

Using Games in the Classroom

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Key Summary Points

1

Many games purport to teach, practice, or encourage interest in STEM subjects; however, many fail to do so in ways that can be statistically shown to be effective. The potential benefits of such games are often overstated. All parties should be more cognizant of realistically achievable outcomes.

2

Designers and educators should establish parameters to determine what constitutes a successful game experience and design usability tests that measure the degree of improvement in students' aptitude and performance following engagement with STEM games.

3

Progress is being made both in building STEM games and assessing their effects. Analysis of some successful games is helpful in determining how to include games in curricula and demonstrating how they support educational goals.

Key Terms

Game-based learning

Classroom

Implementation

Lesson plan

Pedagogy

Barriers

Introduction

Should games be used in the classroom? Despite the tremendous instructional power and opportunity for game-based learning, this question has had a polarized history.

Game-based learning, as an approach and as a field, is at an all-time high, with more educators than ever using games for learning in their classrooms. Unfortunately though, games still carry a stigma for some educators and the idea of “games in the classroom” is frowned upon in some schools. Even for those educators who want to leverage game-based learning, they can face a high number of barriers, including insufficient access to technology, educators’ lack of general understanding and experience with games for learning, and the lack of data and assessment feedback from games. Despite these challenges, games are becoming a key tool used in many learning environments today (Richards, Stebbins & Moellering, 2013).

Convincing all the stakeholders to support the use of games as instructional tools can be more challenging than other materials: teachers need assurance that the games provides a quality learning experience and will give them back some understanding of student performance; administrators and parents need to understand the pedagogical benefits of playing games; and even students need support in understanding how games can be used as learning tools (SIIA, 2009).

Today there are thousands of games and apps that can be accessed by teachers—from small free apps, to large immersive 3D worlds. For educators, such opportunity is part of the problem:

1. How do you find the right game for your needs?
2. How do you know how to use it effectively?
3. How do you know what students learned from it?
4. Who do you go to for help and support just in time when you need it?

This chapter will discuss the opportunities and challenges of using games in the classroom, and describe some of the basic frameworks and methods for such. Finally, we will explore three case studies of how games have been used powerfully for deeper learning in the classroom, along with several resources to support an educator seeking to use games in their own classroom.

A Brief History: 30+ Years of Learning Games

Although paper and board games are a commonly featured element in many classrooms, the presence of digital games has seen a slower uptake. This has been the case for both educational games (those specifically designed for learning and education) and commercial games, or COTS (Commercial Off-The-Shelf games, which were built for entertainment but at times have been used as instructional tools in the classroom).

Digital games first entered the classroom in the 1980s during the CD-ROM era. Adoption was slow, but growing steadily. However, in the 1990s a number of factors led to a tarnished image of the market, and ultimately to its consolidation to just a few key players, which prevented rapid adaptation in schools (Shuler, 2012). Over the past decade, we have seen a growing number of teachers who have demonstrated outstanding and powerful learning experiences with students by leveraging digital games, demonstrating deeper learning and engagement of students, proving to others that games can have a place in the classroom. In a recent survey conducted by the Joan Ganz Cooney Center, 32% of the K-12 educators sampled reported they use digital games 2-4 times per week in their classrooms, with 18% reportedly using them every day (Millstone, 2012). A majority of this usage is with educational games, with just 18% reporting the use and adaption of commercial games for classroom instruction (Millstone, 2012). But with all of the available games, and all of the different types of classrooms and learning goals, what exactly does it look like to use games effectively in the classroom?

Key Frameworks

Before exploring how games have been, and can be, used in the classroom, it is helpful to understand the landscape games and game-based learning. In this section we will look at the various types of games available for use in the classroom, the benefits to using the various types of games in the classroom, as well as the potential barriers and challenges to implementing them.

The Games Landscape

There is an extensive variety of games, which makes it difficult to select one versus another for a particular classroom or curricular need. To help with this task, Squire (2008) offers a taxonomy of game types through two educator-centric lenses: timescales and modalities. These two lenses for choosing classroom content are often primary for educators, as time available for instruction and the type of learning method or pedagogy they want to use are drivers for designing instruction. Note that the timescale offered roughly estimates what is typically encountered through game play for entertainment, not necessarily for the classroom.

GENRE	Time to Completion	Timescale	Open-endedness	Modes of Creative Expression	Examples	
					Commercial	Educational
Targeted games (puzzle, mini-games)	1-4 hours	weeks	Low	Style of completion: level creation	Angry Birds	Supercharged!
Linear games	20-40 hours	month	low	Style of completion: machinema	Viewtiful Joe, Ninja Gaiden	DragonBox
Open-ended sandbox games	100-200 hours played over multiple months	2-24 months	high	Style of completion: multiple solution paths, modding	Civilization, SimCity, Minecraft	SimCityEdu, MinecraftEdu, Making History
Persistent Worlds	500+ hours	6-48 months	high	Modding; social engineering; game play	World of Warcraft, Everquest	Quest Atlantis

Figure 1.

Targeted games are designed for a specific topic or concept, such as adding fractions or photosynthesis. These types of games are more easily integrated into the classroom because they more easily align with curricula and fit into class timescales.

Linear games can be short or long, but generally include a storyline and pathway through the game. For example, *Lure of the Labyrinth* is a digital game for middle-school pre-algebra students that includes a wealth of intriguing math-based puzzles wrapped into an exciting narrative game in which students work to find their lost pet and save the world from monsters.

Open-ended or sandbox games, which offer tools and a context to construct items and/or outcomes in the game, are gaining popularity in the classroom, as they offer a rich context in which to target specific learning objectives. For example, *Civilization V* is a commercial game that leads the player through the growth of a civilization and empire; there are many examples of the use of this game in the classroom to target numerous learning goals, including trade routes and ethical thinking (McCall, 2011; Fitzgerald & Groff, 2010). *Making History* is offers a similar open-ended world to explore dynamics in history that was built specifically for education.

Finally, persistent worlds, virtual worlds that are on-going, such as many of the popular massively multiplayer online games like *World of Warcraft (WoW)*, are often the most complex to integrate into the classroom, but can offer some of the most rich learning environments (McCall, 2011).

