Baker-Doyle, K. J. (2018). I, pseudocoder: Reflections of a literacy teacher-educator on teaching coding as critical literacy. *Contemporary Issues in Technology and Teacher Education, 18*(2), 255-270.

I, Pseudocoder: Reflections of a Literacy Teacher-Educator on Teaching Coding as Critical Literacy

Kira J. Baker-Doyle
Arcadia University School of Education

This article is a commentary essay that uses the connected learning framework (Ito et al., 2013) as a lens to explore the relationship between making, coding, and critical literacy in the context of literacy teacher education. Critical literacy theorists have argued that it is important to understand the perspective and positionality of an author in order to make sense of a text in the context of history, society, and cultural norms (Alvermann, Moon, & Hagood, 1999; Gee, 1999; Jewitt, 2008). Likewise, software, written by coders, is also a form of media that requires interrogation and critical analysis. Increasingly, digital technologies have played a part in individuals' social, political, and economic lives, yet only a small percentage of individuals can read the code that has designed this software (Rushkoff, 2010). Therefore, to foster greater civic literacy and engagement, an important aspect of literacy instruction in the digital era should include a basic understanding of the fundamentals of coding languages. However, few teacher educators have the knowledge of computer programming to integrate coding into literacy education courses and, therefore, this aspect is missing from much of current teacher education.

```
Welcome to the game of ACADEMIA.
You have 7 years (turns) and then you have to battle for tenure.
Here are the rules:
Get points for teaching, research, and service by doing work.
But BE CAREFUL, when you do too much work, you lose mental health points!
Gain mental health points and stay in the game by balancing work with self-care. Let's
get started....
```

Figure 1. *Console output, ACADEMIA game.*[/caption]

I am an associate professor of education. I teach literacy methods courses and study teacher networking. In fall 2017, I decided that I would learn to read and write in a computer programming language. This decision came after 5 years of working with and studying connected technologies.

My first major foray into the world of digital networking occurred when I created a blog in 2013 to publish personal writing and connect with others. Soon thereafter, I began participating in Twitter chats and online education-related forums. After a year or two of this work, I started to recognize how ubiquitous computer code and algorithms are in life and how much they influence the ways in which people work, play, socialize, and vote. I was working blind in a digital world, which frightened me. What I did know about coding was that it is a language.

I imagined, therefore, that a literacy methods educator such as myself might be able to learn to code and have some unique insights about how to teach it. I enrolled in a computer science course and began to learn the basics of Java. My first major assignment was to make a text-adventure game.

Figure 1 is a text box with the opening dialog of the game. The first person to play it was my 12-year-old son. I watched as he read the words that appeared on the console out loud: "Welcome to the game of ACADEMIA..." Before he continued to play, he asked, "What's this game about, anyway, Mom?" I thought about it for a minute. Then I replied, "My life. It's about my life."

In this article, I tell the story of my inquiry into a new language (Java) from the perspective of a literacy teacher educator and how I learned to bridge my understandings of teaching English to teaching a critical literacy of code. Much has been written about teaching coding (Belman & Flanagan, 2010; Hayes & Games, 2008; Kow, Young, & Tekinbas, 2014; Schrier, 2014), and even the literacy of coding (Apperley & Beavis, 2011, 2013; Gee, 2003; Hsu & Wang, 2010; Peppler & Kafai, 2007; Walsh & Apperley, 2009; Zimmerman, 2007). Few first-person narratives of learning to code from the perspective of a teacher educator have been recorded, however.

My contribution to the field, then, is a narrative inquiry (Connelly & Clandinin, 1990) that can speak to teacher educators who are unfamiliar with computer programming and design. In addition, since teaching is primarily a female profession, and there is a historical gender gap in science, technology, engineering, and mathematics (STEM) education (Apple & Jungck, 1990; Beede et al., 2011), a focus on the literacy of coding and design might provide new ideas for teacher educators to design literacy methods courses that can bridge this gap for their preservice teachers.

I use the connected learning framework (Ito et al., 2013) as a lens to consider how the insights I gained through my exploration could apply to literacy methods courses in teacher education. This framework offers a way of thinking about learning that integrates the influence of digital culture and technologies on social interactions.

