the upper secondary schools in the countryside because the schools are often dealing with similar problems and the network has functioned well as a platform for consultation among the schools. In the autumn of 2016, the collaboration in the Distance College Network was not yet fully formalized. Administrators in the schools are learning to develop changed practice in and between the schools. The Distance College is an interesting example of the way in which educators in sparsely populated regions in Iceland are taking the Internet in their service to respond to problems of diminishing student cohorts well known all over the world at the same time as schools and education is the lifeline of rural communities.

Conclusion

The national curriculum guide states that "compulsory school pupils should preferably be offered to take distance or flexible education at upper secondary school as part of their compulsory education without special fee" (Icelandic Ministry of Education and Culture, 2014, p. 80). Following this policy the majority of the unit-credit-based (i.e., course based) upper secondary schools have made their courses available for students who have capacity to add courses to their compulsory schedule. LMS's have made it practical and easier for upper secondary schools to open access to their courses which some are offered fully online. Other schools have preferred to organize on-site teaching in collaboration with compulsory schools in their community, however supported by LMS's. This arrangement, which is a kind of advanced placement, calls for collaboration of both school levels which may be bridging the gap between them and supporting many pupils in moving to the next school level.

In the compulsory schools, the use of LMS's has increased collaboration between schools, such as sharing of learning material through the *Moodle* platform between teachers and schools within Reykjavík. The number of projects initiated by enthusiastic teachers are indicative of their wish to use new technologies in the service of better education for all, with concern for social justice. The case of the Language Centre shows that online education at the compulsory level can be effective and successful. However, some other projects, although having shown promise, have not managed to become sustainable or to be scaled up. Too often there has been a lack of understanding and support/funding on behalf of educational authorities, such as in the case of the Icelandic school for children living abroad. When it comes to use of online and distance learning, Iceland is at different end of the scale compared to more populous nations. In the Icelandic context, the main concern is not how to educate the masses, but how to reach the few when cost is high per student.

As for the upper secondary schools/junior colleges online learning has become an important part of the way in which the schools organize their programs with different blended learning models. In general academic programs the possibility of taking several courses online has enhanced flexibility for upper secondary students for catching up or advancing quicker through the three to four years for matriculation exams. An OECD assessment from 2015 found 73% of Icelanders in the age group 25–64 had earned the equivalent of a high-school degree, which was lower than the OECD average of 76% but in 2017, 78% of adults aged 25-64 had completed upper secondary education while the OECD average had dropped to 74% (OECD, 2018). Without the opportunity of distance education at the upper secondary level this rate would be even lower. For older people who quit school without finishing a high school diploma the online offerings give possibility to combine work and/or family and study. This applies to students in industrial-vocational programs who are usually older when they enroll. The Technical College in Reykjavík and the comprehensive schools in the countryside have taken this into account and offer many of their programs in a blend of online and face-to-face sessions which are planned for in the evening or weekends to make it possible to combine work and study. The Distance College Network of the small schools at the countryside has been crucial when several schools work together and gather students from several places in one cohort for being able to offer one to two year programs for vocational studies. In this way it has been possible to provide education for groups like paramedics and social- and school assistants as well as boatmasters and mechanics, for which there is high demand in the labour market in the countryside. The smaller schools' exchange of students and teachers online, has become a lifeline for rural schools, which many are situated in vulnerable communities. It is worth noting how some of the rural schools have managed to attract students from the capital area in response to diminishing student cohorts in their area. The Distance College is a good example of what grassroots movements can accomplish. However, their work is not always appreciated by the educational authorities and although small grants have been allocated for supporting the network, the existence of the small schools continues to be threatened.

The feasibility of use of ICT for networking of small schools for supporting education and sustaining rural communities needs to be examined for informing policy in which the value of education for such communities is taken into account. There is a need for stronger policies and support from authorities regarding the development of distance, online learning and blended learning at the primary and secondary level in Iceland. Allocating funds for developmental projects and identifying and disseminating examples of best practice is recommended.

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Answering the Call of Duty

How the Professional Community of the Israeli Virtual High School Attends to TPACK-related Issues and Students' Identity as Learners of Mathematics

Yaniv Biton, Sapir Fellus, Dafna Raviv, & Osnat Fellus

Abstract

The growth in using technology as a platform for professional learning communities has formed unique opportunities in education systems. This chapter contributes to understanding such learning communities by exploring the community of the teachers and tutors of the Virtual High School in Israel. The authors examined the communication methods employed by members of this professional community to explore learning opportunities that were generated within and between the teacher-tutor and tutor-tutor sub-communities via recorded synchronized meetings, communal documents, social networks, WhatsApp, and email. It was found that the VHS professional learning community not only generates insights that pertain to technology, pedagogy, and content knowledge (TPACK) but also attends to students' perceptions of self as learners of mathematics. The authors suggest that continual technology-based collaboration among VHS teachers and tutors can generate more individually tailored pedagogies that can address students' emerging needs in learning advanced-level mathematics and physics in the VHS.

Introduction

Computer technology that creates never-before-available opportunities for learning and teaching has been foregrounded as a futuristic perception of schooling and education (Anderson, 2010; Christensen & Horn, 2008). This is not surprising given the fact that such technology can not only be used to create shared learning spaces for students regardless of their geographical locations (Barbour, 2008), but also to continually generate new pedagogical tools to address learners' needs (Pierce & Stacey, 2010). The purpose of this chapter is to describe how teachers and tutors in the Israeli Virtual High School (VHS) build on the affordances of technology to create space for a learning community in order to identify students' needs and improve pedagogies. The structure, design, and support system that the VHS employs are described elsewhere (see Biton, Fellus, & Raviv, 2017; Biton, Fellus, Raviv, Feilchenfeld, & Koichu, 2018; Biton, Fellus, Raviv, & Fellus, 2017; Fellus, Biton, & Raviv, 2017). In this chapter, we first provide a short background about Israel and some relevant information in regard to Israel's education system with particular attention to mathematics and physics as these subjects are taught in the VHS. We then describe how teachers and tutors collaborate to identify students' needs, to develop pedagogies, and to foster an ongoing learning community. Looking back and going forward, we conclude the chapter with several comments in regard to the first few years of the Israeli VHS and to the future it promises in making the VHS a paragon of teaching and learning.

Background to Understanding Israel

Israel is situated in the south-western side of Asia, hugging the eastern parameter of the Mediterranean Sea, and is surrounded by four Arab countries Egypt, Jordan, Syria, and Lebanon. A land formerly known as the kingdoms of Israel and Judah and that has gone through multiple hands of conquerors regained independence in 1948. In spite – and because – of its official Jewish identity, Israel citizenry is a mosaic of ethnicities, and is composed by both Jews and non-Jews.

According to the 2015 census, Israel's population was an estimated 8.5 million people, of which 75% were Jewish, 21% Arab, and 4% other ethnicities (Central Bureau of Statistics, 2016a). Of the Arab population, 84.1% are Muslims, 7.8% are Christian-Arabs, and 8.1% are Druze. The official languages in Israel are Hebrew, Arabic, and English. Many other languages used by a great variety of communities include Russian, Amharic, Turkish, Farsi, Romanian, Spanish, French, and more.

For its small size – t takes about two hours to go from Israel's farthest Eastern point to its farthest Western point and about six hours to go from its farthest Northern point to its farthest Southern point – Israel is divided into six geographical districts and 15 sub-districts (Central Bureau of Statistics, 2013). The Central District has the largest population, inhabiting 24.2% of the population, followed by the Tel Aviv District and the Northern District, with 17% of the population residing in each. The Southern District is the fourth largest district, with 14.3% of the population. The Jerusalem and Haifa Districts are the smallest ones in terms of size of population, with 12.4% and 11.8%, respectively.

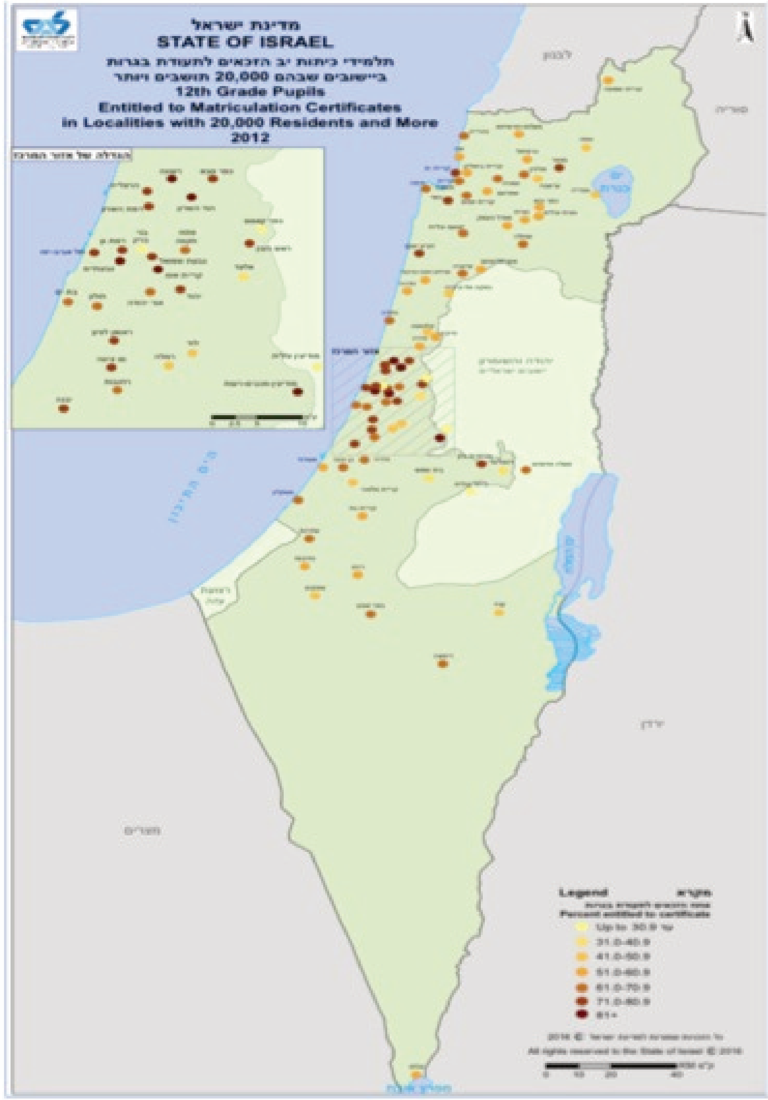
The distribution of the population in Israel has been greatly influenced since the 1950s by two governing principles: the first is an immigrant-population-distribution policy that generally encourages newcomers to settle in more peripheral areas, such as the Southern District. The second principle of population distribution is the development of up-and-coming areas that attract residents of traditionally popular districts such as Tel-Aviv and Jerusalem to move into growing cities such as Petah-Tikvah and Modiin. That being said, much of Israel's population still lives in the central districts. In fact, 40% of the country's population lives on only 7% of the land (Central Bureau of Statistics, 2016a). Interestingly, there exists a difference in distribution of population and locality between Jewish and non-Jewish populations. About 48% of Jewish Israeli citizens live in the Central and the Tel-Aviv district, whereas around 58% of Arab Israeli citizens live in the Northern District and the Haifa District (Central Bureau of Statistics, 2013). This geographic divide converts into a sociocultural and educational divide as well, as we will discuss later.

In terms of educational attainment, Israel has experienced a notable move towards academia and education between 1990 and 2015 (Central Bureau of Statistics, 2016c). In those years, the number of people receiving a higher-education diploma increased 4.8-fold. In addition, Israel was placed fourth among developed countries with the highest percentage of people with post-secondary higher education degrees. This academic mindset is materially supported in Israel's budget – the national expenditure on education in Israel is high compared to the Organization for Economic Co-operation and Development (OECD) member countries. In 2013, Israel spent 6.8% of its budget on education, whereas the OECD's report on the average expenditure on education in other countries was 5.8% (OECD, 2016), demonstrating that Israel is a highly education-conscious country, which values its human capital and the development of its population's education and progress.

Despite its distinguished position in academia and achievement, education in Israel is not identical across the board. The periphery of Israel could be defined as an area remote from, or which has low accessibility to, opportunities, activities, or assets available in other areas (Central Bureau of Statistics, 2016b). As such, people living on the periphery experience a lack of accessibility compared to other citizens living in non-peripheral areas in the country. The difference in number of high school graduates coincides with the difference in availability and accessibility to learning opportunities. The figure below shows a 2012 map of Israel with dots marking locations that have a population size of 20 thousand residents and more.

Figure 1. Grade 12 students entitled to Matriculation Certificates in Localities with 20,000 Residents and More 2012[1]

1. Figure and legend adopted with permission from The Trump Foundation (see http://www.cbs.gov.il/publications16/xii12_1639/pdf/map01_e.pdf



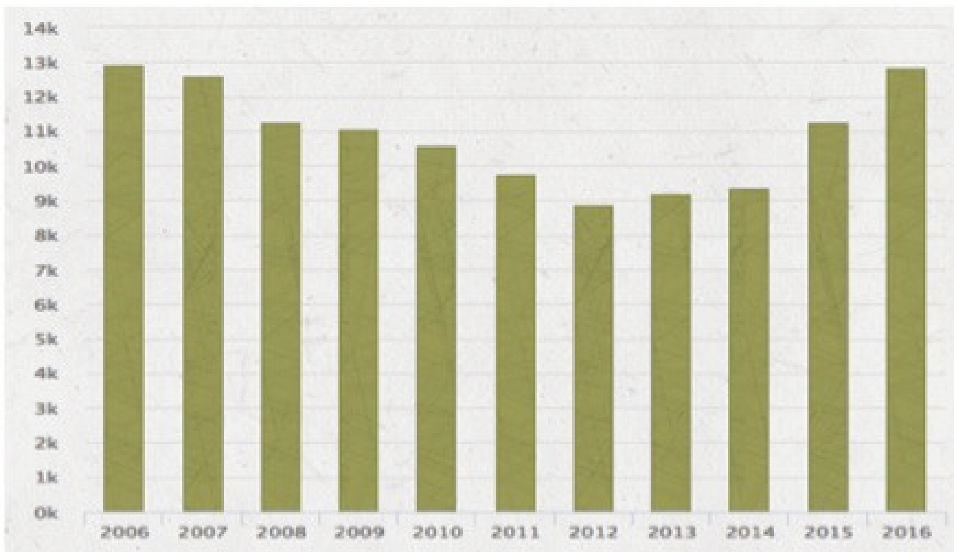
Dark brown dots represent locations that had more than 80% of their student population receive matriculation certificates. The light yellow dots represent locations that had less than 30% of their student population receive matriculation certificates. Notice the density of the dark brown dots in the center of Israel in comparison to the dispersed lighter-color dots in the peripheral areas of Israel. To wit, the center of Israel – enlarged on the left – that has the greatest concentration of high-school students compared with the peripheral areas of Israel denoted by lighter-coloured circles demonstrates the comparatively lower academic achievements in Israel's periphery (Central Bureau of Statistics, 2016d).