Squire’s framework also can be distilled into a simple classification as seen in Figure 2.

	Commercial Built for entertainment	Educational Built for learning and instruction
Short Form Shorter games that can be played in a brief amount of time, often puzzle or linear games	Examples: • Angry Birds • Mario Kart	Examples: • Lure of the Labyrinth • Quandary
Long Form Longer games that typically are more complex and take longer to play, such as open-ended and persistent world games	Examples: • SimCity • World of Warcraft	Examples: • Minecraft • Making History

Figure 2.

Short-form games include the previously defined targeted games and some linear games, such as *Angry Birds* or *Mario Kart*. Games in this category are easier to integrate into the classroom than long-form games, and are seeing a surge in numbers due to the growth of apps and purchases of mobile devices in K-12 education (Richards, Stebbins & Moellering, 2013).

Long-form games extend beyond one class period. They require more planning and preparation by the teacher, and a deeper commitment to curriculum time and alignment. However, they can be leveraged in a “flipped classroom” model, where play occurs outside class time and serves as the context for further classroom instruction (Richards, Stebbins & Moellering, 2013). Although more work may be involved to leverage these games successfully, they also offer the potential of developing 21st century skills, such as problem solving, decision-making, planning, strategy, and collaboration (Klopfer, Osterweil, Groff & Haas, 2009).

Case Study One: *The Ward Game*, A Living Video Game

The Ward Game is a pervasive educational game designed to teach Ken Kesey’s classic novel, *One Flew Over The Cuckoo’s Nest* to high school seniors. *The Ward Game* has been played twice at Royal St. George’s College, and each iteration lasted 30 days and involved about 60 students. A pervasive game employs communications platforms such as mobile devices, desktops and laptops to carry out gameplay in physical spaces in the real world. In the case of *The Ward Game*, the school was transformed into a psychiatric hospital, and each senior English classroom became a ward analogous to the one in the novel. The game echoes the novel’s critique of post-industrial institutions and students assume the roles of patients who are subjected to systems that playfully induce conformity and control that mirror those used by the tyrannical Nurse Ratched in *One Flew Over the Cuckoo’s Nest*. An atmosphere of mock-oppression and mild paranoia pervaded but, paradoxically, players were conferred a high degree of choice, flexibility, and self-determination. Game mechanics such as missions, role-play, mini-games, lotteries, surveillance, points and achievement were employed extensively to engage players and externalize some of the novel’s key narrative features. QR codes, propaganda videos, Twitter feeds, Facebook pages, and a host of other online tools all contributed to creating an immersive environment.

Evidence gathered during gameplay and post-game surveys indicated that the majority of players reported being engaged, interested, and productive, with many observed instances of intrinsic motivation. Notable examples include: players who requested more work after they had already achieved the maximum allowable points; students with a history of apathy who came alive and worked tirelessly to complete tasks; and groups of players who organized themselves to creatively challenge the game’s authority. Many of the artifacts created through self-selected tasks emerged as some of the best work produced all year, even though they were not graded. Finally, players quickly realized that progress in the game was hastened by knowledge of the novel’s content, which encouraged higher book completion rates than in previous units. There were a few students who were observed behaving disengaged during the game, but most participants reported enjoying themselves, and, in many cases, unwittingly worked harder than they had in the past, despite it being played during the scourge of senioritis!

To successfully implement an educational pervasive game, a series of logistical and curricular hurdles must be cleared. Schools need to align their curricular goals and regional standards with the game’s

open-ended dynamics and diverse outcomes. In addition, more work has to be done to develop methods of assessment to accurately gauge pedagogical benefits and reconcile them with curricular mandates. A school's technology resources must also be considered, as pervasive games generally require and are greatly enhanced by access to computers, mobile devices, wifi-enabled devices, and other communications platforms. There should also be some thought to gender as *The Ward Game* was carried out in an all-boys school, so any documented successes may not be replicated in a co-ed or all-girls environment.

A teacher who runs a pervasive game is rewarded with a unique and creative experience, but it is a demanding enterprise. Despite the broad constraints of the narrative arc, the freedom afforded players causes the game to evolve organically, which forces the teacher to negotiate significant unpredictability. Furthermore, a teacher must be able to improvise and maintain constant vigilance to compensate for the current absence of dedicated software that might track scores and achievements, increase feedback loops, and manage more complex and responsive game mechanics. Regardless, even in the most sophisticated pervasive games, gameplay depends on the designer, or "puppet master," rather than artificial intelligence.

Finally, the novel on which to base an educational pervasive game must be carefully selected. *One Flew Over the Cuckoo's Nest's* structure and institutional setting transfers well to a traditional school environment, but not all novels lend themselves to become activated as a game. It would be worthwhile to research what literary structures and forms concede a game-based dynamic.

The challenges posed by implementing literary educational pervasive games like *The Ward Game* are far outweighed by the exciting pedagogical opportunities and rewards they present. Using a game can breathe new life into the study of literature at a time when reading, especially by boys, is in decline (Whitmire, 2010).

Key Findings

Despite the often-cited lack of evidence of the impact on learning with games, scientists have conducted a considerable amount of research in support of game-based learning and its effectiveness. For example, we have a cursory understanding of the valuable skill development that playing games can support. According to a review conducted by McFarlane et al. (2002), these include:

1. Strategic thinking
2. Planning
3. Communication
4. Application of numbers
5. Negotiating skills
6. Group decision-making
7. Data-handling

Recently, the Gates Foundation funded SRI International to do a sweeping review of the research on digital game-based learning, and their initial findings were quite promising. In a meta-analysis of over 77 studies that met review criteria, they found that digital games could enhance student learning, as measured by cognitive competencies relative to traditional instructional approaches (Clark, Tanner-Smith & Killingsworth, 2013). These results support the sentiments of many educators—according to the Joan Ganz Cooney Center’s 2012 Teacher Survey, more than 60% of teachers reported that digital games help them personalize instruction, better assess knowledge, and collect helpful data for lower-performing students, as well as promote deeper engagement and collaboration among all students (Millstone, 2012).

