1. Beyond Coding

Youth Creativity, Literacies, and Social Engagement in a Computer Programming Club

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Abstract: As momentum builds around computer programming clubs and broader movements promoting "computer science (CS) for all," less work has explored the many other ways that young people are developing and demonstrating creative, multimodal literacy practices as well as social engagement in these CS-focused spaces. The purpose of this paper is to share insights into these issues, based on a study of 1 such "code club" situated in a public library in the Southwestern United States. Specifically, this paper presents an analysis of data collected over the course of a 10-week summer session of the code club (June 2017–August 2017). A total of 47 students aged 8–14 participated, which met twice a week with a library facilitator. As part of the study, I collected observational, artefactual, and audio-recorded data from each session and engaged in first- and second-cycle qualitative coding (Saldana, 2015) to identify the ways in which students drew on multimodal literacy practices as they navigated, interpreted, interrogated, and designed their learning experiences across virtual and face-to-face contexts (Serafini, 2012). Findings from this study suggest that a wide variety of creative practices can be observed while students engage with digital content, procedural literacies, and social contexts "beyond the screen." This paper contributes to the work of connected learning by providing additional evidence into the diverse and multidimensional learning practices that can occur within code clubs and similar environments, as well as the ways that teachers, parents, librarians, and other adults can support students engaging in these practices.

Introduction

As we can see in both the popular press and academic discourse, momentum has been building around computer programming clubs and broader movements promoting "computer science (CS) for all." (Balli, 2017; Fields, Giang, & Kafai, 2013). However, fewer efforts have explored the many other ways that young people are developing and demonstrating creative, multimodal literacy practices, as well as social engagement in these CS-focused, informal learning spaces. These "code clubs" are particularly interesting spaces in which to examine issues of connected learning, as debates about the value of computer programming as a career-unlocking skill are beginning to complicate discourses surrounding the CS4All movement (Futterman, 2015). Beyond these debates, however, questions about what actually occurs within the "buzzing, blooming confusion" of these informal learning experiences can provide important insights into the value of youth engagement in these spaces beyond learning how to program (Barab & Squire, 2016, p. 4). This paper takes up this challenge by offering an analysis of one such code club, highlighting the diverse, creative, and expressive literacies and social engagement practices demonstrated by participating students over the course of just a short span of time.

Specifically, the paper reports on a study examining the literacy practices demonstrated by students participating in a library code club. Broadening the analytical focus beyond computer programming, the study sought to address the following areas:

- The ways that participants' literacy practices appeared to engage aspects of multimodal digital media *content*;
- The ways that participants' literacy practices appeared to engage aspects of *procedurality*, including the

computational logics underlying various programming languages and tools; and
- The ways that participants' literacy practices appeared to engage broader issues of social *contexts* of the production, dissemination, and use of this digital media by wider audiences.

By framing the focus on the study in the context of literacies, this paper aims to contribute to an understanding of the diversity and complexity of youth engagement, learning, and socializing even in spaces that appear to have a more singular curricular focus.

Perspectives and Framing

The analysis shared in this paper is grounded in a perspective of literacy as a situated, sociocultural, and multimodal phenomenon (Rowsell, Kress, Pahl, & Street, 2013). Literacy is *situated* in that it involves cognitive capacities (e.g., decoding and processing written letters), social practices (e.g., reading in a classroom, as opposed to in the home), and material technologies (e.g., reading a physical or electronic book), but always within a specific context or situation: What counts as "being literate" has been demonstrated to vary across cultures, communities, and institutions (Mahiri, 2004). Literacy is *sociocultural* in that beyond the immediate situation (e.g., a child reading a book in a third-grade classroom), it is shaped by broader social, historical, cultural, economic, and ideological contexts (Street, 2006). Finally, literacy is *multimodal* in that beyond its linguistic dimension, it involves artifacts that use a variety of modes of communication—image, sound, gesture, and more—to represent and exchange social meanings (Serafini, 2012). Following this logic, the remainder of this paper will reframe the singular "literacy" in the plural, as *literacies*, in order to recognize the multiple ways of being and becoming literate that different people bring to different situations (The New London Group, 1996). In addition, this view allows us to expand the idea of *texts* as encompassing more than just words written on a page to more closely approximate a social-semiotic definition of a text as a material instantiation of these social exchanges of meaning.