In Israel, in order to be eligible for a high school diploma, each student needs to accumulate at least 21 units of study in mandatory and elective school subjects (Director General's Circular, 2015). One of the mandatory school subjects that are required to obtain a high school diploma is mathematics, which we focus on in the following sections. There are three levels of mathematics the lowest of which is three-unit level and the higher levels are four- and five-unit levels. The Israeli VHS was set up in order to provide courses in mathematics and physics at the most advanced level – the five-unit level – to students in the periphery and other areas as we elaborate on in the following sections.

Nation-Wide Effort to Increase the Number of Students in Advanced Mathematics and Physics

The geographical dispersion of the Israeli population may provide part of the picture that relates to eligibility to a high school diploma in Israel. In regard to mathematics, between 2010 and 2013, while more than 50% of students opted for the three-unit level mathematics, only about 10% of students took the five-unit level exam in mathematics (Lipshtat & Bartslevski, 2016; The State Comptroller of Israel, 2014). Among other things, this was related to the notable shortage of teachers who were qualified to teach advanced mathematics, and thus students gave up on the challenge and resigned themselves to learning lower-level mathematics. This was particularly true of students living in the geographical and social periphery of Israel. Consequently, the deterioration in attaining high-level mathematics education has negatively impacted students who, on the one hand, wished to pursue their studies at the highest level, but on the other hand were dissuaded from the downturn of mathematics instruction in Israel's schools and from the perceived difficulty of the matriculation exams (Majar, 2016). Students who did take the highest level of mathematics also gained the opportunity to receive one of the most valuable experiences that would allow for their continued engagement in the fields of science and technology (Ministry of Education, 2016), a prominently fulgurating issue in Israel and abroad. Figure 2 shows the number of students taking the most advanced-level mathematics (i.e., the five-unit level of mathematics taught in Israel).

Figure 2. Number of students who took five-unit level mathematics matriculation exam 2006-2016[2]



See, in particular, the steady decline in the number of students opting for five-unit level mathematics between 2006 and 2012 and the steady increase in the number of students taking it between 2012 and 2016. This shift is attributed to concerted efforts to recruit, qualify, and certify teachers, and to implement new policies that would catalyze educational change in mathematics. In order to better understand the context of mathematics education in Israeli high schools, we provide more information in the next section.

In Israel, a Grade 10 student must select a certain unit-level – either three, four, or five – in selected high school subjects such as mathematics, English, biology, physics, and chemistry, for example. Ultimately, the education of an Israeli student culminates at the end of high school, with some matriculation exams taken in Grade 11 and most in Grade 12, after which the student receives a certificate recognizing that he or she attained a high school diploma. Taking the matriculation exams is an important milestone in Israeli society, and its successful completion functions as gatekeeper for admission to higher education. A student's choice of taking a five-unit level course, which is the highest level available, offers educational, social, and personal development, such as granting students the opportunity to apply to competitive and desirable postsecondary programs. Most academic fields in science, technology, and mathematics give entry to students who took on the particular challenge of the five-unit level mathematics, physics, and other science subjects. Moreover, rising to the challenge of five-unit level courses immeasurably endows the student with personal qualities highly valued in society, namely: a sense of responsibility, perseverance, resilience in the face of hardship, tenacity, and an ambition and desire to succeed.

2. Figure and legend adopted with permission from The Trump Foundation (see http://www.trump.org.il/scoreboard/?lang=en)

Indeed, to encourage more students to opt for five-unit level mathematics, the Ministry of Education (2016) listed the advantages associated with such a choice. After having taken a five-unit level mathematics, a student has not only a much wider variety of choice of post-secondary programs to go to, but also an increased chance of getting accepted to programs than those who have taken three- or four-unit level mathematics. In addition, a student's entry point into highly respected jobs in fields such as high-tech depends on the student's successful completion of the five-unit level mathematics course. Opting for five-unit level mathematics is also associated with more desirable, prestigious placements in the Israeli army where Israeli citizens (i.e., Jews, Druze, Muslims, and Christians, as well as Israeli citizens of other religions) serve under the Israel Defence Service Law. Another advantage associated with taking five-unit level mathematics is higher-paying jobs in comparison to those who finished high school with three- or four-unit level mathematics (Israel's Ministry of Education, 2016).

The aforementioned sobering national patterns, combined with the current Israeli government's obvious emphasis on the importance of high-level mathematics in high schools, spearheaded by the Minister of Education, Naftali Bennett, have catalyzed an educational reform in Israel with the aim of increasing the number of students in the five-unit level mathematics and physics classes (Israel's Ministry of Education, 2016). In 2015, Israel's Ministry of Education presented their national plan to strengthen mathematics education. The impetus for this plan was the decline in the number of students taking the Grade 12 five-unit level mathematics exam. This has driven the Israeli Ministry of Education to formulate the two following overarching objectives (Israel's Ministry of Education, 2016):

- within four years, the number of students in advanced-level mathematics will reach 18,000 students; and
- within four years, the number of teachers who teach advanced-level mathematics will double from 1,000 to 2,000 teachers.

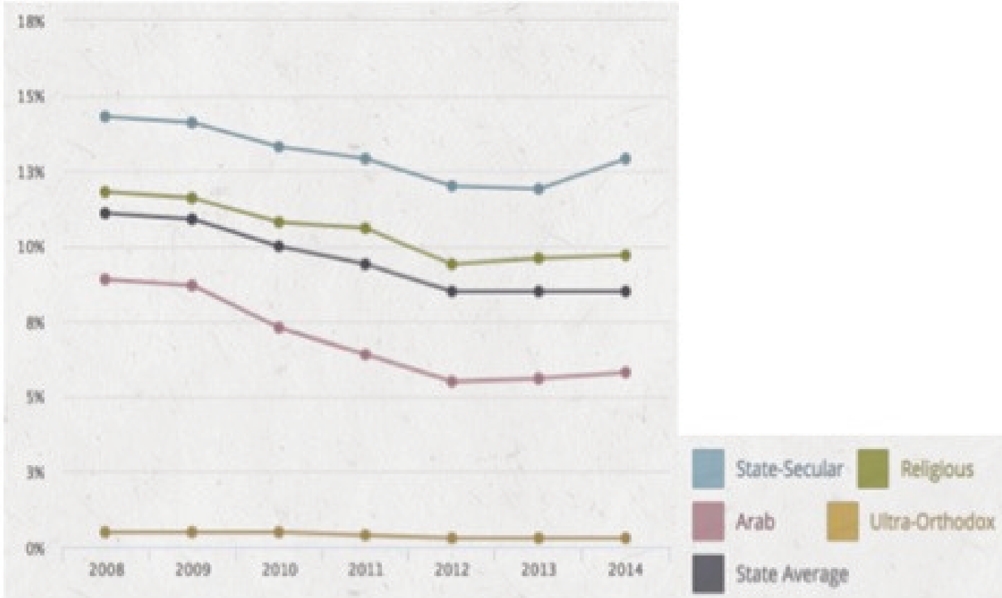
At the school-level, the Israeli Ministry of Education approved the opening of classes that would have as few as six students, instead of the previous 15-student minimum required to create an advanced-mathematics class. The intention here was to advance the equality of opportunity across the country, and especially advance students coming from smaller schools in non-central areas that may not have the same opportunities as more centrally located schools. In addition, in order to prevent students giving up on the five-unit level mathematics challenge in favor of the easier four-unit level, the Israeli Ministry of Education specified that each school should individually invest in each and every student. The aim of this goal is to encourage excellence and to inspire students to have the tenacity to continue their five-unit level mathematics education (Israel's Ministry of Education, 2016).

Bridging the Gap in Israel's Peripheral Population

In addition to geographical differences that might explain the disparities between the academic achievements of students living in central versus peripheral Israel, differences in educational tracks and their respective educational supervision systems – to which communities and families in Israel prescribe – might also be crucial in elucidating these disparities in schooling and academic achievements. Education in Israel is planned, organized, and provided as a direct extension of respective religious and ideological beliefs. As a result, there are a few educational tracks in Israel of which the four main tracks include State-Secular, Jewish-Religious, Jewish Ultra-Orthodox, and Arab. Although Israel's Ministry of Education presents a curriculum that each school is expected to follow, it is up to the discretion of each educational track to decide what, when, and how students will learn. Consequently, disparities in mathematics and physics achievements among students across different schools might be explained by decisions to invest in or divest from the curriculum guidelines in some subjects but not others. Figure 3 shows the disparities in advanced-level mathematics matriculation exam completion among the different educational tracks.

Figure 3. Students taking the advanced-level mathematics matriculation exam in Grade 12 between 2008-2014, divided according to education track[3]

3. Figure and legend adopted with permission from The Trump Foundation (see http://www.trump.org.il/scoreboard/?lang=en).

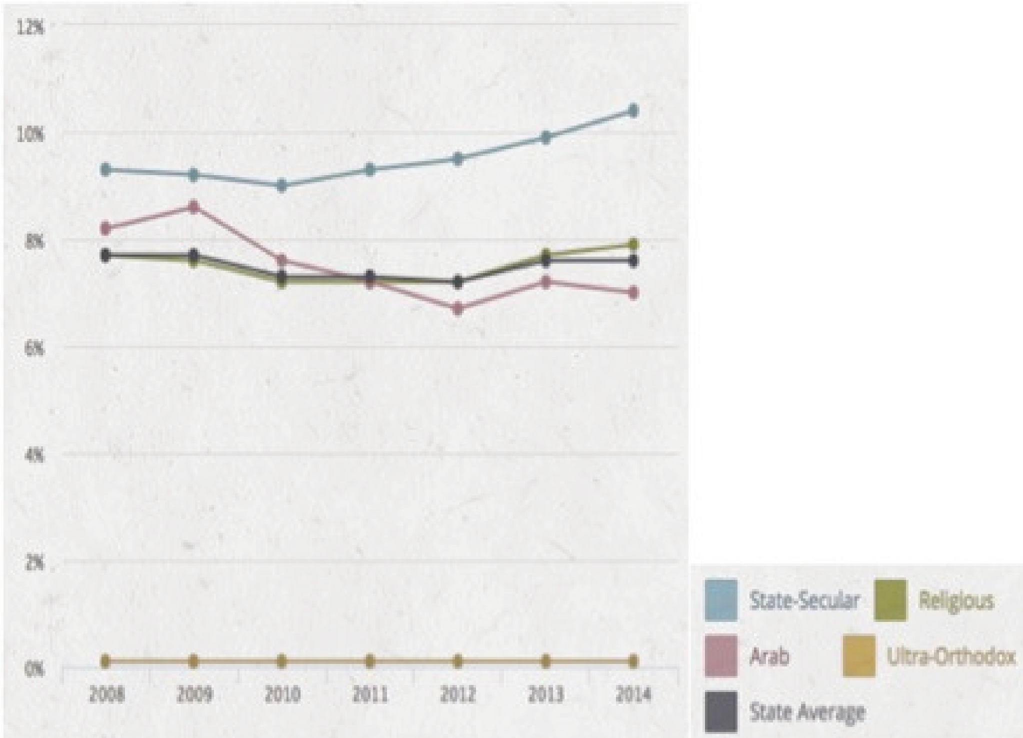


Notably, the State-Secular educational track has the highest proportion of students taking the five-unit level mathematics matriculation exam, while the Ultra-Orthodox educational track is the lowest, and is almost negligible (The Trump Foundation, 2016a). Notice that the number of students in the state-secular education system who take advanced-level mathematics is consistently the highest compared to their counterparts in the other educational tracks. In 2014, for example, the number of students who studied advanced-level mathematics in the state-secular track was 33% more than students in the religious-track, and 120% more than students in the Arab-track.

Similarly, as Figure 4 illustrates, looking at the trend in five-unit level physics, students in the state-secular education system grew bigger in number in comparison to their counterparts in other educational tracks. In 2014, for example, the number of students in the state-secular track who studied five-unit physics was 32% more than students in the religious education track, and 48% more than students in the Arab education-track" (The Trump Foundation, 2016a).

Figure 4. Students taking the five-unit level physics matriculation exam in Grade 12 between 2008-2014, divided according to education track[4]

4. Figure and legend adopted with permission from The Trump Foundation (see http://www.trump.org.il/scoreboard/?lang=en).



Against this backdrop of a collective vision, diversified and context-unique educational tracks, geographical spread of students, and varied demographics, the Israeli VHS was set up and launched in September 2012. It has since addressed some of the pressing issues discussed in the first part of this chapter. The second part of the chapter focuses on the Israeli VHS and its students and teachers to which we turn next.

Israel's Virtual High School

The Israeli VHS was launched in September 2012 following a daunting downward spiral of the number of high school students taking high-level mathematics and physics. The VHS was founded not only with the vision to provide Israeli high school students with the platform to complete advanced-level mathematics and physics, but also with the specific goal to address the issue of a lack of access to advanced levels of these subjects for students who live in the rural and peripheral areas of Israel. Such students usually attend schools that do not have teachers with the qualification to teach these high level courses, or schools that do not offer these courses due to low interest among the students.

The endeavour of creating Israel's first VHS was undertaken and supported by the partnership and collaboration between the Center of Educational Technology (CET), the Trump Foundation, and the Israeli Ministry of Education. The strong collaboration and cooperation between the different parties led to a mission statement that put forth and pushed forward students' academic and educational achievement in Israel underscoring the equality of access to advanced-level mathematics and physics for all students. In order to better understand how this partnership works, we next provide a short description of each party in this triad.