Barriers

As with any new instructional tool, there are barriers to digital game use in the classroom. Some are physical barriers, some are cultural, and some are perceptual. These barriers include (Richards, Stebbins & Moellering, 2013; Groff & Mouza, 2008):

1. **Cost:** The cost of the game as well as the technology and resources needed to implement the game.
2. **Access to required tech resources:** With limited resources in a school, it often can be difficult to schedule access to the computers and technology when you need them.
3. **Emphasis on standardized tests (perceived lack of space for such pedagogies):** An emphasis on high-stakes testing in many educational contexts limits the time and ability for an educator to explore new methods and tools.
4. **Standards alignment:** It is not always clear what a game is teaching, or can teach, which makes it more difficult for an educator to use and justify what standards it is targeting.
5. **Platform compatibility:** Games require various technology and platforms to run, all which not be accessible in a given school.
6. **Professional development:** Training and support are often needed and requested by many educators before using new types of tools.
7. **Research on effectiveness:** The lack of research on effectiveness of games has cause some to argue they are not demonstrably effective learning tools yet.
8. **Teacher beliefs and attitudes about learning:** The constructivist nature of instruction needed for game-based learning can be orthogonal to a teacher’s prior practices and beliefs on teaching and learning.
9. **Student beliefs and attitudes about learning:** Likewise, new exploratory and constructivist ways of teaching and learning with games may be very different than a student’s prior classroom experiences and expectations.
10. **School norms and professional perception of game-based learning:** Attitudes and beliefs by peer teachers and administrators about games as classroom tools can be an inhibiting factor as well.

Kirriemuir & McFarlane (2006) explain that the most frequently encountered perceived or actual obstacles include:

1. **Assessing the appropriateness of the game:** It was difficult for teachers to identify quickly how a particular game was relevant to some component of the statutory curriculum, as well as the accuracy and appropriateness of the content within the game.
2. **Stakeholder support:** There is difficulty in persuading other school stakeholders as to the potential/actual educational benefits of computer games.
3. **Time:** There is a lack of time available to teachers to familiarize themselves with the game, and methods of producing the best results from its use.
4. **Irrelevant content and functionality:** The amount of irrelevant content or functionality in a game, which could not be removed or ignored, thus wasting valuable lesson time.

A central component of the movement to help game-based learning be a central tool in today's classroom is to provide educators with the knowledge, resources and support necessary to overcome these barriers.

Approaches to Game-Based Learning in the Classroom

Just as there is a diverse range of games, there is also a range of different approaches to using both commercial and educational games in classroom settings. Below are a handful of approaches that fall in the range of both pedagogical as well as logistical approaches, which are not mutually exclusive.

1. **Preparation for future learning.** Learning only has meaning, and can be retained, when there are prior frames onto which one can hook new knowledge (Bransford, Brown & Cocking, 1999). Games are rich, immersive environments that create context and frames upon which concepts of a discipline can then be explicitly unpacked and explored (Klopfer, Osterweil & Salen, 2009), and the nature of games themselves can also serve as discussion prompts. As such, the teacher can use the game as a collective, shared experience that sets the foundation for future instruction. For example, games have been used as a starting point for discussion based on a teacher demonstration, perhaps asking why the developers chose to portray certain elements in the way that they did or examining the content of a game to see if it matches with what the class has previously learned to be true about a certain concept or phenomenon (Sandford & Williamson, 2005).
2. **Game narratives as learning context and backdrops for project-based learning.** One of the most meaningful elements of games is the story. For example, educators have successfully used console games in project-based learning, where the game is used to set the context and narrative. An educator at Meldrum Primary School in Scotland used *Guitar Hero* as the backdrop for a six-week project, where students were placed in teams of four as "bands" and given various roles such as "band manager" and "accountant" as they completed various tasks such as managing the tour budget, travel schedule, and negotiating contracts. Over the course of the project, the actual game play dwindled dramatically, eventually stopping altogether because they students were much more

interested in engaging in the project tasks than the game play. As a result, the project was able to capture deep engagement and cover an array of educational standards (Groff, Cranmer & Howells, 2012).

3. **Extended learning experiences deepen inquiry.** Classroom instruction may be targeted directly at one or several learning standards. However, the reality of our world is that these concepts play out in a complex context. Long-form games such as *Civilization III* and *Europa Universalis II* are complex worlds, that allow learn extended time and multiple dimensions to explore many concepts as they relate and interconnect with one another. Although these long-form games do not necessarily fit into any single specific curriculum, they can often encompass multiple dimensions of the curriculum in a rich and meaningful way.
4. **Flipped classroom model.** The increasingly popular flipped classroom model of instruction, where students engage with a digital learning experience outside of classroom time so that collectively the class can then build on that experience during classroom time, offers possibilities for game-based learning as well. Game play outside the classroom can be a great way to give students a rich and meaningful experience that can be done individually on a student's out-of-school time so that classroom time can be leveraged for deeper, extended inquiry based on the concepts targeted in the game. This approach is generally more effective with smaller, puzzle-based games. It is also important to note that all students in the learning environments must easily have access to the games and technology outside of school for the flipped model to be equitable and effective.
5. **Concept reinforcement.** Games can be engaging ways to support skill development as students move from novice to deeper understanding. This is true of games that are not just "drill-and-skill" games, but also for many high quality educational games. In other words, the game can serve as the targeted instructional experience, or it can serve as the extended practice and reinforcement of concepts as the learner seeks to get stronger in their understanding of the concepts.
6. **Just-in-time learning.** Since games can serve as rich and meaningful environments and experiences, they can present opportunities to push on learner misconceptions. Just as educational games in particular can be useful tools for support students' concepts they may be struggling with, many rich game worlds present numerous teachable moments for concepts and topics that might not otherwise arise (SIIA, 2009).

Implementation Models and Logistical Details

So what does successful implementation of games in the classroom look like? This section offers some useful strategies and common practices to get started, and go deeper, with games in the classroom.