Building on these foundations, this paper conceptualizes digital-age literacies across three overlapping and interconnected dimensions (Aguilera, Stewart, Mawasi, & Cortés, 2019). At the content dimension, we can highlight aspects of the multimodal content rendered "on the screens" that have become a ubiquitous part of our daily lives (Serafini, 2012). Within the procedural dimension, we can consider the technological rules operating "behind the screen" that constrain these digital literacy experiences, as well as the potential affordances that digital tools may lend to literacy learners (Golden, 2017; Murray, 1997). Finally, we can look "beyond the screen" at the contextual dimension of digital media technologies—particularly at the sites of production, dissemination, and use of these technologies for exchanging meaning (Rose, 2012). Such a multidimensional framing of these literacies is important for expanding our analytical perspectives on what "counts" as literacy in a digital age.

Method

The methodology and analytical approach in this study are guided by paradigms of naturalistic and interpretive inquiry, which emphasize the study of social phenomena, such as teaching and learning, through methods that attempt to preserve, rather than manipulate, contexts of study as they occur in "real-world" settings (Barab & Squire, 2016). Further, interpretive paradigms of inquiry seek to understand the perspectives of participants as they interact in their local

contexts; rather than attempting to present an "objective" analysis of findings, such studies are informed and shaped by the subjective experiences and socially constructed realities identified by participants (Erickson, 1986).

Context and Participants

This paper focuses on an analysis of data collected over the course of a 10-week summer session of the Code Club (June 2017–August 2017). A total of 47 students aged 8–14 participated in the summer Code Club, which met for two separate sessions (one group from 3 to 3:45 p.m., and one from 4:15 to 5 p.m.) on Thursday afternoons, along with a library facilitator. About 12 of the Code Club's participants identified as female (26%), with the remaining 35 students identifying as male (74%). Surveys administered during the Code Club sessions suggested that participants came from a wide range of schooling backgrounds, including local public school districts, charter schools, private schools, and homeschooled experiences. Surveys also indicated that participants had a wide variety of background experiences and interests outside of the Code Club. The study was conducted in an urban public library setting in a metropolitan area of the Southwestern United States. As the sole public library in its city, it serves 737,233 visitors each year. The library occupies a total of more than 100,000 square feet, and it includes one of the largest youth libraries in the United States. The observational data for this study were collected within this youth library, a space that included a youth computing area with 15 operating desktop computers. A donation to the library's program also provided 10 additional laptop computers, which the students used to varying degrees.

Data Sources and Collection Procedures

As part of a larger, yearlong study of the Code Club, I collected observational, survey, and audio-recorded data over the course of a 10-week summer session (June 1, 2017–August 4, 2017), as described below:

Observational data. The main source of observational data used in this study were postsession field notes that I composed after both Code Club sessions had ended, shortly after the closing of the library at 5 p.m., via audio-recording and subsequent transcription. These field notes contained a detailed narrative of my observations as a researcher/facilitator in the space.

Survey data. To better inform my understanding of students' backgrounds and individual experiences, I designed a brief survey for students that I administered during the early part of the summer sessions. The survey collected basic demographic information such as age and school attended, along with questions about prior Code Club experience, experiences with technology outside of Code Clubs, and engagement in Code Club activities outside of the scheduled time.

Audio-recorded data. To aid in the construction of post-observation field notes, I began collecting audio recordings from June 15, 2017, until the end of the session. While these recordings were not transcribed and coded for the purposes of this project, they helped inform the overall construction and analysis of the postsession field notes.