The CET is an independent organization that operates for the public's benefit. Its vision is to advance high-quality, innovative education intended for every K-12 student in Israel. The CET strives to provide K-12 teachers and students with technological tools, pedagogical models, and other services related to the intersection between technology, innovation, and education in order to foster an Israeli society that is technologically savvy, productive, moral, and socially responsible (CET, n.d.). Not surprisingly, the Trump Foundation, with whom the CET aligns itself for the fruition of the Israeli VHS, has similar goals. More specifically, the Trump Foundation aims to "dedicate its resources to the improvement of educational achievement in Israel" and "focuses primarily on the quality of teaching of mathematics and the sciences in

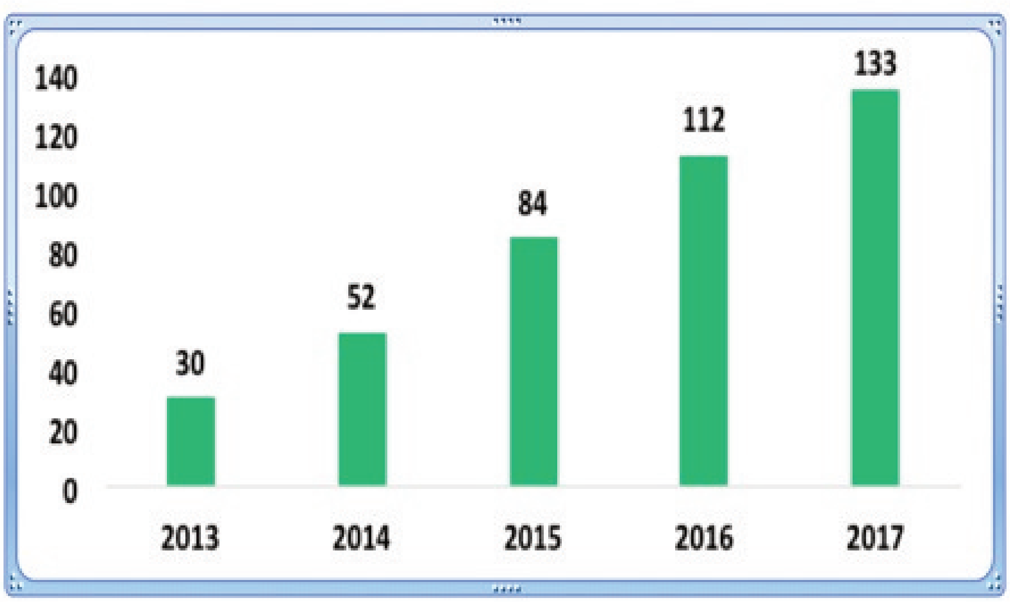
Israeli secondary schools" (The Trump Foundation, 2016b). Through concerted cooperation and collaboration, both the Trump Foundation and CET are instrumental for the Israeli VHS sustained flourishing.

Naftali Bennett, the current Minister of Education in Israel, has declared a national effort in collectively increasing the number of students who opt for the highest level of mathematics and the number of teachers who can teach it. Promoting a collective vision was identified in the research literature as one way to introducing and sustaining a system-wide educational change. Taking this recognition one step further, both Gurley, Peters, Collins, and Fifolt (2015) and Gurley (2017) identified shared mission, vision, values, and goals as the fuel to effectively introducing change. Gurley (2017) argued convincingly that "leaders of educational change must start by coming to an understanding of the critical importance of shared mission, vision, values, and goals (MVVG), fully adopted and passionately owned by all school stakeholders, coalescing exclusively around high levels of student learning" (Gurley, 2017, ¶ 4). Indeed, the shared MVVG that brought together CET, the Trump Foundation, and the Ministry of Education opened space for the three parties to orchestrate change in creating a level playing field in mathematics education.

To make it possible for students, regardless of where they live, to study five-unit level mathematics and physics, the Israeli VHS has a unique platform where the courses are taught fully online. This means that all the interactions between students, teachers, and tutors take place online with no face-to-face meetings. As such, students attending the VHS do so as part of their formal education, and their online classes are embedded within their home high school course schedule. The VHS provides between five and six synchronous lessons a week in either mathematics and/or physics – four with a teacher of mathematics in a class of about 20 students from all over Israel, and additional two to three after-school hours with a tutor who is a university student of mathematics or related sciences. Each tutor is assigned to work with two to four VHS students. (For a more detailed description of the VHS, its design, structure, and support system see Biton, Fellus, Raviv, Feilchenfeld, and Koichu [2018] and Biton, Fellus, Raviv, and Fellus [2017].)

As noted above, the Israeli VHS was launched with the support of the Trump Foundation to provide accessibility to advanced-level mathematics in remote schools that either do not have qualified teachers to teach mathematics at an advanced level or have a handful of students who are interested in taking advanced-level mathematics but the size of the group does not justify opening an advanced-mathematics class. In its first year of operation, the VHS started off with 30 high schools that enrolled students to the advanced-level mathematics and/or physics with the VHS. Four years later, in September 2017, the VHS had students enrolling from 133 high schools (as shown in Figure 5) dispersed throughout Israel.

Figure 5. Number of participating high schools in the Israeli VHS

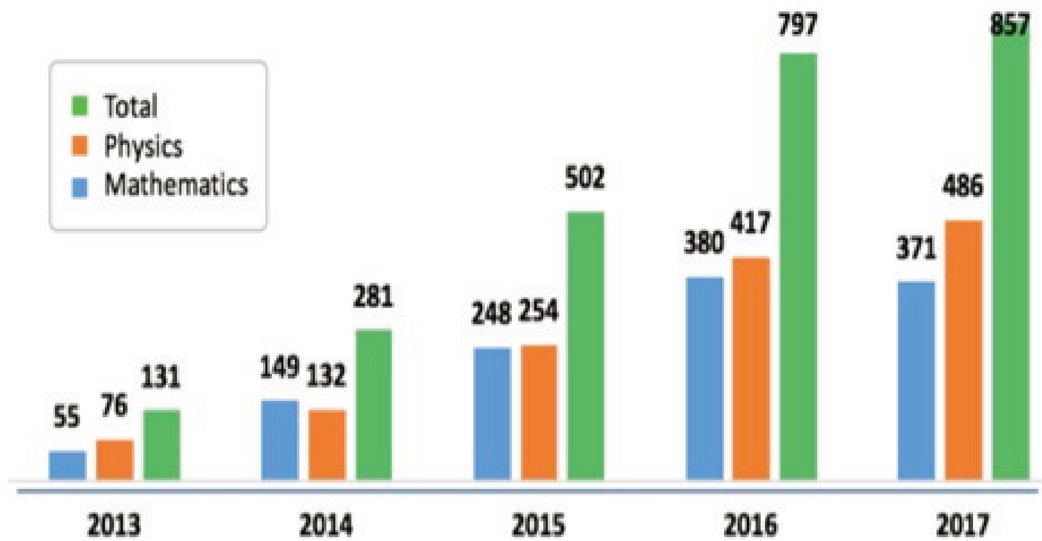


As the following sections demonstrate, a significant contributor to the current surge in Israeli students entitled to the five-unit level mathematics and physics diplomas is the Israeli VHS. We next show the growing upturn in the number of Israel's students undertaking high-level mathematics and physics, and how technology as well as key partnerships in the government and broader society were instrumental in doing so.

Students of the Israeli Virtual High School

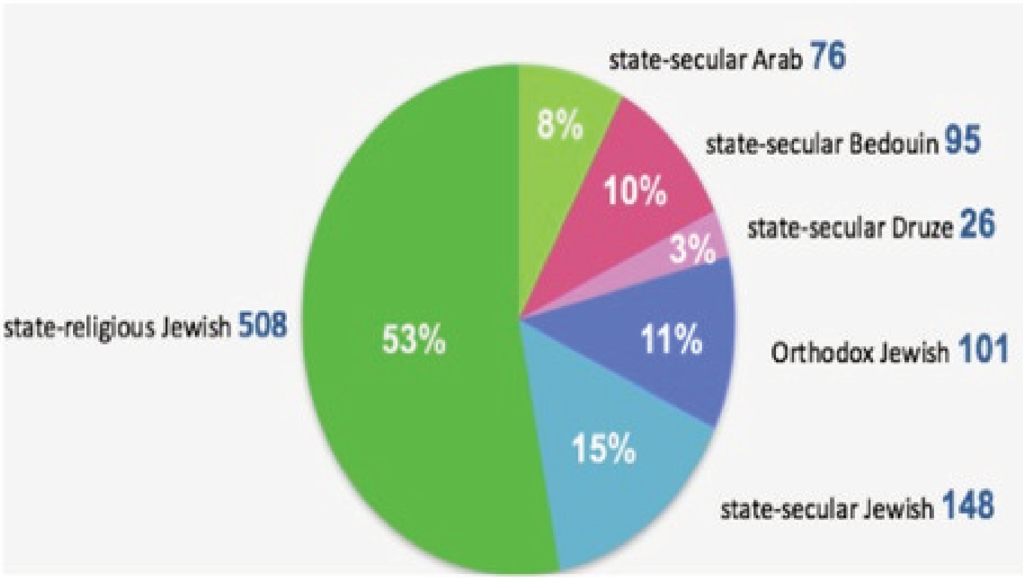
The first year of the Israeli VHS began with 131 Grade 10 students from about 30 high schools. The number of mathematics teachers was six in 2012 and 13 in 2013. The number of tutors was 40 in 2012 and 59 in 2013. To date, there are 857 students in the Israeli VHS including 11% from Orthodox Jewish schools, 23% from Arab high schools, and about 10% from Bedouin high schools. The VHS also grew in number of teachers. The current number of teachers is 30, and of tutors 115. Figure 6 illustrates the growth of the Israeli VHS since its inception in the school year of 2012–2013.

Figure 6. Growth in demographics of the Israeli VHS



Although the primary goal of the Israeli VHS was to increase the number of students entitled to a five-unit level mathematics matriculation certificate, the program has also been successful in contributing to bridging the academic gap between students living in the periphery and students living in the center of Israel. Through recruiting, retaining, and supporting students from all socioeconomic levels including previously marginalized groups in the Israeli society, the Israeli VHS works to orchestrate these students' success in advanced mathematics and/or physics. As can be seen in Figure 7, the 857 VHS students in the 2016–2017 school year came from diverse school types thus representing the multitudinous backgrounds of Israeli educational tracks.

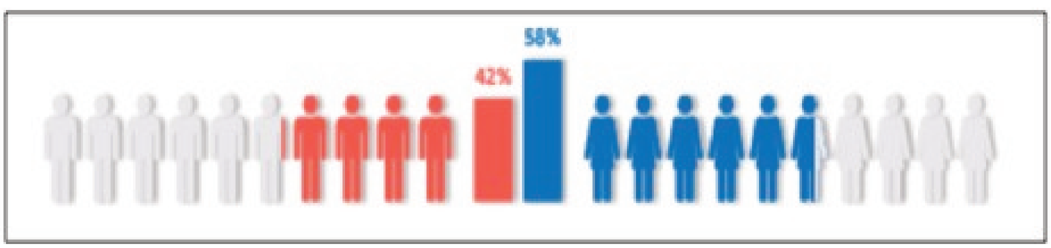
Figure 7. Students' types of home schools



Note that the combined sectors of Arab students (including Bedouins) comprised 20% of the VHS student body. This is similar to the size of the Arab sector, which stands at 25% of the whole student body in Israel. Similarly, students from Orthodox Jewish stream comprise 11% of the VHS students, which reflects the proportion of this population in Israel. This speaks to the contribution of the Israeli VHS in creating equitable opportunities in different sectors that would otherwise not be able to access advanced-level courses in mathematics and/or physics.

In terms of gender representation, the Israeli VHS has a slightly increased presence of female students (Figure 8). This may speak to Walkerdine's (1998) work on gendered mathematical identity that was shown to be strongly associated with socioculturally available selfhoods (Betz & Sekaquaptewa, 2012) and other identity-related dimensions such as discourse (Bishop, 2012) and cultural backgrounds (Nollenberger, Rodríguez-Planas, & Sevilla, 2016; Sfard & Prusak, 2005).

Figure 8. Gender demographics of the Israeli VHS 2016-2017

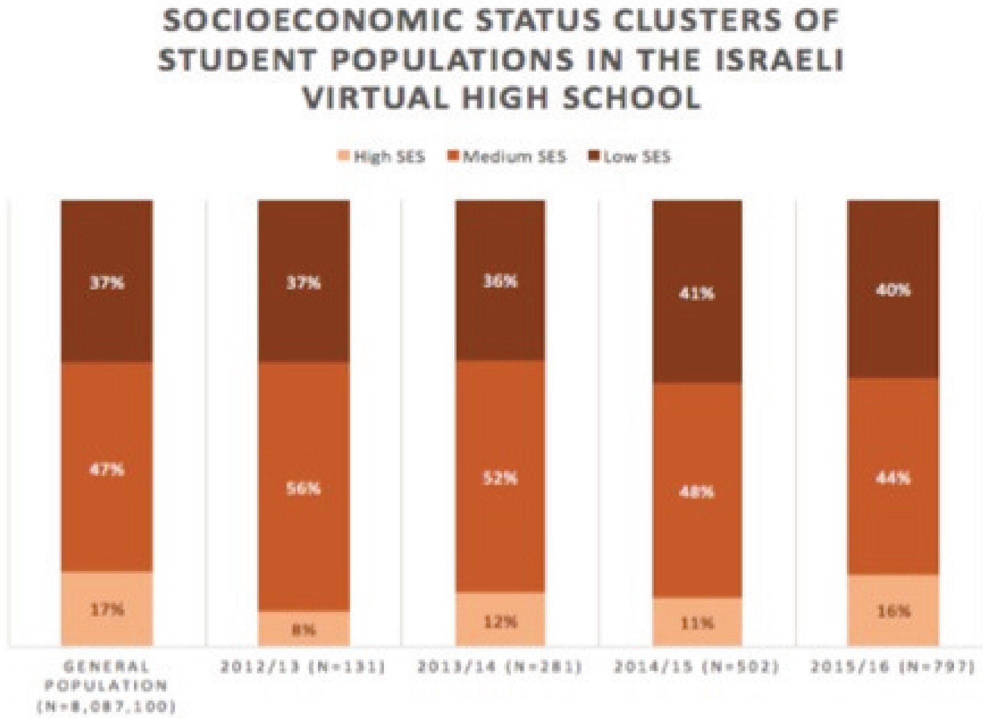


Notably, among the Arab students in the general Israeli student population, more female than male students take the most advanced-level mathematics (Ministry of Education, 2017). These patterns compare with the demographics of the VHS students, and suggest exciting new dispositions and opportunities ushered in by the Israeli VHS.

In regard to students' socioeconomic background (SES), the VHS students come from diverse backgrounds of SES. As Figure 9 illustrates, the VHS kept a balanced representation of the different SES that reflected the distribution in the general population.

Figure 9. Socioeconomic background[5] of the Israeli VHS students compared to the general population (CET, 2016).