1. **Prep first.** Like any instructional tool, a teacher must have a good understanding of the tool to be able to use that tool effectively. So, taking some time to thoroughly explore the tool and prepare the lesson is valuable. This is particularly true of games that may not be so straightforward at first glance. That being said, it is important to have an understanding of the scope and dynamics of the game, although it is only critical to be an expert in the content, not the game itself. According to Sandford & Williamson, “It is clear that teachers need a detailed and thorough understanding of the game, both in to identify learning opportunities and to develop students’ understanding of the game sufficiently for them to be able to learn by using it; the time teachers have to become familiar with the game therefore provides one important criteria to consider in selecting games for use in schools” (2005, p.11).
2. **Allow for extra time the first class period where the game is used.** For larger games, prep time can be significant, but the payoff can also be great. When getting started with a new game, build in extra time—more than you would for a traditional lesson or lecture—to enable the students, and you, to get familiar with this methodology in the classroom.
3. **Getting started: Quick trial versus full immersion.** Depending on the game and how familiar your students are with game-based learning, you may choose to start the game-based experience gradually using the “toe in the water model,” where you first introduce the game in a short, 15-30 min session. This gives the students a no-pressure opportunity to explore the game, and for the teacher to gauge student interest and engagement with the game before embarking on the full lesson or unit. However, for games that require deeper immersion in the storyline and gameplay, blocks of several classes provide the opportunity for an immersive approach (SIIA, 2009). In such cases, you should design a set of lessons and activities that help students learn how to play the game. For example, a game like *Civilization IV* would benefit from several initial periods of game play to become familiar with the game. This may seem like a large commitment of classroom time, but typically there are a significant number of targeted learning goals for long-form games like this—so the benefits gained are worth the time commitment.
4. **Determine student grouping.** Depending on the game, it may make most sense to have students work individually or in groups of two to four. Some teachers report that they prefer grouping students for a variety of reasons, including that some games already enable collaborative decision-making and grouping can reduce barriers to learning by teaming proficient gamers with non-gamers (SIIA, 2009). Groups may be formed by mixing or aligning abilities; however, it is generally encouraged to mix gamers with non-gamers.

5. **Conclude by reflecting and debriefing to elucidate core concepts.** Returning groups or teams to whole-group discussion throughout a long-form game and/or at the conclusion of game play is critical to making connections to the learning goals and the larger world. Debriefing sessions allow students to reflect on the content of the game, and to share the knowledge that they have acquired. They also help them make links between the game and the learning outcomes (Sandford, Ulicsak, Facer, & Rudd, 2007; SIIA, 2009).

Putting these elements together in effective ways is not that different from traditional classroom instruction and management. Since many games are rich, immersive experiences, their implementation becomes an “instructional arc” that you are co-constructing with your students.

Figure 3 demonstrates what some of these arrangements may look like in your classroom. The teacher might start first with an introductory activity that discusses the concept at hand, then students engage in game play (individually or in partners/groups), followed by whole group debriefing and synthesis (strategy A). Or, the teacher might introduce the concept, have students observe him or complete a task or move around the game world, then students engage in game play in teams while taking turns engaging in other learning tasks targeted at the concept (strategy C).

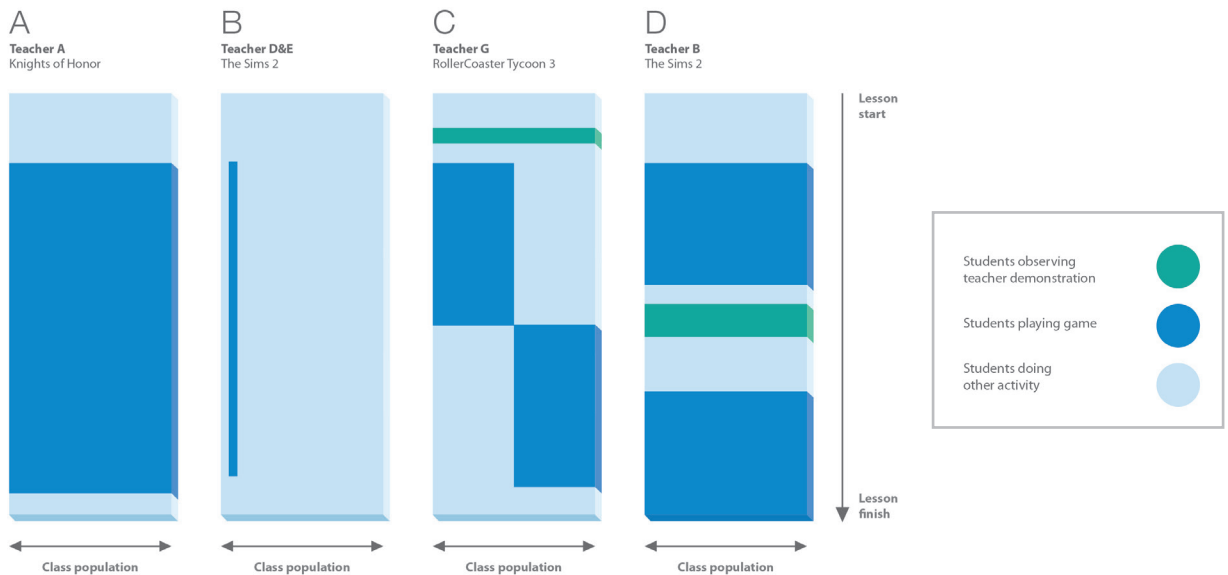


Figure 3.

These are just a handful of possible configurations and strategies. The manner in which a game is implemented in the classroom will in large part depend upon the type of game, but more importantly, how the educator decides to use the game. Figure 4 discusses a taxonomy of game implementation strategies. For example, games might be use as an “Authoring System”, where the game is used as a tool to produce an artifact that demonstrates learning and/or understanding. Such an artifact could be building in *Minecraft*, an animation in *Scratch*, or a game in *Little Big Planet*. Or, a game could be used as a “Manipulating System” where the game essentially serves as a simulation that can be manipulated by the learner, as a way to explore a concept or even demonstrate understanding of that concept. Figure 4 offers an explanation and examples of a number of game implementation strategies.