Qualitative Coding as Analytic Procedure

For the purposes of this study, the main analytical focus was on the post-observation field notes, as constructed by me and informed by in-session observations, survey data, and audio recordings. Following models proposed by Saldana

(2015), I engaged in first- and second-cycle qualitative coding to identify patterns and discrepancies that could inform an understanding of the ways that students engage in multidimensional literacy practices as part of their experience in a computer programming club. I used the NVivo software to upload and store revised copies of the field note transcriptions; apply, categorize, and manage codes; run "queries" for code frequency and cross-code references; and to generate and store analytical research memos throughout my process.

I began my first cycle of coding by generating and applying attribute codes to each set of field notes I analyzed. These codes named various attributes of each document, including time of generation, participants mentioned, and activities observed, and provided an overall "summary" of each field note document to assist me in the management of the broader analytical process.

Drawing on the conceptual framework previously outlined, I then engaged in a process of structural coding, defined as "a content-based or conceptual phrase representing a topic of inquiry to a segment of data to both code and categorize the data corpus" (Saldana, 2015, p. 83). In the case of this study, I generated and applied the codes of {On the Screen}, {Behind the Screen}, and {Beyond the Screen} across broad areas of the field notes to correspond to the content, procedural, and contextual dimensions of the conceptual framework.

Having generated structural codes to create an initial "mapping" of the field note observations and identifying sections to look into further, I moved toward second-cycle coding through *process coding* (Bogdan, 2012), which uses gerunds ("-ing" words) to connote action in the data. I developed and applied these codes to capture a sense of the different literacy practices that I observed and noted through observation. Process codes that I generated and applied to the data were drawn primarily from my own understanding of "traditional" and new media literacy literacies, as well as constructed from reviews of the literature and my own experience (conversations, course work, lectures, etc.).

During a second cycle of coding, I reorganized and reexamined the first-cycle codes I developed through a process referred to as *pattern coding*, so that I could move toward "a coherent metasynthesis of the data corpus" (Saldana, 2015, p. 208). Pattern codes, as Miles and Huberman (1994) describe them, are "explanatory or inferential codes, ones that identify an emergent theme, configuration, or explanation" (p. 69). In the case of this analysis, pattern codes were first generated and applied to the existing procedural codes rather than to the original field notes themselves. These codes were generated based on "families" of literacy practices (Luke & Freebody, 1999) that I identified as I reviewed and revised codes from the first-cycle processes. Thus, the codes {gamemaking}, {game-playing}, {game-modding}, and {watching videos about games} were grouped under the "meta-code" {Gaming}, which I later revised to the pattern code of {Big "G" Gaming Practices} (Gee, 2003).

Findings

In this paper, I have aimed to map a range of literacy practices and resources that students appeared to engage with in the Code Club beyond just growth in the skill of computer programming. Specifically, this study sought to address the following question: *In what ways do students engage in multidimensional literacy practices as part of their experience in a computer programming club*? Based on the qualitative coding process described above, I summarize findings that address this question across the three dimensions of the conceptual framework.

The Content Dimension: Media Creation, Remixing, and Sharing

Approaches to literacy development with new media have historically emphasized "receptive" (sometimes considered passive) competencies such as reading, listening to, or consuming media. However, in line with research across the field of connected learning, evidence from the present underscores the prevelance of "productive" (sometimes considered active) literacy practices, such as creating, remixing, and sharing media content. A field note entry from July 7, 2017, exemplifies such an entanglement of productive and receptive literacy practices. In the transcript that follows, I describe working with Hannah, a female focal participant aged 10 who attends a local charter school, on an original animation she is developing on the Scratch platform:

> Again, expressed being a little stuck in a project / not really sure what to do next / What I was suggesting to her / beyond trying to brainstorm new ideas for her project / was to look into other projects / and see what other people have created / to get some inspiration. / She did jump back into the Scratch gallery after that, //and viewed an animation. / I believe it was about some type of food, / and appeared engaged when I asked her about it / Not too long after that / jumped back into her own project, / again asking for a little bit of guidance with / sequences of actions and events in her animation//. (Post-observation recording, July 7, 2017)

Here, I interpreted Hannah's moving from "stuck" in an ideational phase of a project to "jumping back" as mediated by inspiration gained from exploring the animated work of others who have shared on the Scratch platform. Hannah's work on her animation exemplifies just one of the many ways that students demonstrated creative literacy practices within the Code Club. Other examples included practices I coded as {Digital Sprite Creation}, {Game "Modding"}, {Audio Production}, and {Reading and Writing Code}.