Several principles of the framework were particularly relevant to my analysis. The connected learning principle of production-oriented learning (often called "making"; Peppler, Maltese, Keune, Chang, & Regalla, 2015; Sheridan, Konoplasky, Williams, & Wingo, 2016), is applicable to both writing and coding, and focuses on the design process, which is especially important in programming. Two other relevant principles are peer support, and openly networked learning. These principles consider the social exchanges and relationship development that occurs through making.

When I enrolled in the coding course, my goal was simply to understand coding as a language from the perspective of a literacy methods teacher. However, the connected learning framework helped me to see how code, literacy, empathy, and civic engagement intersect. As such, I uncovered how instruction in coding not only relates to literacy instruction, but how it can foster critical literacy and civic engagement.

In particular, my journey into the realm of computer programming and connected learning revealed several key themes that are relevant to literacy education. The first theme, framing, is how pseudocode (comments that explain what the program does) can foster metacognition and use of a collective design process. The second theme, peer craft, is about the relationship between remixing (or, "poaching") code (Jenkins, 2012), peer review, and code craft. Finally, the third theme, critical pathmaking, refers to the ways in which coders can intentionally design games and applications (apps) using narrative mechanisms to foster empathy and civic engagement. Teaching these themes can bridge English and coding instruction and serve to facilitate greater critical literacy and civic engagement.

The Connected Learning Framework

In 2013, Mimi Ito and colleagues published a report that laid out a framework for designing production-based, openly networked, and peer-supported learning environments (and experiences): the connected learning framework. The report emerged from a study of youth learning in the digital age. The study described youth's engagement in participatory culture; a culture of sharing, crafting, remixing, and support that was enhanced through media-making and digital connectivity. The framework includes three learning principles (learning is interest powered, peer supported, and academically oriented) and three design principles (experiences are openly networked, have a shared purpose, and are production oriented; Ito et al., 2013).

Research on connected learning has examined programs designed with connected learning in mind and looked at existing programs through the lens of the connected learning framework. Examples of programs that have been designed with connected learning in mind include the Connected Learning MOOC (CLMOOC), an online learning experience for educators launched initially by the National Writing Project (Smith, West-Puckett, Cantrill, & Zamora, 2016), the YouMedia project, a youth media program in Chicago Illinois (Larson et al. 2013), and Connected Camps, which teach Minecraft and gaming to youth (Ames & Burrell, 2017).

Elsewhere are examples of qualitative research on programs for youth and activities of youth that have used the connected learning framework to analyze and describe activities and work, such as Henry Jenkin's study of the Harry Potter alliance (a network of Harry

Potter fans) (Ito et al., 2015; Jenkins & Zimmerman, 2016) and *Teaching in The Connected Learning Classroom*, a whitepaper that describes teachers' practices in terms of connected learning (Garcia et al., 2014). The literature base on connected learning highlights how collective work and participatory culture (Jenkins, 2006a, 2006b) supports engagement and learning.

Participatory culture values the development of a craft or skill set through collaborative work, mentorship, and sharing. It is a producer-oriented culture, which seeks to improve the abilities and knowledge of the members of the community through sharing partially completed and fully completed work for feedback and as models.

Digital tools for media making and sharing can support and enhance participatory culture because they enable members of a community to share their work more easily. Coding culture has long been a participatory culture, because early coders often shared their work with each other and were one of the first communities to be able to share their work through digital networks (Baker-Doyle, 2017; Coleman, 2013).

This connection between the nature of coding and an important element of the connected learning framework (participatory culture) led me to think that the framework could also serve to help me analyze my experiences in learning to code and develop implications for practice. Furthermore, connected learning is oriented toward building greater democratic participation, equity, and opportunity through the development 0f social capital – resources that exist through relationships (Adler & Kwon, 2002). In this way, the connected learning framework's orientation helps me to focus my analysis on *critical* literacy of coding and civic engagement.