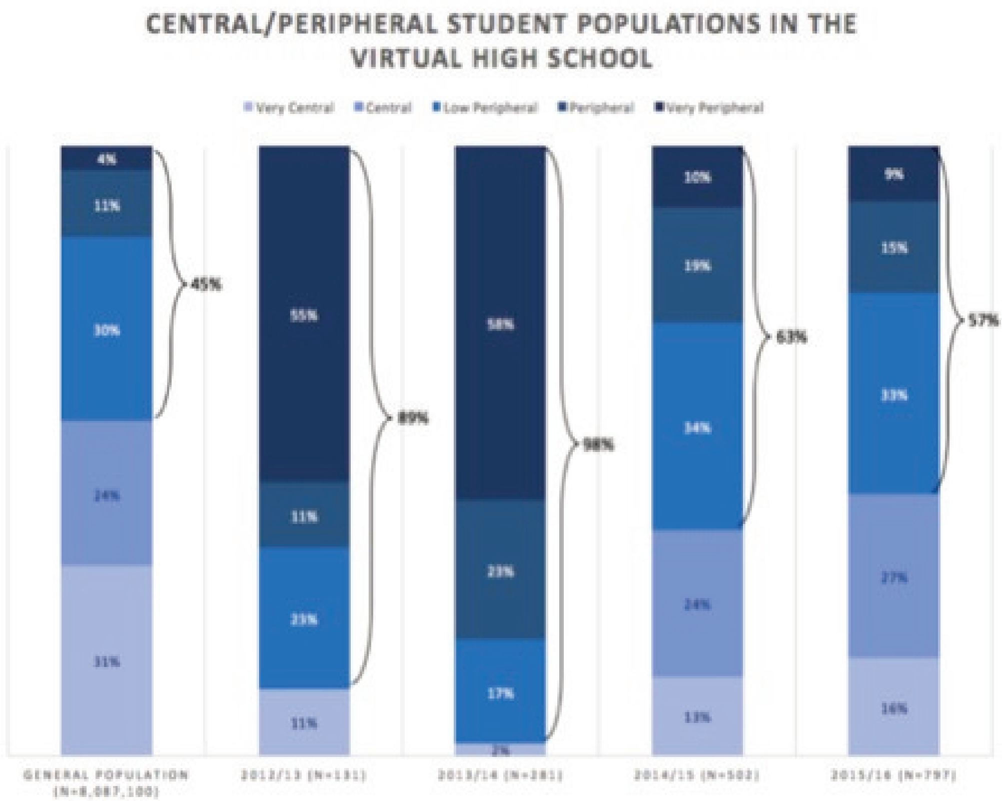
5. For an explanation about how the SES scores are formulated (see Yitzhaki, Golan, & Tur-Sinai, 2013).



Notice the similarity between the distribution of the SES in the Israeli general population and in the VHS with an emphasis on a higher representation of students from low SES. This goes hand in hand with the efforts of the VHS to increase accessibility to advanced-level mathematics and/or physics to all Israeli students.

In a similar vein, the VHS students come from diverse geographical areas. This addresses the purpose of the VHS to cater to the needs of students who are willing to do advanced-level mathematics or physics but cannot take such courses because they live in the peripheral areas of Israel that experience an acute lack of qualified mathematics teachers. Figure 10 represents distribution of the Israeli population in dense and less dense areas.

Figure 10. Geographical distribution of the Israeli VHS students.



In comparison to the general population, the Israeli virtual high school has a greater proportion of students coming from geographic and sociocultural peripheries (CET, 2016). Notice that although the population living in the peripheral areas of Israel comprise only 45% of the whole Israel population, it comprised more than 80% and 90% of the VHS student population in the first two years of its operation, respectively.

As can be seen in the graph above, this was adjusted in the following consecutive years as a result of an effort to include students living in the center of Israel but who could not access advanced-level mathematics and/or physics because of unavailability of qualified teachers. While the shift yields a more balanced representation that reflects the distribution of the Israeli population, it also reflects the complex nature of the Israeli context that generates conditions that preclude the studying of advanced-level mathematics and/or physics regardless of locality and proximity to the center of Israel.

In the school year of 2012-13, the first year of the VHS, 93% of its students were from the lower socioeconomic brackets, whereas in 2015-16, this proportion dropped to 84%. Importantly, these proportions of students taking the advanced-level mathematics and/or physics are more comparable to proportions in the general public, as students coming from low socioeconomic status brackets are often underrepresented in advanced-level courses (Lipshtat, & Bartslevski, 2016). Nevertheless, there is a higher proportion of students from the periphery of Israel who study in the VHS compared to the proportions in their general educational system. In 2016, about 24% of students enrolled in the VHS came from a peripheral to very peripheral area of Israel, compared to only 15% of the same population enrolled in the general educational system (Mehachani-Belkin, Levin, Kedem, & Froynd, 2016).

The students attending Israel's VHS are undoubtedly of very diverse backgrounds, making the virtual classroom all the more unconventional. It is precisely this unorthodox composition, in addition to the fact that the courses are conducted virtually, which makes the Israeli VHS unique. Managing these classes, all the while taking into account the heterogeneity of the students, necessitates a pedagogical and managerial adjustment and continual investment by the teachers and the management team involved in the operation of the courses.

Recognizing that teachers and tutors play an integral role in the success of students, and that their efforts directly affect students' motivation and sustained participation in the advanced mathematics and/or physics classes, this chapter on the Israeli VHS focuses on its teachers and tutors putting forth and pushing forward their developing sense of community.

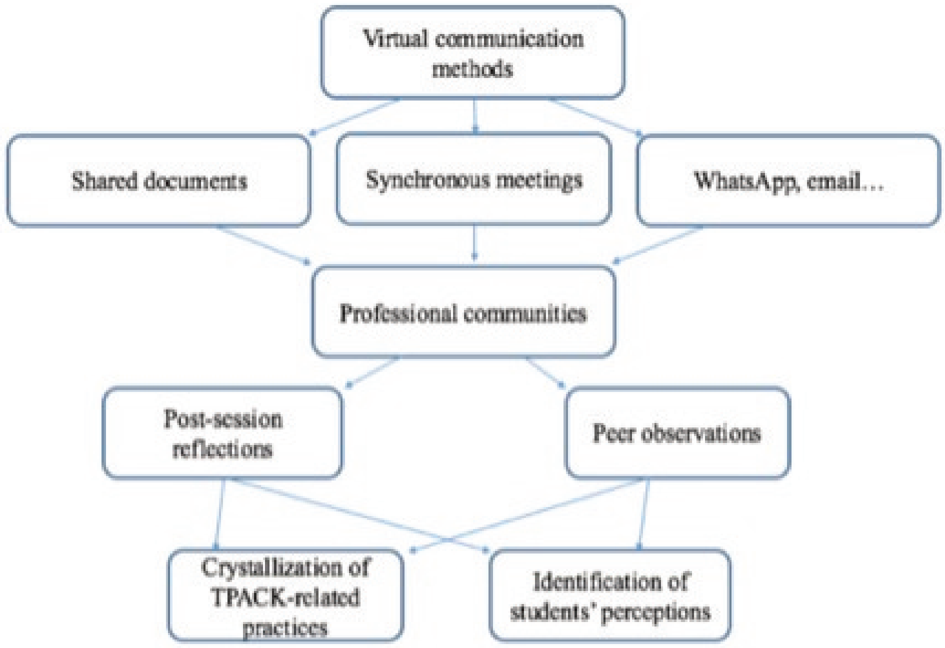
Teacher-Tutor and Tutor-Tutor Professional Community in the Israeli VHS

Through synchronous lessons and tutorials, the VHS aims to provide professional instruction materials and to create new pedagogical opportunities afforded by what Pierce and Stacey (2010) call computer-enhanced teaching and learning, and what Fellus and Biton (forthcoming) frame as the interaction between technology, creativity, and authorship. We see professional learning communities as groups that engage in a continued renewal and improvement of daily activities (Korland & Hertz-Lazarovitz, 2006). Such engagement provides opportunities to enhance personal responsibility and professional comradeship. In the context of the Israeli VHS, in order to be able to collectively discuss emerging issues that pertain to the teaching and learning of mathematics, teachers and tutors engage in synchronous and asynchronous communication. In these communications, teachers and tutors create a professional learning community by collectively identifying pedagogical issues and jointly formulating solutions and practices that specifically address emerging needs.

Before examining the VHS teachers and tutors as a professional learning community, we highlight some of the benefits recorded in the literature on online learning that include flexible working hours and more effective outreach to new audiences because learning can take place regardless of time or space constraints (Arbaugh, 2004). Online learning also provides individualized and differentiated instruction that (Archmbault et al., 2010), in turn, promotes learners' innate curiosity and deepens their learning (Bakia et al., 2012). We argue that professional communities in the context of online learning may generate similar benefits. In order to explain what we mean by the term *professional communities*, we draw on Seashore, Anderson, and Riedel's (2003) conceptualization of the term as teachers' collaboration in discussions about their work both in the classroom and outside it. This is particularly relevant to our work because when it comes to online professional communities, research suggests that lack of face-to-face interaction inhibits teachers' collaboration (Rice & Dawley, 2007), and is also time consuming (Carr & Chambers, 2007).

Different types of professional learning communities are identified in the literature that shed light on processes of continual learning (Biton, 2014; Korland & Hertz-Lazarovitz, 2006), where members may come from different fields of expertise (Greene, 2007), or from the same field of expertise (Biton, 2014; Waldeck, 2008; Weiss & Pasley, 2006), engage with object-focused learning (Greene, 2007). In this chapter, we bring forth the VHS professional community whose members are from the same field of study – mathematics, and are continuously engaged in identifying and configuring improved and more effective ways to teaching and learning of mathematics. Working in a virtual environment that is innately characterized by less time- and space-related constraints provides rich opportunities of collaboration and cooperation among members of the professional community. Indeed, teachers and tutors in the VHS engage in communication over content and pedagogy through diverse technological tools that include synchronous and asynchronous communications, *WhatsApp*, e-mail, and shared documents.

Figure 11. Communication methods and emerging learning opportunities among members of the VHS professional community



The figure above visually represents a summary of the diverse communication methods employed by the VHS teachers and tutors, the venues that were conducive for the creation of this professional community, and the insights garnered through the collaboration among its members. This professional community were formed in and through post-session reflections and peer observations to allow for the crystallization of mathematics-related use of technology, pedagogy, and content knowledge (TPACK) (see discussion on TPACK in Biton, Fellus, & Hershkovitz, 2016; Chai, Koh, & Tsai, 2013; Niess et al., 2009).

The following three episodes provide examples that illustrate how, through virtual communication methods, the VHS teachers and tutors develop shared insights around TPACK and students' perceptions of self as learners and doers of mathematics.

Episode 1: Teaching asymptotes. The following is an excerpt from a shared document (i.e., Google Docs) that provides a telling example of the professional learning community of the VHS tutors. The purpose of the shared document through Google Docs was to provide an update of lessons taught and of pedagogical difficulties that arose during the lessons. The excerpt includes a short interaction between three tutors.

> Mor[6]: It was hard [for the students] to understand that there is such a thing as an asymptote – that there is something that doesn't touch the axis yet is continually decreasing. I told them they would be given a fuller explanation later.
>
> Eitan: Since we're dealing with asymptotes (tending to infinity or minus infinity) without actually mentioning the word "asymptotes," students are likely to say that they can accept such a phenomenon but there is no real understanding of how such a thing could happen. A positive function that is continually decreasing but never touches the x-axis seems very strange at this stage. Therefore, it is worthwhile to give them a small example to help them understand. I gave the example of one divided by x, explaining only for integral values of x and only for x>1. After a really simple example I could sense that, for the students, the phenomenon suddenly made sense.

6. All student and tutor names are pseudonyms.

> Moriah: Thanks, Eitan, for the tip on 1/x. We substituted large numbers and saw that the values kept getting smaller but never reached 0. That was so catchy that later Maayan [a student] used the description "One divided by a million" to relate to an asymptote.

This episode illustrates how members of the professional community engage in sharing of identified difficulties in conceptualizing mathematical ideas. Mor writes in the shared document about the difficulty her students encountered in understanding what an asymptote is. Eitan then shares his way of introducing the subject, and Moriah, another tutor, provides feedback of using this pedagogical approach in her class.

Episode 2: Social dynamics and students' identity as learners of mathematics. The next episode illustrates how a teacher (first author) and one of his tutors working with two of the VHS students comprise a learning community that identifies a student's perception of self as a learner of mathematics. The tutor-based VHS model is unique, as far as we know, to the Israeli VHS. In the following conversation, the tutor brought up issues that pertain to students' discoursal identity as learners of mathematics. We use the term discoursal identity in the context of school mathematics to refer to the way people talk about themselves and others as learners and doers of mathematics (see discussion of the turn to discoursal identity in Harré and Gillett [1994]; an operationalization of discoursal identity in Ivanič [2006], and an exploration of the term in the context of mathematics education in Fellus [2018], in Heyd-Metzuyanim [2017], and in Wagner and Herbel-Eisenmann [2009, 2014]). The first author, who was at the time a mathematics teacher in the VHS, received an email from one of the tutors assigned to his class asking to discuss an issue that pertained a student who positioned herself and another classmate as mathematically "weak" and "strong," respectively, and how this shaped the student's engagement during the lesson. In an ensuing interaction between the first author and the tutor, this is what the tutor shared:

> About fifteen minutes before the beginning of the last tutoring session, I got a message from Ofek [a student] saying that she would be half-hour or an hour late because she did not yet get home from school—it was raining. She joined us an hour late and said that because she skipped lunch, she would grab something to eat and return in fifteen minutes. All this time actually turned out to be a private lesson for Sarah [the other student in the tutorial group]. She did very well and managed to do all the exercises using the algebraic technique that had to be used with the exercises, as well as the new material—law of sines and a lot of work with fractions. However, after Ofek joined us as we were doing the exercises, Sarah suddenly began to forget it all and could not manage with fractions that she could do easily just an hour earlier and she even got confused with the basic order of operations as she was isolating a variable in a simple equation—isolating cosine in the law of cosines. It was not about a temporary lack of concentration. Rather, it was a real misunderstanding of things she couldn't fix even after she realized she made a mistake. When I tried to ask her how it happened that suddenly she doesn't know very basic things, she sent me a *WhatsApp* message saying: "I simply feel less smart than her [Ofek]." After the session, I talked with her on the phone and tried to boost her self-confidence. I hope it helps.

This has generated a discussion between the first author and the tutor on how to support Sarah and how to foster her identity as a learner and doer of advanced-level mathematics. This example illustrates the added value in the support system that the Israeli VHS sets up to buttress students' learning through the close collaboration between the respective course teachers and the tutors assigned to their classes. Such a support system can more easily allow for a close familiarity with the students to more effectively address challenges they may experience.

When considering the work of professional communities in the context of the VHS, we must also acknowledge and be cognizant of issues pertaining to students' positioning of themselves as learners and doers of mathematics and/or physics. We call this work of positioning *discoursal identity* and point to the growing empirical evidence that sheds light on the paramount role discoursal identity plays in students' level of engagement (see, for example, Heyd-Metzuyanim, 2017; Hogan, 2008; Mason & McFeetors, 2007). The very structure of the Israeli VHS where tutors work with small groups of up to four students and where they continually collaborate with the course teachers allows for the identification and understanding of self-perception as learners and doers of mathematics and the timely intervention to make amends and help boost learners' self-confidence in learning and doing mathematics. Such a constant stream of support would not have been possible if it were not for the continual collaboration of the VHS teachers and tutors, i.e., its professional learning community, through available virtual communication methods.