Type		Description
AUTHORING SYSTEMS	Games as "engines" or authoring platforms.	In this scenario, students produce an artifact through game play—be it a game (Spore), a mod (Starcraft), a video (machinima in WoW, the Sims, Second Life, etc.), a visual text (Sims Family Album), an avatar (Mlis), or a body of code (Alice, Scratch). Rubrics for evaluation of these artifacts come not from the game, but from the design domain to which the artifact is related, as well as from the kinds of understandings the artifact was produced to express.
CONTENT SYSTEMS	Games as content.	In this scenario, commercial off-the-shelf (COTS) or other games are used to deliver understanding about a particular subject or content area. For example, students play SimCity to learn about urban planning, or Civilization to learn about history. When games are used this way students must be provided with opportunities for reflection on and discussion of the content in spaces external to the game in order to allow students to see the game as part of a larger body of knowledge on that subject.
MANIPULATING SYSTEMS	Games as simulations.	In this scenario games are valued as dynamic systems with which students can test theories about how systems work, as well as how certain principles of dynamic systems can be observed and played out. For example, students may play Bridge Builder to learn about bridges as systems of engineering, or use Soda Play as a way to test out physics-based theories. Animal Crossing could be played in order to have students work with elements of a capitalist economy and theatre games can be played to have students reenact situations or scenarios as a way to see how the system can be affected by manipulating certain factors. Simulations often include their own internal assessment measures (data) that can be used to assess student understanding of both micro and macro elements.
TRIGGER SYSTEMS	Games as context.	In this scenario games are used to create an experiential context for understanding around a topic, issue, or principle that a teacher can build on. For example, a math teacher might have students play Dungeons and Dragons as a way to have them explore probability, or Pictionary as a way to introduce ideas about forms of communication. When games are used this way students must be provided with opportunities for reflection on and discussion of the content in spaces external to the game in order to allow them to see the game as part of a larger body of knowledge on that subject. Depending on the amount of time available, commercial, casual, and non-digital games can be used. This approach can be paired with the use of games as engines—students can be asked to design a game as a way to immerse themselves in research around a topic. Later learning experiences can then build on what was learned in order to build a game.
GATEWAY SYSTEMS	Games as technology gateways.	In this scenario games are used as a way to give students experience with technology, whether this is learning how to use a particular piece of software or platform (i.e. learning how to use a PC or browser) or kind of technology (mobile phones, wireless devices, writing, programming). Assessment models would be based on the effectiveness of a student with a system and their ability to use the system to do what they want it to.
REFLECTIVE SYSTEMS	Games as illustration.	In this scenario games are used as contexts for student reflection. For example, a teacher might ask students to play a game and then discuss the choices they made: why did they choose that avatar skin over another one? Why did they choose to attack that country and not another one? What made them uncomfortable and what were they surprised at having chosen to do? Commercial, off-the-shelf, web-based downloadable games can be used, as well as board games.
POV SYSTEMS	Games as exemplars of point of view.	In this scenario games allow students to take on certain identities and associated points of view. Students might play an RPG where they have to choose to play both a "good" and "bad" character and compare differences in strategy, choice, and values held by those characters. A teacher might ask students to use a theatre game to reenact a familiar scenario, but told from several points of view, with the goal of each character being to shift the outcome of the scenario on their favor.
CODE SYSTEMS	Games as code worlds.	In this scenario students use writing as the primary mechanic of game play, whether they are playing text adventures or designing or playing text-based mobile games. The emphasis here is in the use of writing as both a mode of action and expression. Because writing itself is produced as an artifact of the game play, this writing can be assessed to capture student understanding. There is an opportunity to connect this approach to games with the introduction of a programming curriculum that might use authoring platforms like Scratch or Alice, or virtual worlds that support object creation like Second Life.
DOCUMENTARY SYSTEMS	Games as documentary.	In this scenario the play of a game is used as documentary evidence of student ideas/understanding. For example, students may be asked to play the Sims in such a way as to recreate certain social scenarios that they are interested in. Machinima or storyboarding with screenshots can be used to capture the details of the situation, which then can be used as the basis for additional discussion or reflection. Commercial, off-the-shelf, web-based downloadable games can be used.
IDEOLOGICAL SYSTEMS	Games as text.	In this scenario games are "read" as texts that express certain underlying ideologies, values, beliefs, etc. In the same way that Uncle Tom's Cabin can be read as an expression of the antebellum South, Animal Crossing can be played and analyzed as an expression of late 20th century capitalism, Chess can be played and analyzed as a game about territorial conflict, or Diplomacy as a model of the intricacies of international diplomacy. When games are used this way students must be provided with opportunities for reflection on and discussion in spaces external to the game and ideally in relation to other media. Commercial, off-the-shelf, web-based downloadable games can be used, as well as board games and other kinds of non-digital games.
RESEARCH SYSTEMS	Games as research.	In this scenario students design games as a research activity, which produce material to be used in later learning experiences. Because a designer must be knowledgeable about the system he or she is designing, using game design in this way requires students to think through how their players are learning and what they need to know about the subject of the game. In this way, students not only research material to be used but also edit this material and are introduced to issues around credibility and point of view. Different kinds of research methods can be introduced as part of the work, as well.
ASSESSMENT SYSTEMS	Games as assessment.	In this scenario games can be used as environments for assessing student learning of curricular content or state standards. For example, students might play Quest Atlantis to show their understanding of certain science concepts or they might play a MiLK game that centers on answering questions around certain academic content. All of these uses of games integrate a 21st century skill critical to the design and play of games: systems thinking. While playing video games, young people perform complex tasks within rich and highly immersive multimedia-driven, interactive environments. Sample tasks include: running political campaigns (Political Machine) or football franchises (NCAA Football '08), building environmentally sensitive communities (SimCity), navigating virtual worlds they create (Second Life), managing complex social relationships (The Sims 2), or trying to find a diplomatic solution to the Israeli-Palestinian conflict (Peace-Maker). Don Menn (1993) claims that students can only remember 10 percent of what they read; 20 percent of what they hear; 30 percent, if they see visuals related to what they are hearing; 50 percent, if they watch someone model something while explaining it; but almost 90 percent, if they engage in the job themselves, even if only as a simulation.

Figure 4.