The Narrative Inquiry Approach

I use an autobiographical narrative inquiry approach to describe my experiences and analysis in this article. Narrative inquiry is a method that is particularly useful to teachers and teacher educators, because the stories that teachers present relate to phenomena and problems of practice that are of interest to the broader professional community (Connelly & Clandinin, 1990). As a descriptive approach, narrative inquiry requires a balance of rich storytelling and reflection that connects back to other literature in order to analyze themes that arise through the inquiry (Clandinin, Pushor, & Orr, 2007; Mawhinney & Petchauer, 2013). Also, stories are told in an authentic voice and reveal the relationship between the storyteller and their context. Finally, some scholars have argued that, for educators, narrative inquiry should serve to improve the contexts of learning for the students of the authors (Bullough Jr & Pinnegar, 2001).

In this article, then, I share stories that highlight themes of my experiences taking a computer science course and then situate these stories within the context of existing research and literature in connected learning, computer science, and game design. The themes and stories are primarily drawn from my personal journal reflections, which I wrote each week.

In journal entries I reflected on my experience learning the material (challenges, questions, and "aha" moments), interactions with the teacher and students, and ways in which the course connected to my work as a literacy educator. During this process, some new entries would connect back to or build upon earlier reflections. My selection of themes came in part from looking at key topics or reflections that threaded throughout the journal.

I also sought additional information and experiences beyond the course to expand upon what I was learning in the course. For example, when I was assigned to design a game, I explored and played several games that were similar to the game I wanted to design in order to understand the elements and mechanisms that drove the player experience. In addition, my involvement in the connected learning scholar network, CLinTE (Connected Learning in Teacher Education) and the computer science work group of the Philadelphia STEM Ecosystem, exposed me to a range of computer science scholars and educators, which helped me to understand how my work was situated within the larger learning ecology (Salen, 2008) of computer science. Hence, I used the connected learning framework as my primary lens in understanding my experiences and sought additional literature and examples to contextualize my stories.

Themes

This section highlights themes that represent my salient moments and experiences in learning to code. My perspectives were shaped by my existing beliefs and understandings about learning and, in particular, about literacy. My pedagogy of literacy has been influenced by scholarship of new literacies (Alvermann et al., 1999; Cope & Kalantzis, 2009; Gee, 1999; Hull & Schultz, 2002; Jewitt, 2008; The New London Group, 1996; Vasudevan, 2006) and critical literacy (Freire & Macedo, 2005; Gutiérrez, 2008; Kanpol, 1997; Kellner & Share, 2005; Luke, 2012; Morrell, 2012).

Understanding the perspective and positionality of an author is important in order to make sense of a text in the context of history, society, and cultural norms. Further, code itself is a unique textual form. Therefore, during my time learning to code, I was particularly attentive to issues of authorship, positionality, social interaction, and cultural norms.

Pseudocode as Framing Mechanism

"Just so you know," the teacher announced, "Things are going to get way more complex. So, even if things seem easy now, make sure to practice, practice, practice." My instructor made this announcement on the second week of class. I had faith in my ability to memorize certain scripts. I was not worried.

By the fifth week, I had a problem. I knew all of my commands, but things *were* getting too complex – I could not remember why I had added a line of code somewhere, and I could not figure out what command to do next based on the previous command. It was the sixth week that saved me. On this week, the instructor introduced pseudocode.

Pseudocode is text embedded in a program that is not read by the computer, but by the programmer. It tells a programmer what the code is doing and helps programmers to organize their code into steps or parts. In Java programming, using two backslashes (//) at the beginning of the line makes the computer ignore the line, and the programmer can write directions in that space (see Figure 2).

"Aha!" I thought, "an outline!" Finally, I was back in my comfort zone. I could do outlines. Yet, as I worked, I realized that this pseudocode was something more than merely an outline. It was a subtext. Indeed, pseudocode, which makes visible the larger design at play in a program, is an important tool for what Zimmerman (2007) called "gaming literacy," or a systematic understanding and application of game design.

Zimmerman (2007) identified three essential elements of game design: systems-based thinking (understanding process and dynamic relationships), play (innovating within and

on structures), and design (creation of context that encountered by a player). Furthermore, it enables design thinking (Gee, 2003; Hayes & Games, 2008) and the ability to see and plan out large systems at all levels of detail, a powerful skill for any kind of writer.

```
//Step 1: Import packages
import java.util.*
//Step 2: Introduce main program
public class program1 {
public static void main(String[] args); {
//Step 3: Write some code here
//Or you can write anything in the comments line. The computer will never know!
}
}
```

Figure 2. *Example of pseudocode.*

The connected learning framework provides another lens to understand the power of pseudocode in teaching English. Pseudocode is not only a means for organizing the logic of a program, it can also be a framing mechanism to support a crucial aspect of the connected learning framework: collaborative or peer-supported design work.