Episode 3: Extreme points of trigonometric functions without the derivative. The following exchange took place via *WhatsApp* among five members of the VHS tutors—i.e., what we define here as the VHS professional community.

> Shlomi: Is there a short way of explaining how to find extreme points of trigonometric functions without the derivative? I think I'm missing some trick about it.
>
> Adi: Obviously you can use the derivative – which question are you looking at?
>
> Shlomi: In the practice session there are two questions that require solutions without using the derivative…
>
> Moshe: I don't think there's a way of telling if a point is minimum or maximum without using the derivative.
>
> Moshe: Unless there's some kind of regular pattern.
>
> Shlomi: That's it – I didn't find anything special
>
> Maya: Is this a distance function?
>
> Gil: I think the idea is that we use what we already know – that the cosine function has a maximum at an angle of half pi and so one divided by the function has a minimum at that angle. And since it's a double angle, then at half of half pi.
>
> Gil: The students are expected to remember the graph of the function and to use that to solve the problem without the derivative. At least that's how I explained it to my students.

This interaction demonstrates how the tutors, members in the VHS professional community, work together to find better ways at teaching extreme points of trigonometric functions without the derivative. Shlomi, one of the tutors initiates the interaction by asking whether there is a short way of explaining how to find extreme points of trigonometric functions without the derivative. Moshe admits that there is no "way of telling if a point is minimum or maximum without using the derivative" thus, positioning derivatives as an essential part one cannot do without. But when Moshe adds, "unless there's some kind of regular pattern," Gil pitches in by saying one needs to use their background knowledge to be able to solve the problem, "that the cosine has a maximum at an angle of half pi and so one divided by the function has a minimum at that angle, and since it's a double angle, then at half of half pi." He then adds, "the students are expected to remember the graph of the function and to use that to solve the problem without the derivative. At least that's how I explained it to my students."

It is through the availability and acceptance, among the VHS tutors, of virtual communication methods as channels of communication that opens space for the VHS professional community to raise queries, brainstorm ideas, configure solutions, and collectively identify ways of practice. This type of cooperation demonstrates Seashore, Anderson, and Riedel's (2003) recognition of teachers (read the VHS tutors) as learning communities.

These three episodes demonstrate the particular gains that the environment of the VHS infuses into creating the professional learning communities in the Israeli VHS. Teachers and tutors utilize technology to build a professional learning community and ultimately provide unique benefits to the students (see Fellus & Biton [Forthcoming] for a discussion on technology in the context of mathematics education). The multifarious gains that are made possible by the operation of the VHS professional learning community, as was evidenced above, include not only TPACK-related pedagogical developments but also attention to students' emerging identities as learners and doers of mathematics. These professional learning communities can operate through available technological tools, which, in turn, allow for a huge potential in improving teaching and learning of mathematics in a way that specifically addresses and caters to the emerging needs of the VHS students.

Conclusions and the "So What" Question

Israel's educational diversity, socioeconomic differences, and dispersed population distribution, has left many high school students in the social and geographical periphery. This has resulted in unequal opportunities to learn advanced mathematics and/or physics across Israel. In particular, the number of students opting to take the highest level of mathematics and physics has seen a worrying decrease, especially among students disadvantaged by living in Israel's non-central areas, or attending schools disadvantaged by the lack of qualified teachers to teach advanced-level mathematics or physics. Through a nation-wide effort to increase the number of Israeli students taking advanced-level courses, spearheaded by the Ministry of Education, and orchestrated by the CET and The Trump Foundation, the first Israeli virtual high school was created and launched in September 2012.

Providing access to high-level courses for the peripheries of Israel has resulted in an increase in the number of students entitled to the five-unit level mathematics and physics matriculation certificates. As we have shown, the recruitment of students who normally do not take the five-unit level courses, such as students from Ultra-Orthodox and Arab educational tracks, has contributed to, what we call, the democratization of the learning of advanced-level mathematics and/or physics, which was made possible through the VHS. This inclusion of more demographically and socioeconomically diverse students is seen as an achievement in and of itself. Furthermore, we showed how the development of a professional learning community makes it possible to not only identify issues that would have otherwise remained in the shadows, but also collaborate with fellow tutors and the course teacher to formulate a stronger support system for the students. If it weren't for the Israeli VHS, these learning opportunities would have remained unrecognized or unappreciated.

With all its successes, there is much to understand in how the VHS can contribute to the success of more students learning advanced-level mathematics and/or physics. Future lines of inquiry that look into learning in VHS and academic accessibility for all may look into issues of students' attrition and support, ownership and authorship in students' making sense about mathematical ideas, and perception of self as learners and doers of mathematics and/or physics. As we see it, these may be carried out in and through TPACK-enhancing opportunities.

Professional communities benefit from technology-enhanced environments. In the episodes we brought forth, we see how technological tools allowed the VHS teachers and tutors to connect over issues that were relevant to enhancing teaching and learning in the VHS. Even though research such as Rice and Dawley (2007) suggested that face-to-face interaction is paramount to learning within professional communities and that it was less time consuming than online interaction (Carr & Chambers, 2007), we showed that in the context of the Israeli VHS, professional communities have a potential to making the VHS a paragon for the teaching and learning of advanced-level courses.

Given the insights garnered by the VHS professional community, it does not seem far fetched to argue that a continual technology-based collaboration among VHS teachers and tutors could become a means of more individually tailored pedagogies that can address students' emerging needs in learning advanced-level mathematics and physics in the VHS. What is important to keep in view is that the VHS can potentially shape new forms of learning and make learning opportunities more available to more students. Further investigation of the affordances of teaching and learning in the VHS can provide more TPACK-related valuable insights and make it possible to more effectively and efficiently utilize the affordances of online learning.

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PART IX

Emerging Issues

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Introduction

Kathryn Kennedy

Emerging Issues is one of the new areas of the 2018 edition of the *Handbook of Research on K-12 Online and Blended Learning.* It was introduced in this edition because the field is constantly in flux, with something new being developed by the minute. At the same time, there is a lag time in the research that can be conducted on it, especially if it's a concept that is just getting off the ground. There are two chapters in this edition; the goal is that future iterations would have multiple chapters that would only stay in the emerging section for one edition before being moved into the research sections (or before simply disappearing) as the issue would no longer be emerging.

The first chapter is by Wendy Drexler who talks about the importance of defining personalized learning, especially with many overlapping concepts, including blended learning and competency-based learning. Drexler discusses the importance of differentiating these terms as to not only be clear about what is happening in the learning environment but also to be specific about the strategies for enhancing the students' learning experiences. She asks key questions to assist in this differentiation, such as "What is the desired learning outcome?," "What are the instructional design elements?," and "What is the learning environment?"

Following Drexler's chapter, Jacqueline Zweig and Erin Stafford highlight the need for researchers and practitioners to become deliberate and meaningful partners in the research process. In this approach, both researchers and practitioners have key roles in identifying the research questions that matter to practice, designing studies that help us understand what is happening in a learning environment, ensuring the quality of the data, and making sense of the results and the implications together. Through these collaborations, researchers and practitioners can help move the field of online learning research forward.

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Personalized Learning

Wendy Drexler

Abstract

Personalized learning has become an educational buzz phrase. It's nearly impossible to interact with K-12 school district or building leaders, review strategic plans, or attend educational conferences without the mention of personalized learning. Ask the simple question, "What do you mean by personalized learning?" and one is likely to get a different answer from each individual asked. This paper includes a discussion of several frequently used definitions of personalized learning and a set of questions that can clarify the details of personalized learning initiatives. The ideas of blended learning and competency-based learning are also defined and positioned within the context of how they relate to personalized learning.

Personalized Learning Defined

A previous chapter in the Handbook focuses on Personal Learning Environments (PLEs). Personal learning is differentiated from personalized learning based on the amount of control the learner has over content, what is learned, how it is learned, and how learning is organized. The learner retains full control of the PLE. It may be used in both formal and informal learning settings. Conversely, this chapter will focus on how learning is personalized in formal school settings, typically by the teacher or through technology-enhanced methods, based on established content standards.

The ability of technology to facilitate personalization and customization is a theme across many aspects of human life. A quick browser search on the terms personalized medicine, personalized news, or personalized customer experiences, will yield millions of websites. And based on your online behavior, if you are signed into one of your accounts, your search will yield personalized results. Your social media experience is customized to your interests in an effort to keep you engaged and coming back for more of the same information. This idea of connecting a person to precisely what they wish to know, or learn, has been translated into the field of education as personalized learning. This broad and possibly vague understanding of the term is fueled by multiple definitions and no clear or consistent means of articulating the details of how one personalized learning initiative or application compares to another.

The United States Department of Education National Educational Technology Plan (2017) defines personalized learning as "instruction in which the pace of learning and the instructional approach are optimized for the needs of each learner. Learning objectives, instructional approaches, and instructional content (and its sequencing) all may vary based on learner needs. In addition, learning activities are meaningful and relevant to learners, driven by their interests, and often self-initiated" (USDOE, 2017, p. 9). The Bill and Melinda Gates Foundation (2017) goes further in trying to characterize this form of learning by highlighting the value of teachers' use of digital tools in formative assessment, to achieve higher levels of student mastery, and to help students understand their own learning process. "In personalized settings, which happen inside and outside the classroom, teachers assess students' strengths and needs in order to better align their teaching with each student's learning style and interests while maintaining high standards" (Bill and Melinda Gates Foundation, 2017). The International Association for K-12 Online Learning (iNACOL) (2015) defines personalized learning as, "tailoring learning for each student's strengths, needs and interests – including enabling student voice and choice in what, how, when and where they learn – to provide flexibility and supports to ensure mastery of the highest standards possible."

The challenge to educational researchers and the field of educational technology is to determine in what situations and with what tools can personalized learning effectively be applied. How do we recognize the perfect personalized approach when we see it? What are the critical design elements of effectively aligned instruction? How do we measure the effectiveness of the fit between teaching and the learning and if the personalization makes a difference? How do we embrace the broad definition of personalized learning and avoid prescriptive approaches that may focus only on a single design or method? To complicate matters, terms such as blended learning and competency-based learning are often used in concert with personalized learning, further confusing what is actually happening from the students' perspective.

Differentiating between Blended, Personalized, and Competency-Based Learning

Blended, personalized, and competency-based learning are often included in the titles or descriptions of state, district, or school initiatives in which technology plays a role. Unfortunately, the terms alone do not effectively describe what is actually taking place in the classroom. Blended learning refers to the learning environment. It is a broad description of the blend of activities that take place face-to-face and online. Personalized learning refers to the customization of learning activities to individual students and the level of control the student has in making learning choices. Competency-based learning refers to the learning outcome, typically some form of mastery. But, mastery is only one type of learning outcome. It does not fully encompass all the processes students apply to learn.

The terms blended, student-centered, personalized and competency-based learning are not interchangeable. Patrick, Kennedy, & Powell (2013) recognize the need to "mean what you say" when defining and integrating personalized, blended, and competency-based education when they provide a continuum of instructional design approaches. Personalized learning is often associated with technology and data collection in support of formative assessment to inform instruction or learning goals. But, the same term may also refer more broadly to the multitude of ways in which learning can be customized for or by students. As such, personalization may also exist on a continuum of teacher and student (Drexler, 2010). At one end of the continuum is the more traditional teacher-centered classroom with limited student choice. At the other end is the student-constructed personal learning environment created with little or no teacher intervention and heavy input based on the learners' needs and interests. Multiple visions of personalized learning can be explored based on the breadth of the definition and where the application of a given definition falls on the continuum. Definitions may also be geared to the agenda of those supporting a particular initiative or selling a specific solution.

Blended learning, on the other hand, is characterized by different combinations of face-to-face and online learning activities. Blended learning may be used to support personalized learning. Some blended learning examples that mix online learning with classroom activities include station rotation, flipped lessons, flexible models customized to the students' needs, a la carte models in which students take one or more fully-online courses in combination with face-to-face classes, and virtual learning in which students attend an online school within a brick and mortar school (Patrick, et al., 2013). Blended learning is not synonymous with personalized learning; rather, it exists as another continuum of learning environments and options that may support student-centered learning and customization depending upon the instructional design.

Competency-based learning is defined as "a system of education, often referred to as proficiency or mastery-based, in which students advance or move ahead on their lessons based on a demonstration of mastery" (Patrick et al., 2016, p. 22). More than forty years ago, Spady (1977) referred to competency-based education as a "bandwagon in search of a definition." He went on to categorize competency-based education as a "data-based, adaptive, performance-oriented set of integrated processes that facilitate, measure, record and certify within the context of flexible time parameters the demonstration of known, explicitly stated, and agreed upon learning outcomes that reflect successful functioning in life roles" (p. 22). Students were either given, or they set their own competencies, and they moved independently toward mastery in guided or self designed pathways. Data-supported decisions, flexible use of time, and performance based outcomes were tenets of competency-based learning even before the technology was available to support them more easily. Forty years later, the use of the terms competency-based learning and personalized learning are increasingly seen together.

In an effort to operationalize the definition of personalized learning, Basham, Hall, Carter, and Stahl (2016) conducted an 18-month study in an urban reform district (URD) to identify the design characteristics of personalized learning environments. Their primary focus was on students with disabilities, though they found that all students could benefit from the individualized design. The following elements of operation within the personalized learning environment were incorporated: highly self-regulated environments in which students established weekly and daily learning goals; transparent, continual, and actionable data on which teachers used to plan and revise learning activities; opportunity for student feedback; and a Universal Design for Learning (UDL) framework as a key instructional consideration (Basham et al., 2016). This study represents only one example of how personalized learning can be operationalized and customized for students in a way that allows for increased student control and data-informed assessment.

Technology can play a useful role in blended, student-centered, and competency-based learning. In blended learning, it provides students with the ability to learn anywhere and anytime in online learning environments where learning analytics can be mined for formative and summative assessment. In personalized learning, technology allows for access to content, connections to other learners and experts, and a customized experience that can be more easily managed by a teacher or controlled solely by the student. In competency-based learning, technology allows for data collection through which teachers and students can monitor and achieve milestones toward mastery. Data collection and analysis may be leveraged in blended, personalized, and competency-based learning, possibly adding to the confusion around the terminology. As these terms are discussed in the field and initiatives are proposed, a few key questions will better facilitate understanding among all stakeholders.

Questions to Clarify Blended, Personalized, and Competency-Based Learning

Asking the right questions can clarify initiatives, policies, and the design of content applications that incorporate or claim to facilitate personalized learning. Even as these questions are considered, it's worth reemphasizing that personalized learning is a broad concept that can be approached and realized in many different ways. As such, details are critical to fully understand the vision and appreciate the method through which learning will be personalized, as well as the context in which it will take place. Clearly articulating the learning goal is a good place to start.