The Procedural Dimension: Big "G" Gaming as Exploratory Practice

Throughout my analytical process, I noted many instances in which students engaged with digital games, though not solely in the practice of playing them. Instead, students throughout the Code Club demonstrated what Gee (2003) referred to as Big "G" Gaming practices—experimenting with play styles, playing with the logics of computation, "hacking" premade tutorials toward personal preferences and goals—largely toward the goal of exploration. As positive as this seems, however, these practices also led to moments of difficulty for some students.

In one session, for example, 11-year-old and experienced Code Clubber Natasha expressed some frustration with a programming challenge as she played through the gamelike *CodeCombat* (2013) web application. Notes from one session described Natasha's interactions with the gamified tutorial:

> They described making sure to get out of the dungeon alive / and also attacking two particular monster characters / What the instructions did not specify was that // the monsters had to be attacked in relatively quick succession. / Otherwise, they would drain the player of his or her hit points / so they had a chance to complete the level. / And that's what Natasha was running into with her code / essentially she had the correct amount of attacks in a row with the first monster. / But for the second monster / there was a movement command that she had placed / between her two attacks, / Such that the second monster she ran into had a chance / to drain her character of all its hit points / before she could continue //. (Field notes, July 6, 2017)

In this case, Natasha's prior reliance on scripted tutorials promoted by Code Club facilitators proved less helpful than actually engaging in the practices of playful experimentation with game mechanics and outcomes. At the same time, by taking a solely play-focused stance, Natasha would miss out on opportunities to understand the programming languages

underlying these game mechanics. Only by engaging in discussions about a wide range of gaming practices would she and I later be able to develop solutions to this programming puzzle.

The Contextual Dimension: Navigating, Negotiating, and Connecting Learning Contexts

Finally, a third grouping of creative literacy practices reflected the ways that students *navigated* relationships with peers and adults, *negotiated* norms, rules, and expectations of the Code Club space, and *connected* with communities, peers, and resources beyond the physical and temporal boundaries of the Code Club.

Included within this dimension were the ways that Riri, a relative newcomer to the Code Club, took cues for how she spent her time, not from facilitators, but primarily from watching her brother, Luke, pursue his own interests (Field notes, July 13, 2017). Miles, a more experienced participant in the Code Club, once spent his entire session reviewing and commenting on the creations of peers in the online Scratch platform (Field notes, July 20, 2017). Finally, Colleen, a visiting international student, demonstrated her own engagement with the social contexts of literacy production by verbalizing doubts about the originality of her remix of a game called *Flappy Bird* (dotGears, 2013), as in her mind, "it wasn't my idea first" (Field notes, June 22, 2017).

In response to the overall question that guided this analysis, I found that students drew on literacy resources and practices in a wide range of ways across the dimensions of content, procedurality, and context. Among these practices were (a) the creation, remixing, and sharing of media, (b) the enactment of Big "G" Gaming practices as a means of exploration, and (c) the navigation, negotiation, and connecting of social learning contexts.

Discussion

Findings from this study suggest that despite the Code Club's stated focus on computer programming, a range of opportunities for creative literacy engagement beyond programming were taken up by participating students. This is, of course, not to diminish the importance of the complex literacy practices students engage in at the procedural dimension of computational media—reading and writing code, experimenting with the logics of computation, and encoding meaning through the manipulation rules and rule systems. Instead, these findings highlight the importance of expanding our lenses of analysis in these spaces to include how students are engaging simultaneously with *content*, *procedurality*, and the social *contexts* that are mutually constituted by sites of online content production, dissemination, and everyday use. This study contributes to the broader literature base underpinning connected learning by providing additional evidence into how youth literacy practices are can be enacted on, behind, and beyond the screen, and subsequently, the ways that teachers, parents, librarians, and other caring adults can support students developing creative literacy practices in a digital age.