The use of pseudocode as a framing mechanism in teaching coding supports collaboration and the iterative design process by providing coders the ability to understand others' systems of logic and respond by offering alternatives or building upon them. Previous research on teaching coding has shown that production-oriented, peer-supported learning activities help both to motivate youth and to develop their ability to design complex programs (Pelletier, Burn, & Buckingham, 2010; Peppler & Kafai, 2007).

From the perspective of a literacy teacher, the concept of framing holds great power because it a clear link can be established between writing in English and programming, and it supports collaborative, process-oriented writing. Students who learn to use pseudocode in programming develop a design-thinking habit of mind that can be applied to writing other languages, including English. Also, the concept helps to build a culture of collaboration and work that encourages learners to analyze their thinking, big and small. Finally, it provides a theoretical lens for which to decode others' work, posing questions of intent, structure, mechanisms, and purpose to a text.

Peer Craft

In the real world of coding, style matters. My instructor showed us several different ways to write one type of command. "But," she said, pointing at one, "if you are in a job interview, and someone asks you how to do it, don't do this one, because no one will hire you." Throughout the course, she would show a command that could be done several different ways, but stressed that it would be important to see how "real coders" used it.

I was fascinated at the idea that style was equally important as function in the coding world and wanted to see some examples of this myself. I went in search of real code at GitHubGist.com, a website that allows coders to share bits of code and comment on each other's work.

Looking at this site and similar sites through the lens of connected learning allowed me to understand the dynamics of learning that are important for developing what I call peer

craft, or the ability to craft a code collectively while being attentive to the style and aesthetics of the community. First, this site was openly networked. That is, social connections were facilitated through public discussions about the code that individuals shared. It was also a site for peer-supported learning. Enabled by framing mechanisms of pseudocode and contributor's narrative descriptions of their code, readers not only commented on contributor's code, suggesting modifications or additions, they shared resources and new ideas with them.

Finally, coders remixed each other's work. They took the original posts, copied the code, and then made their own modifications to them. These were linked back to the original posts.

Peer crafting has long been a part of coding culture. In *Coding Freedom* (2013), Gabriella Coleman described the concept of "productive freedom" as systems, structures, and tools similar to that at GitHubGist, which coders have intentionally built in order to "autonomously improve their peers work, refine technical skills, and extend the craft-like engineering systems" (p. 3). These contexts make for an aesthetic where "craft and craftiness converge" (p. 17).

The practice of remixing, or poaching code (Jenkins, 2012) to build newer, better code is also embedded in programs that teach youth to code, such as MIT's Scratch platform (Resnick et al., 2009; Roque, Kafai, & Fields, 2012). As a parallel, Pelletier et al. (2010) argued that "textual poaching" is an important aspect of creative media literacy practice. They studied children's use of the Making Games program and found that students borrowed themes, plots, and characters in designing games. For example, one student used the framing and plot structure of Star Wars to make a new game, and another incorporated Harry Potter in order to represent a certain character type.

Peer crafting even happens within video games, by players themselves. Kow et al. (2014) used the connected learning framework to examine how players engaged in the game of Starcraft II and found that a central point of peer-supported learning and production was the practice of modding, or using digital tools to modify the look, feel, or storyline of a game. They noted, "Many mod makers develop deep technical skills in computer programming as a result, as well as the collaborative skills required to complete ambitious designs combining artwork, audio, and level design" (p. 5).

Peer craft in game design develops a coder's "gaming capital" (Walsh, 2010), the productive knowledge and proficiencies for gaming that develop because a coder becomes embedded in a social ecosystem of gaming (Salen, 2008) through the exchange of ideas, code, and paratexts (media products that emerge from digital games). Furthermore, Walsh (2010) argued that gaming capital is an aspect of literacy development.