What is the desired learning outcome?

Educational initiatives are presumably meant to improve learning outcomes. Unfortunately, the needs of the learner are sometimes lost when the initiative becomes the end goal (Salomon, 2016). Technology integration, which is often a component of personalized learning, offers a prime example. Teacher use of technology is often identified as a goal in professional development and evaluation. However, when taken out of the context of the desired learning outcome, it is reduced to an exercise that checks a box, rather than an effective means to engage students in effectively mastering a learning end. Personalized learning, when identified as the goal, is at risk of becoming another "bandwagon in search of a definition," as was the case with competency-based learning in the 1970s (Spady, 1977). Ultimately, personalized learning offers the potential for age-appropriate scaffolding of student-centered processes that better prepare students to take more control of their learning (Drexler, 2010). The critical conversations that take place around educational policies and school-based initiatives should continue to focus and refocus on the specific learning goals they are trying to facilitate. Personalized learning then becomes one component of an initiative designed to support learning outcomes rather than the outcome itself.

What are the instructional design elements?

For the purpose of this question, instructional design refers to the methods and activities chosen to meet specific learning goals or standards. Station rotation is a relatively common blended approach to personalized learning in which students rotate through different learning activities. One station might include a technology-supported application designed to help learners reach mastery of a skill. The application personalizes the approach by offering the student support and practice along with formative assessment data that measures progress. The student can learn at whatever rate of time is required to achieve the skill. Another station may be designed for one-on-one conferencing with the teacher. Other stations may include independent research or collaborative learning in which students work together to solve a problem or complete a project. Station rotation is only one model of personalization with numerous options for different combinations of stations, all of which require individual lesson plans that identify the content of the lesson, learning objectives, and the way in which the learning will be assessed.

Learning may also be personalized by allowing the student to determine the means by which he or she meets a given learning objective or standard. In one example of this approach, seventh grade students construct their own personal learning environment comprised of multiple online tools and applications along with connections to outside experts and other learners with whom they can collaborate (Drexler, 2010). This scenario places much greater control of the learning process and responsibility for the learning on the student. The options for personalization are so varied and potentially complex that a detailed understanding of the instructional activities within any personalized learning approach is critical.

What is the learning environment?

As previously discussed, blended learning can facilitate personalization by extending the learning environment from the traditional classroom during regular school hours to online platforms, social learning connections, or fully online courses that take place anywhere and anytime including beyond the normal school day. A learning management system (LMS) often serves as the platform through which the online activities or courses are accessed. Learner analytic data are gathered within the LMS that reflect how much time is spent in the platform, what activities have been completed, how the student has interacted with other students, and how assignments have been completed and assessed. In order to fully understand the learning environment, it is also important to know what learning activities are taking place in person and what activities are completed online. In either case, different features of the platform or LMS may be applied. It further helps to understand which features are in use and for what purpose.

What are the supporting tools, technologies, or applications and the role of each in the learning process?

While an LMS can provide structure within an online course or serve as a repository of resources for a face-to-face course, there are many other technologies and applications that currently exist or are in development to support personalized learning. These applications may serve very different purposes depending upon the context of the initiative. As such, it is useful to understand the role of the application(s) within that context and how it supports specific learning goals.

How will the learning be assessed?

Some of the many different applications designed to personalize learning for mastery include formative assessments that provide feedback as the student progresses through the learning. Other applications, such as the LMS may provide assessment templates or applications that can be customized by the teacher to meet the goals of the lesson or unit. Assessments may also come in the form of rubrics that are scored based on the submission of an artifact or project. There are too many examples of assessment to list, but asking how learning will be assessed further refines the context under which personalized learning initiatives are operationalized.

What type of data will be captured and by whom? Where and how will it be stored? How will it be protected?

The Family Education Rights and Privacy Act (FERPA, 1974), also known as the Buckley Amendment, is a United States federal law that protects student educational records. The law's initial focus was to give parents and students access to educational records and limit the release of those records to third parties. Considering it was written and enacted in 1974, it does not effectively consider data privacy issues related to digital resources. FERPA was amended in 2008 and 2011 to address the state and district use of school records that are shared electronically. The definition of "authorized representative" was extended to "outside parties contracted by the school" (Weber, 2016, p. 68).

The Children's Online Privacy Protection Act (COPPA) was passed in 1998 to protect personally identifiable information (PII) in children under 13 years of age. The law was revised in 2013 to extend to images, photographs, and videos due to advances in facial recognition software (Weber, 2016). The Protection of Pupil Rights Amendment (PPRA) protects information gathered in surveys in United States Department of Education Programs. PPRA has an exception that allows the use of PII for "developing, evaluating, or providing educational products or services for students or schools allowing the release of PII to for-profit entities without consent" (Weber, 2016, p. 67). New considerations for the protection of PII are continually raised as technology evolves.

Weber (2016) proposes a set of student privacy principles aligned with current medical ethics principles. While these guidelines have not, as of yet, been written to law, they can serve as a useful set of questions to ask when evaluating personalized learning platforms or applications. Weber's Principles for Proposed Student Privacy Law (2016) asserts that individuals should be able to make decisions about their data, should not be harmed by the use of their data, should know of anticipated risks and benefits with a chance to opt-in or out, should fully understand the implications of usage of their data by second and third parties, and should not release the use of their data under duress or conditions of deceit (p. 69). The need to critically question the implications and use of student data will continue to evolve as technology further enables the identification, analysis, and application of learner analytics. One begins to feel that a dual degree in law and software engineering is needed to appreciate and effectively manage the risks and benefits. Still, the simple questions of what student data, where and how it is stored, and how it is protected can generate valuable conversations around the method in which learning is personalized.

Conclusion

There is no one definition of personalized learning, nor is there a single implementation or means of data collection to facilitate personalization. Terms such as personalized, blended, and competency-based learning exist on continuums on which infinite examples are represented. The only way to discern the details of a personalized learning initiative is to ask good questions that will generate meaningful information. What is the desired learning outcome? What are the instructional design elements? What is the learning environment? What are the supporting tools, technologies, or applications and the role of each in the learning process? How will the learning be assessed? What type of data will be captured, and by whom? Where and how will these data be stored, and how will this information be protected? Armed with these questions, all stakeholders can better understand the meaning, context, learning goals, and details associated with a given personalized learning initiative.

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Researcher-Practitioner Partnerships for Online Learning

What, Why, and How

Jacqueline Zweig & Erin Stafford

Introduction

Given the complex and rapidly changing nature of online learning for elementary and secondary students, it is not surprising that research on online learning is still in its early stages. While the number of studies with direct, relevant findings for improving practice have increased since the 2014 edition of this handbook, each of the current chapters suggests that there is a critical need for more research specifically focused on k-12 online learning. To begin to address this need, researchers and practitioners can join forces to conduct practical research through researcher-practitioner partnerships (RPPs). By collaborating to tackle problems of practice, RPPs can identify and address some of the common challenges to conducting rigorous research in this arena and can increase the evidence base on what works to improve student learning and success in online courses.

What are the challenges to conducting rigorous research on online learning?

Conducting rigorous research to understand best practices in k-12 online learning is complicated by variation in all aspects of implementation. For example, students can take online courses through full-time virtual schools or as supplemental courses within their brick and mortar schools. Further, there are several aspects of content delivery that may differ across programs or even courses, including whether the content is delivered synchronously or asynchronously and whether or not an online teacher is present. There is also variation in the availability and quality of data, and the pace at which the technology, policies, and structures change. These differences make it more difficult to develop appropriate analytic models that investigate interventions related to online learning. Simple differences in how students take their courses (e.g., at home versus during an assigned classroom time), what courses they take, and the quality of the data captured by the technology and student information systems make it hard to ensure that results can be attributed to one particular aspect of online learning.

Even if these basic data and study design challenges are overcome, one fundamental problem often remains: the questions of interest to online learning researchers may not address the real-time problems of practice that online learning practitioners face in making decisions for students. With all of these challenges in place, how can researchers, practitioners, parents, and learners begin to understand "what works" when it comes to online learning for k-12 students? One answer is to join forces through an RPP.

What is a researcher-practitioner partnership?

At the heart of the RPP is collaboration. The partnership is built on the idea that researchers and practitioners jointly identify and study problems of practice and investigate potential solutions. In these partnerships, researchers and practitioners bring different perspectives to a common goal and can work together to build research studies that are mutually beneficial. These partnerships can take many forms. Coburn et al. (2013) identifies three partnership types: (1) a research alliance, where a district and a research organization focus on investigating questions in that district, (2) a design-based research partnership, where partners aim to simultaneously build and study solutions in real-world contexts, and (3) networked improvement communities that leverage diverse experiences in multiple districts or schools to understand what works where, when, and under what condition (Coburn & Penuel, 2016). The federal government and several foundations have supported different types of RPPs – from researchers partnering with a single education agency to cross-jurisdictional alliances to a mix of state and local education agencies and non-profit organizations.

To be successful, RPPs must identify and clarify roles for each partner, jointly negotiate the focus of the work, develop communication procedures and strategies, create processes to build respect and long-term commitments between researchers and practitioners, and commit resources to foster the partnership and conduct the work (Coburn, et al., 2013; Connolly, et al., 2012; Henrick, Cobb, Penuel, Jackson, & Clark, 2017. Penuel, 2014; Roderick & Easton, 2007; Tseng, 2012; W.T. Grant Foundation). Further, RPPs enter into data sharing agreements supported by well-defined processes. Finally, RPP staff must possess both the technical and the interpersonal skills necessary for sustaining the long-term relationships such work requires (Coburn, et al., 2013; Connolly, et al., 2012; Henrick, et al., 2017, Roderick & Easton, 2007; W.T. Grant Foundation). Given the time and effort needed to make these partnerships successful, who should be involved in them and what do they gain?

What could RPPs look like for online learning?

Considering the time and effort needed to make these partnerships successful, members of an RPP need to understand what they can contribute and what they will gain through collaboration around a problem of practice. Below we discuss the important roles of online learning professionals, local and state education agencies, and researchers in forming an RPP in k-12 online learning. Together these three groups can:

- Develop and prioritize research questions that address problems of practice;
- Determine what administrative and learning management system data is available to address the research questions and create a shared understanding of each data element;
- Develop a practical sustainable plan to systematically collect data that is not available, either through traditional means, such as surveys, or through technology, such as adapting a learning management system to capture more information about course activity;
- Create an analytic plan that addresses the research questions and attends to the complexity of the implementation of online courses; and
- Interpret results, use the research to change or inform practice, and recognize who else should learn about the results.

Online Learning Professionals

Whether it is an online teacher, administrator, or course developer, online learning professionals are armed with "on-the-ground" perspectives on students, parents, and the environments in which online learning takes place. In the context of an RPP, these professionals can help identify the problems of practice that need to be addressed. They have the knowledge and experience to raise important questions about the effectiveness of their courses, supports for online students, recruitment and training of online teachers, and their expectations for and relationships with brick and mortar schools. Similarly, they have the ability to implement new approaches and work with researchers to design studies that can be feasibly carried out in their contexts.

Both online learning program administrators and content developers are crucial to resolving two of the big uncertainties when conducing online learning research: what online learning data is captured and how that data is stored. Online learning programs and content developers often have staff who are experts in the data that they collect – from learning management system data to student enrollment data. The knowledge from these professionals ensures that the data elements used in research are appropriate given the context of their systems. Lastly, online learning professionals are poised to be major users of research, as results may suggest changes to the approach, implementation, and structure of online learning.

State and Local Education Agencies

State and local education agencies raise questions about the use of online learning across the education system they support. These agencies develop strategic goals for the education system and can speak to how online learning fits within those goals, which may include a focus on college-and-career readiness or competency-based learning. State and local education agencies may also oversee online learning programs or be involved in developing criteria for the programs that offer online courses to students in their jurisdictions.

These agencies are a critical partner in the design and execution of research. They have access to data that online learning programs and content developers may not, such as student demographic and academic performance data. These data elements are often necessary to understand differential trends or effects based on student characteristics. State and local education agencies are also key partners in knowledge utilization by supporting the dissemination and use of findings to a wider audience across the state or district.

Researchers

In an RPP, researchers must come prepared to tackle a problem of practice identified by the practitioners (Henrick et al., 2017). Researchers can help narrow and refine questions of practice into research questions – for example, moving from “How can we prepare students to learn in an online environment?” to “Does access to an orientation course increase the likelihood that first-time online students complete their courses?” Researchers can also put a question in the perspective of existing research, and can determine what is needed to answer the question, such as particular data elements or a specific research design. Researchers are responsible not only for designing and executing the research, but also for ensuring that the design and execution are feasible given existing structures, data, and supports, and responsive to the identified context and need.

Researchers also support practitioners in understanding research and making sense of findings. This involves translating findings from technical to non-technical language and ensuring that all parties understand any important limitations, including whether or not the results can be generalized. Researchers can encourage knowledge utilization by supporting practitioners as they share the results and make changes to their programs. Finally, researchers are responsible for moving the research forward by disseminating the work to others in the field.

How can these partnerships benefit online learning?

Online learning is complex due to variation in programs, support structures, state and local policies, and the data collected. That complexity coupled with the widespread use of online learning and the limited research in this arena suggests a need for collaborative research to understand and improve student outcomes. Interviews with members of RPPs revealed that benefits to this approach included the ability to focus on problems of practice and conduct research that employed rigorous methods and incorporated local knowledge and practitioner expertise (Farrell et al., 2017).

These partnerships can also bring the right people together to understand what data exists, how it is captured and stored, and how it can be appropriately used to address problems of practice. In an analysis of 41 partnerships, the authors found that all focused on explicit or implicit questions around data quality (Thompson, Martinez, Clinton, & Diaz, 2017). Thus, forming these partnerships can improve the quality of the data that online learning programs and state and local education agencies collect. For example, having a district data system identify whether a student’s course was taken online or face-to-face, record the grade or credit given by the online learning program, or delineate full-time online students from brick and mortar students, would improve the quality of future k-12 online learning research.

Finally, dissemination allows the benefits of RPPs to reach stakeholders beyond the partnership. Other online learning programs, education agencies, and researchers can use a partnership’s research results and information about data quality to consider changes to their own systems or inform their own research. Members of RPPs noted that a key benefit of their work was that study findings had the potential for both local application and broader implications (Farrell et al., 2017). By including online learning programs, education agencies, and researchers in the partnership, RPPs have the potential to reach a wider network of stakeholders than when conducting work in silos.

Conclusion

RPPs take time, effort, and shared priorities to understand both what is happening and what works for online learning. These partnerships are one way to bring key stakeholders together, figure out the questions that really matter to the field, systematically collect the data that is going to answer those questions, and make sense of results to inform practice and policy. The payoff for online learning professionals, state and local education leaders, and researchers seems high. To advance the field of online learning, research on "what works, for whom, and under what conditions?" will only help. Building RPPs is one step in that direction.