References

Aguilera, E., Stewart, O. G., Mawasi, A., & Cortés, L. E. P. (2019). Seeing beyond the screen: A multidimensional framework for understanding digital-age literacies. In P. M. Sullivan, J. L. Lantz, & B. A. Sullivan (Eds.), *Handbook of research on integrating digital technology with literacy pedagogies* (pp. 1–31). Hershey, PA: IGI Global.

Balli, E. (2017, February 9). Library coding clubs prepare kids and teens for growing job market. *Cronkite News.* Retrieved from https://cronkitenews.azpbs.org/2017/02/09/library-coding-clubs-prepare-kids-teens-growing-job-market/

Barab, S. A., & Squire, K. (Eds.) (2016). Design-based research: Clarifying the terms. In S. A. Barab & K. Squire (Eds)., *A special issue of the Journal of the Learning Sciences* (pp. 1–14). New York, NY: Psychology Press.

Bogdan, R. (2012). *Qualitative research for education: An introduction to theories and methods*. New York, NY: Pearson Education.

CodeCombat. (2013). The most engaging way to learn computer science. *CodeCombat*. Retrieved from https://codecombat.com/

dotGears. (2013). *Flappy bird* [Video game]. Hanoi, Vietnam: .GEARS.

Erickson, F. (1986). Qualitative methods in research on teaching. In M. C. Wittrock (Ed.), *Handbook of research on teaching* (pp. 119–161). New York, NY: MacMillan.

Futterman, L. (2015, September 22) Beyond the classroom: A look at both sides of the coding curriculum debate. *Miami Herald*. Retrieved from https://www.miamiherald.com/news/local/community/miami-dade/community-voices/article35749131.html

Fields, D. A., Giang, M., & Kafai, Y. B. (2013). Understanding collaborative practices in the Scratch online community: Patterns of participation among youth designers. In *To see the world and a grain of sand: Learning across levels of space, time, and scale: CSCL 2013 Conference Proceedings* (Vol. 1, pp. 200–207). Madison, Wisconsin.

Gee, J. P. (2003). *What video games have to teach us about learning and literacy.* New York, NY: Palgrave.

Golden, N. A. (2017). Critical digital literacies across scales and beneath the screen. *Educational Media International*, 54(4), 373–387.

Luke, A., & Freebody, P. (1999). A map of possible practices: Further notes on the four resources model. *Practically Primary*, 4(2), 5–8.

Mahiri, J. (2004). *What they don't learn in school: Literacy in the lives of urban youth.* New York, NY: Peter Lang.

Miles, M. B., & Huberman, M. (1994). *Qualitative data analysis: An expanded sourcebook*. Thousand Oaks, CA: Sage.

Murray, J. H. (1997). *Hamlet on the holodeck: The future of narrative in cyberspace*. Cambridge, MA: The MIT Press.

Rose, G. (2012). *Visual methodologies: An introduction to researching with visual materials*. Thousand Oaks, CA: Sage.

Rowsell, J., Kress, G., Pahl, K., & Street, B. (2013). The social practice of multimodal reading: A new literacy studies-multimodal perspective on reading. In D. E. Alvermann, N. J. Unrau, & R. B. Ruddell (Eds.),*Theoretical models and processes of reading* (6th ed.; pp. 1182–1207). Newark, DE: International Reading Association.

Saldana, J. (2015). *The coding manual for qualitative researchers*. London, UK: Sage.

Serafini, F. (2012). Reading multimodal texts in the 21st century. *Research in the Schools: A Nationally Refereed Journal Sponsored by the Mid-South Educational Research Association and the University of Alabama*, 19(1), 26–32.

Street, B. V. (2006). Autonomous and ideological models of literacy: Approaches from New Literacy Studies. *Media Anthropology Network*, *17*, 1–15.

The New London Group. (1996). A pedagogy of multiliteracies: Designing social futures. *Harvard Educational Review*, 66(1), 60–93.