The concepts of peer craft and gaming capital have meaningful implications for teaching English. Many programing design platforms are built with intentional mechanisms to support peer crafting and the development of gaming capital. This approach could also be applied to the design of a learning environments in English classrooms. Opportunities to study the craft of other writers, work collectively to fine tune particular pieces, hack or remix each other's writing or published texts to explore new ways of approaching a technique or idea and to make visible the process of revision of a text over time would help to foster a peer craft of writing in English.

Critical Pathmaking

Not until the moment when my son played ACADEMIA, my first game, did I realize the power that I held through this creation. As he played the game, he struggled with making decisions about how to spend his time (and balance his mental health) and worried if he would make it through the final tenure battle (he did). At the end of the game, he sighed and said, "Wow, Mom, your life is hard."

I chuckled a bit to myself, knowing that I am blessed and lucky to have this career. Yet, I also realized that the game helped him to understandd some of the daily decisions I had to make in ways that he had not been able to before. I put him in my shoes, and he empathized.

The lens of connected learning assisted my reflection on this experience. Of all of the principles in the framework, my experience in making this game related most to the principle of interest-powered learning. That is, the game allowe me to share my story with others – not only to tell it, but to let them experience it. It also allowed me to share something that was significant to my life and frame the experience from my own perspective.

James Gee (2008) wrote about this aspect of video games in his article on video games and embodiment. He noted that players must take a "projected stance" in a video game, taking on the character's mind, goals, and virtual body, yet retaining their own goal within the context of the game. My son had to take on a projected stance in the videogame I made and embodied the character of an academic like me on the tenure track.

A few weeks later, I relayed the story of my son playing ACADEMIA to several colleagues. We joked a bit that I should have added a few more pitfalls into the game. Then one friend talked about how her pregnancy interrupted her tenure schedule. Another mentioned that being a Person of Color, she experienced discrimination and micro-aggression, which affected her path toward tenure.

I then realized that more could be done to this game to reflect societal realities. I could make an individual's identity be randomly generated and that social identity shape their experience in the game. I could help players develop greater empathy for people's life experiences through the game design. In doing so, I would be a critical path builder, designing a game in such a way that fosters not only empathy and understanding about the authors' life experiences, but also engages players in critical thinking about social or civic issues.

All technologies are inscribed by the values of their makers and shape the behaviors of the users. Latour's (1992) example of the Berliner lock and key, which was designed specifically for people who often lost their keys (you could not lock the door without taking the key with you) is a classic example of how technologies can be designed with user behavior in mind. Likewise, game-design scholars have argued that there are inherent values in every game, and rather than ignore them, game designers should make intentional choices about the values that a game affords and how those values are expressed through the design (Flanagan & Nissenbaum, 2007; Schrier, 2014; Sicart, 2009).

Two examples of approaches to designing games intentionally with value systems are (a) the Values at Play (VAP) model (Flanagan, Howe, & Nissenbaum, 2005; Flanagan & Nissenbaum, 2007), which works intentionally to embed social justice themes such as gender equity throughout the process of game design, and (b) Miguel Sicart's (2009) systems-based approach to game design, which focuses on design of ethical feedback loops.

Furthermore, Barab, Gresalfi, and Ingram-Goble's (2010) theory of transformational play provides a framework for designing games in which the players are granted dramatic agency to shape a storyline focused on a socially significant problem.

These models and frameworks provide helpful strategies for critical pathmaking in games. Moreover, a significant amount of research shows that games that have been intentionally designed to provide a critical path can influence players' empathy and perspectives about social issues (Schrier, 2014).

Belman and Flanagan's (2010) study reported how players developed greater empathy through playing games designed with the VAP model. In another study, Simkins and Steinkeuhler (2008) showed that role-playing games supported players' ethical reasoning skills. These games stand in contrast to games that have not been intentionally designed in such a way.

Sicart (2009) argued that games that do not create these critical pathways have the consequence of limiting the ethical agency of a player: "Agents within these kinds of systems can engage in unethical behavior without receiving feedback on the morality, or consequences of those actions" (pg. 196). Therefore, intentional consequences and constraints are important design features in games that are made to foster empathy and critical awareness.