Case Study Two: Personal Classroom Study, Egypt Gaming Unit

The BBC has many educational games in the area of history. Two ancient Egyptian games are *Mummy Maker* and *Pyramid Builder*, which have been used by one teacher at Parkside Junior High School in Normal, Illinois. Ancient civilizations are taught in sixth grade and ancient Egypt is one of the major units. Parkside Junior High School has one-to-one Windows 7 laptops for all three grades of sixth, seventh, and eighth. These laptops are not the most powerful and are not capable of running the high-end graphics games of today. When looking for games and simulations to use within the classroom, web-based games are the easiest to implement and the BBC interactive historical games fit very nicely within the content taught at this grade level.

One of the main learning outcomes for the Egypt unit is to understand that religious beliefs were a driving force in ancient civilizations. The *Mummy Maker* and *Pyramid Builder* are great tools to demonstrate these beliefs. These games also focus on key learning standards for geography, invention, civics, job specialization, culture, science, and math. Connections are easily made to other core subject areas and examples from these two games are used throughout the year to reinforce new content.

Modifications are made to these lessons because the makeup of the classroom changes yearly. The academic level ranges from gifted students to students with severe learning disabilities.

In *Mummy Maker* students simulate the embalming process through decisions made within the game. The game is played by clicking through pages. Each page has content to read and decisions to make. Up to three clues can be given throughout the game to assist the player. Students are instructed to go to the website, read the instructions, make choices, and complete the mummification process correctly. Decisions concerning embalming, appearance, jewelry, and decorating are made throughout the game. If unsuccessful the game gives hints to incorrect choices. If the students are successful there will be a message displayed on a white background screen. This simple game can become difficult if hurried. If the students read carefully and think through each decision, it shouldn't take more than two attempts to finish the game correctly. It is rare that this game is completed on the first attempt. Once finished, they are given a blank paper to write down each step, in order, that was taken to successfully make a mummy. Completing the mummy correctly is difficult, but writing down the steps to make a mummy shows deeper understanding. Students need to play the game again and write down these steps on their paper. Writing down the steps becomes an arduous task because many turn in all information they can copy onto their paper, which includes extraneous details. One example to help guide the students is to ask for the recipe for making a mummy. This example cuts down on the extra information and usually leads to success. Eventually through guidance and collaboration, the students complete game and the written steps. The final lesson is a class discussion on what can be learned from Egyptian mummification.

Once they have completed the lessons for the *Mummy Maker*, the students will be assigned the second BBC game, *Pyramid Builder*. The students follow a similar procedure from before with *Mummy Maker*.

Students are instructed to go to the website, read the instructions, make choices, and complete the pyramid. In *Pyramid Builder* you are assigned to build the pyramid for the current pharaoh before he dies. Decisions concerning location, materials, alignment, angle, workforce, food, and worker incentives are made throughout the game. The *Pyramid Builder* is more difficult than the *Mummy Maker* because there are more decisions to make and those decisions require more reading and problem solving. The game also adds some random events that can make correct decisions look incorrect. The frustration level grows after each attempt, but failure leads to greater understanding. As with *Mummy Maker*, each student is given a blank paper to list the steps, in order, of how to build a pyramid. Fewer errors are made in writing down the steps of how to build a pyramid and this because of what they learned from the *Mummy Maker* lessons. The final lesson is a class discussion on what can be learned from Egyptian pyramid building.

These lessons seem very simple to use, but are very difficult for the teacher and the students. Constant assistance and guidance is given based on each student. More guidance is given to students that need extra help and less guidance to those who need a challenge. Open-ended questions and tasks can be assigned or offered to those who want a challenge:

- Where would you build a pyramid in Egypt?
- Where would you build a pyramid in the United States?

These questions are very complex when you consider all the resources and planning involved in building a pyramid, but the *Pyramid Builder* game can be used as a template. The frustration and emotional experience of playing these games helps store the content learned. Former students have been asked, at least six years after playing these two games, to describe what they learned from *Mummy Maker* and *Pyramid Builder*. Most can list all the major steps for completing each game and why they were created.

Both of these short-form social studies games help students follow directions, problem solve, experiment, explore, make decisions, learn from failure, collaborate with other students, collaborate as a class, and report on data learned. These are key components to learning in the social studies classroom.

Assessment Considerations

Games can be powerful mechanisms for capturing rich data on student learning (Phillips & Popović, 2012); however, we are just at the beginning of designing more robust models of assessment-based games and how they might play out in actual educational practice. In the meantime, games are just another instructional intervention, and all learning interventions require assessment tools and supports to be effectively used in the classroom. Many teachers cite that being unsure of what the students learned from the gameplay experience is one of the biggest hindrances to using games in their classroom. On the other hand, some argue that completion of the game signifies successful learning in its own right. For example, researcher James Gee (2009) explains that, “If you are testing outside the game, you had

better have a good reason for doing it... the very act of completing a game should serve as an assessment of whatever the intervention was designed to teach or measure” (Gee, 2009). Yet this can only hold when a game has been purposefully designed for certain learning objectives. Therefore, just as in the case of other learning tools, teachers must work with the game tool and facilitate specific mechanisms to capture the learning and assessment data they desire. In this section we will explicate some of those mechanisms.

Data Collection In and Out of Games

Some games do already include mechanisms that capture data and information that can be used as a type of assessment or formative feedback about student understanding. Generally, these are thought of as internal assessments to the game, as they do not disrupt game play. However, if, how, and to what extent learning data is captured by a game varies wildly among available games and is one of the elements that should be explored when a teacher is first considering a game as a possible learning tool.

If the game does not capture learning data and/or the data reported is not of the type or quality sought by the educator, then external assessments can be used. These are assessment tools that exist outside the game itself (Eseryel, Ifenthaler & Ge, 2011). In classroom practice, games are often one piece of a wider set of group activities that form the curriculum, whereas strategies and tools for exploring student understanding of the concept being targeted are already at play. These might include observations, discussions, quizzes, and group problem tasks, among others. Group reflection is also a key structure of game-based learning that can facilitate higher order cognition and aid in the transfer between virtual and lived experiences (de Freitas & Neumann, 2009). Tasks given to students that are external to the game can be used to explore “near transfer” when the problems emulate the rules and relationships inherent in the game, as well as “far transfer” when the problem reflects real-life contexts with multiple solutions (Gosper & McNeill, 2012).