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Niki Davis, Ph.D., is *Distinguished Professor of e-Learning* at the University of Canterbury, Christchurch, New Zealand where she directs *UC e-Learning Lab* and coordinates UC postgraduate courses in e-learning and Digital Technologies. Past leadership positions have included Director of *Iowa State University Center for Technology in Learning and Teaching* in the USA; President of the *Society of Information Technology and Teacher Education* (SITE), and FLANZ the New Zealand association for flexible and distance learning; chair of educational research for the *International Federation of Information Processing*; and editor of academic refereed journals including *Journal of Pedagogy Technology and Education* and the *Journal of Open Flexible and Distance Learning*. Her 2018 book *Digital Technology and Change in Education, The Arena Framework* is one of over 300 publications. Niki is known internationally for her leadership in the research and development of K-12 online learning and related professional development, including preservice teacher education. Niki's leadership has been recognised with awards including the *SITE Outstanding Global Educator Award*.

Kara Dawson, Ph.D., is a Professor of Educational Technology in the School of Teaching and Learning in the College of Education at the University of Florida. Her scholarship focuses on the ways educational technologies influence teaching and learning within the contexts of K-12 education and online post-secondary environments. In particular, she is focused on how technology can meet the needs of all learners. She has published over 100 articles, has secured over 3 million dollars in external funding and has been recognized for her research and mentoring accomplishments by the University of Florida. She has also served as the Chair of one of AERA's largest special interest groups, SIG TACTL (Technology as an Agent of Change in Teaching and Learning) and serves on review boards for numerous journals including *Educational Technology Research and Development* and *Journal of Research on Technology in Education*.

Terry Diamanduros is a Professor of School Psychology in the NASP-approved School Psychology program at Georgia Southern University and has been a university trainer of school psychology graduate students since 2004. She received her doctorate degree in School Psychology from New York University. She is an active member of the Georgia Association of School Psychologists (GASP) and the National Association of School Psychologists (NASP). Dr. Diamanduros served on the Executive Board of the Georgia Association of School Psychologists from 2010-2012 and also served in NASP leadership as a NASP delegate representing the state of Georgia from 2011-2014. She serves on the editorial board of the *Journal of Child Sexual Abuse*, *Journal of Online Learning Research, and Journal of e-Learning.* She also reviews manuscripts for several other journals including the *Journal of Applied School Psychology, Journal of School Psychology, Journal of Traumatic Stress Disorders and Treatment, and the European Journal of Educational Psychology*. Some of her research interests include the role and training needs of school psychologists in online K-12 schools, social communication among students in online courses, the role of technology on adolescent development, cyberbullying and its impact on youth, the role of school psychologists in cyberbullying prevention, and the impact of trauma on children and adolescents.

Wendy Drexler has been a champion for effective integration of technology for learner empowerment for over 20 years. As assistant professor at Johns Hopkins University, she led Digital Age Learning and Educational Technology MS Degree. Prior to that, Wendy served as Chief Innovation Officer for the International Society for Technology in Education (ISTE) and continues to serve as ISTE faculty. As Director of Online Development at Brown University, she led the design and production of Brown's first online courses. As a post doc at the University of Florida, she managed the research portion of the Enhancing Education Through Technology (EETT) federal Title II grant across 23 school districts in Florida. Before earning a Ph.D and Ed.S in educational technology, Wendy managed eLearning design teams at IBM and AT&T. She has taught in elementary, middle, and high school in both public and Independent school settings. She developed the first blended learning courses for Shorecrest Preparatory School in St. Petersburg. Her research interests include student construction of personal learning environments, balancing teacher control with student autonomy, and advancing the processes that support networked learning.

Bryan Dykman teaches ninth grade English language arts in Portland, Oregon. He is also interested in the practical applications of gamification in classroom settings for engagement and content learning for diverse learners. Currently his research and writing projects aim to support practicing teachers in urban contexts. He is the former publication editor and research support specialist for the Center on Online Learning and Students with Disabilities at the University of Kansas.

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Osnat Fellus is a PhD Candidate at the Faculty of Education, University of Ottawa. Her PhD work focuses on learning and teaching with a specific concentration in theories of identity in mathematics education and in learning English as an additional language. She has recently co-authored One is not born a mathematician: In conversation with Vasily Davydov where she discusses, together with her co-author Dr. Yaniv Biton, issues paramount to teaching and learning mathematics. Osnat currently serves as Editor of the AERA Educational Change SIG Lead the Change Series.

Sapir Fellus is a graduate of the Faculty of Health Sciences at the University of Ottawa and holds an Honours Bachelor of Health Sciences (BHSc). She has recently served as a research assistant in several ongoing research programs in medical sciences with a particular focus on women's health and pregnancy-related research such as identification of molecular subclasses of preeclampsia (a hypertensive disorder of pregnancy) and obstetrical complications. Her interests include advancing medical education and promoting STEM education in high schools for all.

Nancy Fichtman Dana, Ph.D., is currently a Professor of Education in the School of Teaching and Learning in the College of Education at the University of Florida. Her research focuses on teacher and administrator professional development with a particular focus on practitioner inquiry. She has published 10 books and over 90 articles and book chapters on the topic. Throughout her career, she has worked extensively in supporting schools, districts and universities in implementing powerful programs of job-embedded professional development through inquiry across the United States and in several countries, including China, South Korea, Belgium, Portugal, The Netherlands, Slovenia, and Estonia, where her text *Digging Deeper into Action Research,* was recently translated. She has published ten books and over 80 articles and book chapters related to teachers', teacher candidates', administrators', and teacher educators' professional learning through inquiry, receiving several honors for these works that include the Association of Teacher Educators Distinguished Research in Teacher Education Award and the National Staff Development Council (Learning Forward) Book of the Year Award.

Joe Freidhoff, Ph.D., is Vice President at Michigan Virtual™ and in this capacity also serves as the head of the Michigan Virtual Learning Research Institute®. Dr. Freidhoff is a nationally-recognized researcher who specializes in K-12 online learning policy, evaluation of statewide K-12 online programs, management of virtual schools, and quality assurance. Dr. Freidhoff earned his Ph.D. in Educational Technologies from Michigan State University. He also has experience teaching in face-to-face and online settings, having taught undergraduate- and graduate-level courses in both face-to-face and online formats. Before returning to school for his Ph.D., Dr. Freidhoff taught high school English in Michigan.

Enrico Gandolfi, PhD, is assistant professor in Instructional Technology at Kent State University, Ohio. Previously he worked as associate researcher at the Centre for Media and Communication Studies "Massimo Baldini" (Luiss "Guido Carli" University of Rome, Italy). He is author of several academic articles (for Games and Culture, Simulation and Gaming, Information Visualization, Convergence, E-learning and Digital Media, etc.) and book chapters (for The MIT Press, ETC Press, etc.) about games for learning, educational media, data visualization, immersive technologies, and media research. His current research interests regard online communities, social platforms, and immersive virtual reality and augmented reality as educational tools.

Amy Garrett Dikkers, Ph.D., is an Associate Professor in Educational Leadership at the University of North Carolina Wilmington. She teaches in face-to-face, hybrid, and online learning modalities with undergraduate students and current educational professionals through Master's and doctoral programs. Her scholarship in online and blended learning spans the spectrum of Pk-20 educational organizations. To date she has over 20 publications that examine the value of online and technology-enhanced education for diverse populations of students and the teachers who work with them.

Lee Graham, Ph.D., is an Assistant Professor in the Secondary Education and Educational Technology Department at the State University of New York College at Oneonta. Dr. Graham was a co-creator and learner in the #Gamifi-ED and #Givercraft open learning initiatives which focused on the creation and dissemination of information concerning games to teachers, and the ability for middle school students to engage in open gaming environments to increase language skills and comprehension. Dr. Graham's primary research interest is in merging formal and informal learning environments through strategic use of open education for teacher educators. Iterations of these open higher education environments are curated in the #diffimooc and #seaccr archives.

Laura K. Handler is a doctoral candidate in the Curriculum and Instruction, Urban Education program at the University of North Carolina at Charlotte. Throughout her nine years teaching at the elementary level, Laura focused on building school community through parent engagement and service opportunities, experiences that drive her current research pursuits. Prior to working on her doctorate, she also coached teachers in meeting the learning needs of diverse students and led partnership and grant initiatives aimed at enriching the learning experiences offered by the school. Additional research interests broadly include social studies pedagogies, reading instruction, teacher education, and her dissertation examines the experiences of Latinxs with school choice policies in the local context.

Lisa Hasler Waters is an adjunct faculty member of the Division of Learning Technologies at George Mason University. She teaches in the Blended and Online Learning in Schools Master's and Certificate Program. Lisa also teaches computer science to K-8 and is a Technology and Instructional Support faculty at Flint Hill School, where she works with teachers to purposefully use technology to enhance student learning. She was recently recognized as a Distinguished Alumni for the University of Hawaii, Department of Learning Design and Technology.

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Yu-Yin Hsu is an assistant professor in the Department of Chinese and Bilingual Studies at the Hong Kong Polytechnic University. Her research interests involve linguistics theory, sentence processing, and the pedagogy of teaching Chinese as a second/foreign language. She received her Ph.D. degree from the Department of Linguistics at Indiana University – Bloomington.

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Thurídur Jóhannsdóttir is an associate professor of educational studies at University of Iceland, School of Education. She received her Ph.D. in educational studies from University of Iceland in 2010. Her research interest has been on the development of online teaching and learning focusing on teacher education and teacher development as well as use of ICT and online learning in upper secondary schools. She has studied school-based teacher education where the academic part of a teacher qualification is provided through distance and blended learning and considered the possibilities it opens up for the relationship between teacher education and school development. Recently, she has conducted research on development of education in rural communities by looking at the affordances the Internet offers for networking between upper secondary schools at national and international level as well as for school-community collaboration supporting social justice and opening up new opportunities for youth in rural areas.

Iván M. Jorrín-Abellán received his Ph.D. in educational technology from the University of Valladolid, Spain, in 2006. He is professor of educational research at Kennesaw State University, member of the Intelligent & Cooperative Systems Research Group (GSIC), and former director of the Center for Transdisciplinary Research in Education (CETIE-UVa), both at the University of Valladolid. His current research is devoted to the study of the educational implications of Computer-Supported Collaborative Learning scenarios, with special attention to new ways of evaluating these particular settings. He has recently developed *Hopscotch*, a theoretical model and a web-tool to help the generation of educational research designs. This work brings together his main two research strands, educational technology and research methods.

Rebecca Kelly serves as the high school librarian in the Quakertown Community School District. As part of the Quakertown cyber-program leadership team, she developed and implemented their blended learning program, online learning program and 1:1 learning environment at the secondary level. Professionally, she co-chaired the iNACOL Northeast Regional Committee and received the Emerging Leader Award from the Association for School Curriculum and Development (ASCD) in 2013. She holds a Master of Library and Information Science from the University of Pittsburgh, as well as certification in school administration.

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Randy LaBonte has been a senior level executive for over 30 years in the education sector, and works and teaches online in the K-12, post-secondary, and corporate training sectors. His doctoral research led him to take on the role of lead consultant and researcher for seven years at the BC Ministry of Education and he was a member of a team that researched distance education for the Alberta government. He was central in development of policy, agreements, and e-learning standards as well as led the design and implementation the Quality Review process for BC online K-12 schools. He presently teaches online courses for Vancouver Island University and recently took on the role of Chief Executive Officer for the Canadian eLearning Network (http://canelearn.net) while continuing his other contract work and studies.

Chin-Hsi Lin, Ph.D., is an associate professor in the Division of Chinese Language and Literature at the University of Hong Kong. His primary research interests concern emerging technologies in language education. Using advanced statistics such as survival analysis and hierarchical linear modeling, he investigates the learning processes and outcomes associated with online learning in K-12 settings and out-of-school learning contexts.

Peiyi Lin is a postdoctoral researcher at the Institutional Research Center, National Taipei University of Technology, in Taiwan. Before that, she served as a Research Associate at the Institute for Learning Technologies at Teachers College, Columbia University. Her research projects focus on K-12 online learning, teacher professional development in STEM areas, the role of school leadership, the effect of instructional technology on student learning, data mining, and data visualization. Her statistical expertise includes latent variable analysis, multilevel analysis, and longitudinal data analysis. She received an Ed.D. in Instructional Technology and Media from Teachers College and an M.A. in Educational Leadership from Eastern Michigan University. Prior to coming to the United States, she taught high school English for a year in Taipei, Taiwan, where she completed an M.A. in English Language and Literature from National Taiwan Normal University, and a B.A. in English Language and Literature from National Chengchi University. She currently lives in Taiwan.

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Anissa Lokey-Vega earned her Ph.D. in Instructional Design and Technology from Georgia State University in 2010. Prior to this, she worked as a K-12 instructional technology specialist and professional development coordinator in metro-Atlanta. In addition to K-12 experiences, she has been teaching online in teacher education since 2004. Currently, she is an Associate Professor of Instructional Technology at Kennesaw State University and coordinator of two online teaching programs for the university.

Susan Lowes is Director of Research and Evaluation at the Institute for Learning Technologies at Teachers College, Columbia University. She has conducted research at both the university and K-12 levels, with a focus on the impact of technology on teaching and learning, and directed evaluations of multi-year projects funded by the U.S. Dept. of Education, the National Science Foundation, state and local departments of education, and private foundations. She is particularly interested in online learning and has evaluated online professional development initiatives for teachers and administrators, as well as online courses and programs for students. Her recent focus has been on teaching students how to learn online, using the concept of locus of control, and on the use of LMS data to discover patterns of student and teacher interaction. Dr. Lowes is also Adjunct Professor in the Program in Computers, Media, and Learning Technologies Design at Teachers College, teaching a course on online schools and online schooling for K-12 and a course on methodologies for researching technology and education. She received her Ph.D. in Anthropology from Columbia University for work on the island of Antigua in the West Indies and still does some research there when she has some spare time.

Julie Mackey, Ph.D., is an Associate Professor and Dean of Education and Health at the University of Canterbury, Christchurch, New Zealand. Her research interests focus on the use of digital technologies for online and blended learning, e-learning leadership in schools, and teacher professional development. Recent research and supervision has extended to investigate innovative learning environments and themes related to co-teaching, collaboration, and leadership of change, as well as the development of student competencies to thrive in new learning environments.