Additional research has shown that critical pathmaking can also apply to app design. For example, in the Teen Design program at the Philadelphia Public Library, youth designed apps to address issues that they experienced, such as bullying (Fisher, Martens, Peterson-Kempf, & Meyers, 2017). At the Hive network in Chicago, a network of organizations that support youth development, especially in STEM, youth and adults worked to design RideW/Me, an app that could help youth travel to after-school programs more easily, because transportation costs can hinder some youth from participating in educational programs. The development of this app changed the real opportunity pathway for students and had the effect of helping students see themselves as civic actors and leaders.

One youth designer, Marina Malone (2015), reflected on effects of the experience on her civic participation in a blog post:

> You really can't work alone with a project like RideW/Me. A project made for a community is most successful when it's made by the community.... Whether it be tomorrow or in five years, you can find me writing on whiteboards building on RideW/Me or another community project. As a part of this great community, I want to be the best I can be to help others be the best that they can be.
>
> In all these examples, designers must think not only about the technical design of the code, but also their own lives and the social context of the game play. Hayes and Games (2008) noted that this design work can be practice for life itself: "Design thinking, as the ability to think about – and influence – social systems, can thus be a precursor to learning how to negotiate the complexities of modern life" (p. 328).

In the case of critical pathmaking, the connection to teaching English is more complex than the previous two themes. While this concept could serve to help students analyze the inherent values in a text or help writers think of their intentional framing, the agentive, dynamic aspects of the use of the game or app are unique to the realm of coding.

Apperley and Beavis (2011) spoke to the difference between textual literacy and literacies linked to the action-based processes of digital game play. They wrote,

> While the "meanings" of digital games are negotiated and produced in the interaction between "text" and reader (as is the case with any text), we believe it is important that the model also demonstrates how digital games are enacted and instantiated through action. (p. 2)

This difference is an opportunity for teacher educators to use coding to develop their students' theoretical understandings of all literacies as critical, social, and complex, and contextual.

Discussion and Implications for Practice

My final assignment was to design another, more complex game. This time, I decided to create a game that promoted civic understanding and used critical pathmaking to foster empathy and critical thought. I created a game called Citizenville, in which the player is the mayor and has to make decisions that keep citizens happy and healthy and maintains a balanced budget (easier said than done). Many of the scenarios that players encountered were based on real controversies, and historical effects of past decisions. Figure 3 shows code of one scenario and the result of one choice (read the pseudocode for translation to understand each part).

```
//Choices: Invest in failing schools ($2000), Close failing schools ($0), Give loans
for private schools ($1000)
String[] ProblemChoice3 = {"Invest in failing schools ($2000)" , "Close failing schools
($0)" , "Give loans for private schools ($1000)"};

//The Problem to solve: Student test scores are failing at several schools.
int Support3 = JOptionPane.showOptionDialog(null,"<html> Student test scores are
falling in several schools What do you want to do? </html>", null,
JOptionPane.DEFAULT_OPTION, JOptionPane.PLAIN_MESSAGE, null, ProblemChoice3, null);

//If the player chooses "Invest in failing schools," revenue goes up because people
move to the city to attend in the schools
if (Support3==0) {
String SupportInvest = "invested in the failing schools";
String InvestReaction = "The schools have bounced back. People are moving into the city
to attend the schools. Your revenue has gone up, so you broke even on expenditures";
spend +=2000;
approval += 5;
warChest += 1000;
update(SupportInvest, tax, budget, approval, warChest, InvestReaction);
```

Figure 3. *Citizenville code of a choice for a player.*[/caption]

Peer craft was an important element for me in designing the game. I found myself using several techniques that I had borrowed from other games I played in my quest to understand the genre. I taught consequences through game play rather than through explicit telling in order to help the player learn how to make good decisions and engage in a cycle of building expertise (Bereiter and Scardemalia, 1989, cited in Gee, 2003).

I noticed that that narrative itself was important, so as the game went on, the story of Citizenville changed; statistics about the health of the citizens and budget shifted, and player decisions influenced the arc of the story. Like the textual poachers described in Pelletier et al.'s (2010) study of game makers, I used type-cast characters to help players understand the general ethos and background of the other mayoral candidates. For example, one of the candidates that players had to run against was "Joe Plumb," who was modeled after the mien of "Joe the Plumber," a conservative activist and commentator who came to attention in the 2008 presidential election.