In a survey of educators using game-based learning in their classrooms, Sandford et al. (2007) provide glimpses of what it looks like in practice from the teacher’s perspective, to use strategies for collecting information on understanding outside of game play. Sandford et al. (2007) explain that, “You need to guide the students to think. I think they can guide themselves through the game, but they need guiding through the learning, unpicking the game, to learn that little bit more....I was assessing their teamwork and ability to listen and respond to others, I think. So I’ve done an assessment on them based just on observations I’ve done” (2007, p. 11).

It is worth noting that in general, it is considered poor practice to interrupt gameplay with external assessments. The game is an immersive experience, and the flow and journey through the game is a key part of what makes the game such a powerful tool. If that is disrupted frequently it can be difficult for learners to stay engaged, interested, or even able to adequately apply their learning to challenge at hand.

In summary, Sandford et al. (2006; 2007) offer strategies for supporting learning and assessment in game play that include:

1. **Check for understanding:** Ensure that learners have understood the general goals of the game.
2. **Define assessment strategy:** Determine when and how you are going to assess whether you have achieved your lesson objectives. Consider various methods, including observation, essays where learners reflect on their experience, out-of-game problem tasks both very similar to game tasks and those that are more authentic to real-world, and so on.
3. **Review and reflect:** Check that learners understand the underlying ideas or topics introduced by the game so that a link can be established between the game and the topic taught—both individually as well as through group reflection. Some questions to facilitate group reflection include:
 - a. **What is the main topic of the game?**
 - b. **Do the events that take place in the game remind you of something you know,** or something you have heard of from your friends, family or on TV?
 - c. **Why do you think this topic is important?**
 - d. **What did you learn from this game?**

A Note about Learning Environments

Although some games can be implemented fairly easily in any given classroom, some of the long-form games and those with more technical and support demands are much more likely to be successful when the classroom is situated in a larger learning environment where the school leadership is very supportive and external resources and supports are available (Groff & Mouza, 2008). This includes easy access to various technical as well as human resources such as technology integrators and IT staff to help with implementation issues. It also includes school leadership who are supportive of game-based learning and exploring various models of instruction. Teachers and learning environments have greater success with game-based learning approaches when the administrator has strong coaching and team building skills, and support their educators in taking risks and exploring new approaches (SIIA, 2009).

Future Needs

Game-based learning, with all of its potential and challenges, is at an exciting point—there are ever-increasing examples and discussions on the educational effectiveness of games in formal and informal settings. As the field continues to grow, it is imperative to address the needs and barriers of educators and students. To align with classroom requirements, more games must be available that target learning standards and direct curricular needs. They must provide formative data about student performance in-game to better support general instruction. Evidence of effectiveness and outcomes will be increasingly important as the market becomes more saturated and a larger range of options are available when selecting the right game for your learning needs. While we have seen a surge in support for educators seeking to use games, the barriers to entry can still be significant. We must continue to create better resources so more educators can afford to incorporate games into their curricula.

Case Study Three: *Civilization IV* to Teach Historical Thinking and Perspective-Taking

Civilization IV is a long-form game in which players settle and guide their civilization through 6000 years of simulated world history. Unlike learning games for history found on the web, the game is sophisticated and complicated. Cincinnati Country Day School has a one-to-one laptop program and has been experimenting with the use of *Civilization IV* in the ninth grade classroom for seven years. A number of missteps and successes have helped hone a strategy for classroom use of the game.

The most recent iteration involved a three-part strategy. The first part included setting up technology and familiarizing students with the game. The educator ensured that all computers had the game installed and ready to run. The students were then taught how to play. Because of *Civilization's* complexity, the educator provided an overview of the game by running and projecting an instance while explaining key features. Once students had a vague understanding of the game, they began to play themselves. Having some initial goals for the students helps them learn (McCall, 2011). In the case of *Civilization*, each student was first tasked with settling at least 2 cities, improving at least one land tile with a worker, and researching iron working. These goals were important only insofar as a student had to have a basic understanding of the game to achieve them.

Once students acquired a basic familiarity with the game, it was time for them to start observing and recording actively. Students were put into pairs, with one person in charge of note-taking while the other controlled the game. Halfway through the play session, the students in each pair switched roles. The reasoning is that pairing the students and explicitly requiring note taking encourages students to collaborate and actively observe as they play. Active observation notes are critical for analyzing game models in the long term (McCall, 2011). Students were tasked with keeping track of the following elements:

1. The names and geographic settings of the cities
2. The units and buildings each city builds in order, with
 - a. Year building started
 - b. Year building finished
 - c. Why the pair chose that unit/city improvement
3. Interactions with other civilizations, including their demands, what the pair did, and the results
4. What happened to any units exploring, including fights with animals/humans and the results, discovery of new things, villages found
5. The order of the research chosen, such as the technology the pair selected
 - a. Year research started
 - b. Year research finished
 - c. Why the pair chose that research path
6. Any other good or bad events (running out of money; city revolts, etc.)

They were also instructed to save the game when they reached certain years in gameplay (e.g. 3500 BCE; 2500 BCE; 2000 BCE; 1500 BCE). Combined, the notes and the saved games provided a set of data that students could draw upon in the future. Though the particulars of the notes can vary, the emphasis on observation and notation has remained a core step for using historical simulation games (McCall, 2011).

Once students learned to play the game and had a partner for play and observation, the class resumed their study of the ancient world, but received assignments every so often to continue their partnered game. This is a useful trick with a complicated game such as *Civilization*: introduce students to the game, and refer back to it regularly as suitable opportunities arise. Most of these opportunities involved comparing the game models to historical evidence while learning vocabulary along the way. During the class, students engaged in: (1) defining all of the civic elements in the game, (2) choosing what each thinks is the best civic concept in a category, and (3) discussing whether the effects of the civic concept in-game are analogous to the effects of that civic concept in historical societies.