Dorit Maor is a graduate of Tel-Aviv University, (BSc, 1977) Pittsburgh University, USA (MEd, 1980) and Curtin University, Perth, Western Australia (PhD , 1993). During 1995-1998 she was an Australian Postdoctoral Fellow (ARC). She is currently an Associate Professor at Murodch University, School of Education. Dorit conducts research on how technology supports and enhances learning in diverse educational settings and, more specifically, on the intersection between innovative technology and pedagogy. In a recent study, she explored the use of mobile technologies, to connect hospitalized students to their schools, classmates, and families in an effort to reduce their isolation and disrupted schooling experiences. Another recent research involved investigating the use of technology for higher degree supervision in higher education. She has supervised many doctoral students to completion. Dorit's rigorous qualitative research approach resulted in numerous publications in refereed journals, book chapters and conference presentations. She has received significant grants and awards such as ARC post-doctoral Fellowship, ARC grants and Young and Well Cooperative Research Centres (CRC) grant, and the **Office of Learning and Teaching (OLT) Project, Innovation and Development Grant**.

Aidan McCarthy joined Catholic Education Western Australia as Head of Digital Transformation in 2016 after leading and education roles in some of the world's largest organisations, including Microsoft and Apple. Using decades of experience in digital transformation strategy, he has implemented 'Leading Lights', a project that is widely regarded as a new global standard for what technology makes possible for school systems. One of the primary goals of Leading Lights was to show what transformation could look like, and to ensure the policies, systems, change approaches and analytics can quickly be adapted by other systems to accelerate their success. Aidan has more than 30 years' experience in in the education industry, guiding governments, policy makers, universities, non-profits and schools across the globe to effectively plan, implement, integrate and evaluate learning with information and mobile learning technologies. As a member of Apple's Worldwide Strategic Initiatives Group he focused on large and strategic mobile and digital content learning initiatives. As director of the Global Digital Learning Strategy for Microsoft Worldwide Education, Aidan led a worldwide team of pedagogy, learning and technical specialists to support education systems with a vision and strategic plan for digital transformation. Aidan has a Master of Education in Learning Technologies and is completing doctoral research in developing educators in Children's Hospitals to expand their digital pedagogies in mobile learning technologies.

Scott McLeod is an Associate Professor of Educational Leadership at the University of Colorado Denver. Scott McLeod, J.D., Ph.D., is widely recognized as one of the nation's leading experts on P-12 school technology leadership issues. He is the Founding Director of the UCEA Center for the Advanced Study of Technology Leadership in Education (CASTLE), the nation's only university center dedicated to the technology needs of school administrators, and is the co-creator of the wildly popular video series, Did You Know? (Shift Happens). He also is the co-creator of the 4 Shifts technology integration discussion protocol. Dr. McLeod has worked with several hundred schools, districts, universities, and other organizations and has received numerous awards for his technology leadership work, including the 2016 Award for Outstanding Leadership from the International Society for Technology in Education (ISTE). Dr. McLeod blogs regularly about technology leadership issues at Dangerously Irrelevant and is a frequent keynote speaker and workshop facilitator at regional, state, national, and international conferences. He can be reached at dangerouslyirrelevant.org or twitter.com/mcleod.

Michael Menchaca is a professor in the Department of Learning Design and Technology at the University of Hawaii at Manoa. He specializes in online learning and has helped create and establish successful online programs at multiple institutions. He currently coordinates the blended doctoral program in the Department. Dr. Menchaca publishes research in online learning, social justice with technology, and integrating technology into teaching and learning at all levels. He has consulted for numerous universities, schools, districts, and county and state offices. He has served as principal investigator for several state and federal grants. Finally, Dr. Menchaca was an IT specialist for many years, specializing in network management and desktop support.

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Ian O'Byrne(@wiobyrne) is an educator, researcher, and speaker. His research investigates the literacy practices of individuals as they read, write, and communicate in online spaces. Ian has been involved in initiatives ranging from online and hybrid coursework, integrating technology in the classroom, and supporting marginalized students in literacy practices. Ian's work can be found on his website (wiobyrne.com). His weekly newsletter (wiobyrne.com/tldr/) focuses on the intersections between technology, education, and literacy.

Leslie Pourreau received her Ed.D. in Teacher Leadership for Learning—Instructional Technology from Kennesaw State University in 2016. She is a part-time Assistant Professor of Instructional Technology at Kennesaw State University and has 22 years of experience in K-12 education. Her research interests focus on certification policies and professional development practices for K-12 educators in online and virtual school settings.

Allison Powell is the Senior Learning Strategist for BloomBoard where she assists states and districts in re-thinking professional development and licensing. She is the former Vice President for New Learning Models of the International Association for K-12 Online Learning (iNACOL), which provided expertise and leadership in K-12 blended, online, and competency-based learning. Dr. Powell taught in face-to-face, online, and blended K-8 environments. She helped build the Clark County School District's Virtual High School and an online professional development program for the Nevada school district. Dr. Powell has served as a board member for several organizations and universities. She completed her doctorate from Pepperdine University in educational technology.

Keryn Pratt is the Postgraduate and Distance Coordinator at the University of Otago College of Education, Dunedin, New Zealand, where she is a senior lecturer. She is also a member of College's Centre for Distance Education and Learning Technology. Keryn has done research in online and distance learning since 2000, and has taught online since 2004. A particular focus of her research is how New Zealand rural secondary schools are using blended learning approaches to enhance opportunities for their senior students. She is currently a co-chair of the Virtual Schooling SIG for the Society for Information Technology and Teaching Education (SITE) and is secretary of the Flexible Learning Association of New Zealand (FLANZ).

Kristine E. Pytash is an Associate Professor in Teaching, Learning and Curriculum Studies at Kent State University's College of Education, Health, and Human Services where she co-directs the secondary Integrated Language Arts teacher preparation program. She is a former high school English teacher. Her research focuses on the literacy practices of youth in alternative schools and juvenile detention facilities. In addition, she studies disciplinary writing and how to prepare teachers to teach writing. An underlying theme across all her lines of inquiry is how technology significantly influences young adults' literacy practices and their literacy instruction.

Dafna Raviv is Head of Science Education at the Center for Educational Technology (CET), Tel Aviv, Israel. She holds a PhD in Medical Science from Tel Aviv University. Dr. Raviv's work focuses on promoting a sustainable integration of technology and pedagogy in various models including online teaching in the Israeli education system. She is the cofounder of CET's online national campus for in-service professional development. She also served as the principal of CET's Virtual High School for STEM. As Head of Science Education at CET, Dr. Raviv is responsible for development and implementation of innovative programs in science education including printed and digital content for K-12.

Jeanne B. Repetto is an Associate Professor in the School of Special Education, School Psychology and Early Childhood, College of Education at the University of Florida. Dr. Repetto teaches courses in transition, teaching strategies, and oversees the University of Florida's EdHCT: Education Health Care Transition Graduate Certificate. Her research interests lie in the areas of secondary/transition education relating to community, employment, and personal/social choices; Education/Health Care Transition; online at risk learners and student outcomes. Dr. Repetto's work in Transition Education includes having served as the PI of the Florida Transition Center for 19 years, receiving funding for over 10 million dollars in grants. She has written 2 books, 8 chapters and 30 referred journal articles. She is a past president of the International Division on Career Development and Transition (DCDT). She is a recipient of the National Donn Brolin Award for state leadership in transition and the Florida Transition Champion Lifetime Achievement Award. She is a founding member and currently serves as cochair of ICHET: The Interdisciplinary Collaborative on Healthcare and Education Transition.

Kerry Rice is a 2012-2013 and 2015 Fulbright Scholar and Professor in the Department of Educational Technology at Boise State University. Her research focuses on best practices in K-12 online and blended education and includes policy analysis, Delphi and mixed methods studies, and large-scale program evaluations using both traditional and emerging methods in data mining and deep learning analytics. She is the author of *Making the Move to K-12 Online Teaching: Research-Based Strategies and Practices* (Pearson, 2012), led the development of the Idaho K-12 Online Teaching Standards and serves as Coordinator of the Idaho K-12 Online Teaching Endorsement Program at Boise State.

Mary F. Rice is an Assistant Professor of Literacy at the University of New Mexico. Previously, she worked as a graduate research assistant and a research associate at the Center on Online Learning and Students with Disabilities at the University of Kansas. Her current research focuses on technological literacies and technology-based support for literacies accessible and available to diverse students, including those with disabilities. She is also interested in teacher thinking about making curriculum with technologies that supports various literacies.

Jayson W. Richardson is an Associate Professor in the Department of Educational Leadership Studies at the University of Kentucky. His research, teaching, and service links school technology leadership and international development. Jayson is a Director of the Center for the Advanced Study of Technology Leadership in Education (CASTLE). He is the co-editor of the *Journal of Educational Administration*. He has written over 70 articles and book chapters. His work appears in journals such as: *Comparative Education Review*, *Educational Administration Quarterly*, *Journal of Educational Administration, International Journal of Education and Development using ICT*, *Information Technology for International Development*, *Journal of International Development*, *Journal of School Leadership*, *Review of Policy Research*, and *The Teacher Educator*.

Verena Roberts is a passionate online and blended k-12 educator, consultant, Werkland School of Education (University of Calgary) doctoral student who is completing her EdD in Learning Sciences and currently a Technology for Learning Specialist with Rocky View Schools. Her passion is K-12 Open Learning. Verena has taught and designed online courses and consulted about curriculum and technology integration from pre-K to Higher Education in Canada and the United States. She has consulted, facilitated and developed a wide range of open networked learning projects with a focus on designing for sharing, open educational resources (OER), open educational practice (OEP) and emerging blended learning opportunities with Mozilla, CANeLearn, ERLC and iNACOL. She is the 2013 iNACOL Innovative Online and Blended Learning Practice Award Recipient.

Kelly Schwirzke coaches dual enrolled high school students and an early college high school in Santa Cruz, CA. She provides advisory services to school systems, government agencies and other policymakers identifying key trends and implications that help inform policy and reform efforts in the field of online learning. She has served on national workgroups to write and revise quality standards for online instruction, course design, and programs. She has taught graduate courses in educational leadership and instructional design for Keiser University since 2011. She has been an instructor and administrator in K-12 and higher education for the last 25 years. Dr. Schwirzke earned her Bachelor's Degree in English, Master's Degree in Curriculum and Instruction, and Doctorate in Educational Leadership.

Marina Shapiro has a background in Science Education Research (Chemistry) and Learning Technologies. Her research interests are implementing game-based learning environments into undergraduate college chemistry curricula in order to facilitate methods for active and experiential learning, particularly in the context of lecture settings where students are often passive learners. Currently Dr. Shapiro is Lecturer of Chemistry at California State University, Bakersfield where she teaches General Chemistry, Foundations of Analytical Chemistry, Biochemistry, and Food Science lecture and laboratory courses.

Shannon Skelcher is a doctoral student in the department of Educational Technology at Boise State University where she also works as a graduate assistant. As a graduate assistant, Shannon has had the opportunity to collaborate and write STEM+C curriculum and assist and present on research related to the field of online education. Shannon holds a Master's degree of Educational Technology and K-12 online graduate certificate from Boise State University. She previously worked as an online elementary teacher in which she taught a variety of grade levels in K-6. Her current research interests include online education, virtual learning communities, and flipped learning.

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Erin Stafford, M.A., is a Senior Research Associate at Education Development Center, Inc. (EDC). Stafford has extensive experience working with federal, state and municipal agencies as well as foundations, museums, schools and community organizations to answer their questions of policy and practice. Stafford recently co-facilitated a researcher/practitioner alliance on virtual education for the Regional Educational Laboratory (REL) Midwest and served as the analytic technical assistance manager for the REL Northeast & Islands at EDC. In that role, she guided practitioners in setting research agendas, helped build the capacity of state- and district-level practitioners to use data in their practice, and assisted school and district teams in incorporating continuous improvement processes into their decision-making. With Zweig, she is currently leading a grant funded by the Institute of Education Sciences that will estimate the impact of an orientation course on completion rates for high school students taking online courses for the first time. Stafford received her B.A. in psychology and religious studies from Washington University in St. Louis. She has an M.A. in Social and Cultural Foundations in Education from DePaul University.

Skip Stahl is a nationally recognized expert in online learning, accessible educational materials and Universal Design for Learning. He has extensive experience in advising education stakeholders–including states, district leaders, publishers and policy makers–on how to make learning environments and products more effective for all. He was also CAST's Project Director for the Center on Online Learning and Students with Disabilities, a partnership with the University of Kansas and the National Association of State Directors of Special Education. Mr. Stahl was Co-Director of the federally-funded National Center on Accessible Educational Materials (the AEM Center), where he led a national initiative to assure that educational materials are developed and distributed in ways that are accessible, appropriate, and readily available to all students.

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John Watson is the founder of the Evergreen Education Group, and is responsible for conducting, writing, and presenting research as well as providing testimony on digital learning matters to state boards of education, legislatures, and charter school commissions. He has extensive knowledge and experience based on his two decades working in online learning and education technology. This background has afforded him a wide-reaching network across the spectrum of education professionals, policymakers, and subject matter experts as well as the ability to provide insightful, dimensional analysis and recommendations. After earning his MBA and a MS in natural resource policy at the University of Michigan, John went to work for one of the first Learning Management System companies, eCollege, in early 1998. He launched eCollege's K-12 division, called eClassroom, and managed eClassroom's research and business development. This experience was the springboard for John's independent consulting in environmental policy and education which evolved into what Evergreen Education Group is today. John and Evergreen's work has been cited in the *New York Times*, *Wall Street Journal, USA Today, Education Week*, and *eSchool News*, and he has also appeared on NBC Nightly News.

Lauren Vashaw has been with the Evergreen Education Group for the past seven years. Her areas of responsibility have encompassed administration, project management, and research. She has assisted in the research of several projects including the Google Impact Case studies as well as contributed to the latest six editions of the annual *Keeping Pace with Digital Learning Report*. She is also responsible for directing Evergreen's workflow and administrative management. She attended Denison University in Ohio. In 2007, she graduated with a B.A. in psychology and a minor in communication. Prior to working with Evergreen Education Group she worked at Michigan Virtual University analyzing and configuring research data.

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Jacqueline Zweig, PhD, is a Research Scientist at Education Development Center, Inc. (EDC). Dr. Zweig conducts quantitative research in partnership with state and local education agencies to provide new insights into online learning, educator development, and data use. She is the Principal Investigator for a grant funded by the Institute of Education Sciences that will estimate the impact of an orientation course on completion rates for high school students taking online courses for the first time. Dr. Zweig also manages the applied research and evaluation studies for the Regional Educational Laboratory Northeast and Islands at EDC, where she has conducted studies on online learning and educator professional development and growth, and recently co-facilitated a researcher/practitioner alliance on virtual education for the Regional Educational Laboratory (REL) Midwest. Her recent publications focused on online teachers' training, professional development, and experiences. Dr. Zweig received a B.A. in economics from Colby College and a Ph.D. in economics from the University of Southern California.

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