Charting the growth of one of their cities over time and establishing the correlation between availability of resources and city growth is a key aspect of game play and includes a number of activities:

1. Examining the characteristics of a leader in the game and comparing to the leader's real-world characteristics.
2. Assigning characteristics from the game to a historical figure.
3. Using the world editor to reconstruct the rough geography of a place and discussing the impact of the geography on the civilization.

By the end of the year, students achieved the broad objectives for the game. They practiced collaboration and observation, studied a historical simulation in detail, and taken a number of opportunities to consider how the models in that simulation could clarify our thoughts about historical systems.

Best Practices

No matter what type of game an educator can use, there are several basic strategies that will help you get started and better enable success with the game. This section offers a summary of teacher implementation strategies. These strategies include:

1. **Define your learning goals and instructional needs.** Games are no different than other instructional tools. Finding (and using!) the right instructional tool starts with being very clear in your content and instructional needs. With that in mind, identifying the right game will be much easier.
2. **Find one or more games that meet your needs.** With all of the games available, just finding the right one can be difficult. Thankfully that is getting much easier with the recent

appearance of numerous game portals (see “Resources” at the end of the chapter). On sites like these, you can search and sort games based on topics, learning goals, standards, platform, and many other variables.

3. **Select the right game for you.** Once you have found one or two games that interest you, explore each and make sure they are a good fit for your needs and your students. The following questions will help you narrow down the potential games.
 - a. **Is the game you are considering suitable in terms of the technical difficulty and age of your students?** Is the content appropriate for them and will it motivate them?
 - b. What elements of the game support your educational goals?
 - c. Does the game match your learning goals entirely? If not, can you extract elements relevant to your learning goals and use these productively in isolation from the game as a whole?
 - d. **Can you use the game easily in your classroom?** Think about barriers like cost and technical platform. (A quick worksheet, found at XXX, was developed by the Learning Games Network and can help you determine if a game coincides with your needs).
4. **Allow sufficient time for you and your students to become familiar with the game.** Once you have picked a game, make sure you play it! Play through the game a few times playing so that you become familiar enough with it to help your students. Let your students explore the game on their own before offering help. This is especially important for larger, long-form games that are often more complex and have more elements and game mechanics with which to become familiar.
5. **Identify the precise role of the game toward meeting your learning goals.** When planning how to use the game as a learning experience for your classroom, thoroughly understand the game’s role as a tool and how you will use it as a learning context. Some high-quality educational games can be implemented easily and are already a packaged curriculum. Most games, however, need teacher support, which can be a significant burden. It is important to consider your options:
 - a. *Use the parts of the game that work for you:* You do not have to use the entire game. Identify the parts that fit your needs and build the lesson around it.
 - b. *Use the game as preparation for future learning:* New learning has to be hooked onto prior knowledge or a conceptual frame, and games can serve as an excellent ‘shared experience’ that can later be referenced and leveraged during formal instruction.
 - c. *Use the game as pre-assessments:* Games are a great way to help students demonstrate prior conceptions, background knowledge, and vocabulary. They can even be revisited later as an opportunity for practice
 - d. *Allow the game to be played outside of school:* Like the “flipped classroom” model, web-based games that can be accessed students can often be played on students’ own time, with game elements and concepts addressed in

class. Although this approach prevents educators from performing informal observations of student play, students can play for hours at home and do not have to worry about classroom limitations. See the Game Review Tool at <http://playfullearning.com/wp-content/uploads/2015/08/Game-Review-Tool.pdf>

6. **Let the students demonstrate their expertise.** When it comes to actually using the game in your classroom, let students shine on the tasks they excel, such as using technology and helping others use it. Let them provide technological answers and troubleshoot game setup. They will appreciate you deferring to them about something that many students know so much about; be sure to provide support for those students who are less confident, which may include support from peer students.
7. **Build in time for review and reflection.** Much of game-based learning research has demonstrated that the reflection and review activity is what produces the largest impact in learning gains (Sandford, et al, 2006). Be sure to structure and allow group time for review and reflection on play, particularly as it relates to the learning goals.

Resources

Books, Whitepapers, and Articles

Klopfer, E., Osterweil, S., Groff, J., & Haas, J. (2009). *Using the Technology of Today, in the Classroom Today: The Instructional Power of Digital Games, Social Networking, and Simulations and How Teachers Can Leverage Them*. An MIT Education Arcade whitepaper. Available at http://education.mit.edu/wp-content/uploads/2015/01/GamesSimsSocNets_EdArcade.pdf

Abstract: Digital games, social networking and simulations have been leveraged by nearly every industry for deeper engagement and outcomes. This paper explores examples of the types of technologies available in these three areas, and case study examples of how teachers have used them.

Sandford, R., Ulicsak, M., Facer, K., & Rudd, T. (2007). *Teaching with Games: Guidance for Educators*. Futurelab Education. Available at http://linked.eun.org/c/document_library/get_file?p_l_id=17303&folderId=16936&name=DLFE-306.pdf

Abstract: A brief report on best practices and examples of using games for instruction in the classroom.

Sandford, R., Ulicsak, M., Facer, K., & Rudd, T. (2006). *Teaching with Games: Using Commercial Off-the-Shelf Computer Games in Formal Education*". Futurelab Education. Available at http://www2.futurelab.org.uk/resources/documents/project_reports/teaching_with_games/TWG_report.pdf

Abstract: The Teaching with Games project was a one-year study designed to offer a broad overview of teachers' and students' use of and attitudes towards commercial off-the-shelf (COTS) computer games in schools. It aimed to identify the factors that would impact the use of these entertainment games in school and describe the processes by which teachers plan and implement games-based learning in existing curricular contexts. Finally, it aimed to provide recommendations for future games-based learning approaches in schools for teachers, developers and policy makers

Websites

Playful Learning (www.playfullearning.com)
Education Arcade (www.educationarcade.org), "Using the Technology of Today in the Classroom Today"
BrainPOP's GameUP (www.brainpop.com/games)
BBC Mummy Maker (http://www.bbc.co.uk/history/ancient/egyptians/launch_gms_mummy_maker.shtml)
BBC Pyramid Builder (http://www.bbc.co.uk/history/ancient/egyptians/launch_gms_pyramid_builder.shtml)
Civilization (www.civilization.com)

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