Further, I asked multiple people to play the beta version of the game for peer review. Players gave me technical feedback as well as feedback on the content. Yet, what was most interesting to me was how players' identities, knowledge of social issues, and political perspectives shaped how they experienced the game and learned from it.

For example, in the scenario in Figure 3, my son chose to give loans to private schools. To him, it was a matter of saving money; $1,000 was less than $2,000. When he learned that his decision ended up bankrupting all the public schools in the game, he began to ask questions about the issue in our own city, which led to a longer conversation about public education. When a colleague (and education scholar), played the game and got to the same scenario, she predicted the outcome more easily because of her knowledge of the issue and also stated out loud while she was playing the game what her own views were on the subject to explain her rationale and stance.

By the time I finished designing the project and completed the course, I no longer felt I was learning to read and write commands and scripts. I felt that I was learning how to make tools for social change. This understanding, of course, is what critical literacy educators hope their students will learn in English education; that learners see the power of words in shaping themselves and the world around them. This understanding came as a result of making and reflecting on that making, using the connected learning framework as a lens.

The connected learning framework helped to reveal the themes of framing, peer craft, and critical pathmaking, which enabled me to take a more intentional approach to using code to design for critical thinking and civic engagement. Furthermore, these themes bridged to the teaching of English and will help me to develop an integrative approach to teaching critical literacies of English and of code.

The integration of code into literacy education under the framework of connected learning has several important implications for education. First, previous research has demonstrated the importance of digital texts and culture in the lives of youth. Incorporating multimodal forms of texts and experience into literacy instruction offers the opportunity for teachers to make more critical connections to the lives and literacies of youth and give youth more tools to express their stories and ideas (Filipiak & Miller, 2014; Jewitt, 2008; Thomas & Stornaiuolo, 2016).

Further, new forms of digital communication and media-making also afford opportunities for students to participate more actively in civic discourse and work. Mirra and Garcia (2017) argued that educators must work to reimagine civic participation on the whole, given the role that digital tools for communication and production play in the lives of youth.

Finally, the integration of coding into humanities disciplines like English may help to address not only the gender gap in STEM, but also the lack of representation of People of Color in in STEM and technology. Humanities-oriented coding projects, such as Kafai and colleagues' e-textiles work (Buechley, Peppler, Eisenberg, & Kafai, 2013; Kafai et al., 2014,

2014; Searle, 2016), and Buechley and Hill's Lilypad projects (2010), all of which reorient coding and computer science to more crafty, arts-based work, have shown how a bridge into humanities disciplines invites greater participation and unique contributions from underrepresented groups.

In the opening paragraphs of this article, I described a moment in which I told my son that my game, ACADEMIA, was about my life. At the time that I said it, I had meant that it represented some of my life experience. Yet, looking back now, there is deeper meaning to what I said. The game I designed is an expression of myself to the world; my values, my thinking, and my funds of knowledge. A human life inscribed in the program.

In fall 2017, Maha Bali, a scholar who has been involved in the connected learning community for several years, posted a blog post entitled, "Where Is the Humanity in the Computer Science Curriculum?" In the post, she asked the question, "Why is all the focus on teaching lay people how to code and not teaching computer scientists and people who work in tech companies to center empathy and humanity in their work?" (Bali, 2017). From the perspective of a literacy educator who has now learned the basics of coding and game design, it seems that the humanity of code can be revealed through the lens of critical literacy. Additionally, bridging critical literacies of English and computer code has potential to foster greater civic participation and agency.

References

Adler, P. S., & Kwon, S.-W. (2002). Social capital: Prospects for a new concept. *Academy of Management Journal*, *27*(1), 17–40.

Alvermann, D. E., Moon, J. S., & Hagood, M. C. (1999). *Popular culture in the classroom: teaching and researching critical media literacy*. New York, NY: Routledge.

Ames, M. G., & Burrell, J. (2017). 'Connected Learning' and the equity agenda: A microsociology of Minecraft play. In *Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing* (pp. 446–457).

Apperley, T., & Beavis, C. (2011). Literacy into action: Digital games as action and text in the English and literacy classroom. *Pedagogies: An International Journal*, *6*(2), 130–143.

Apperley, T., & Beavis, C. (2013). A model for critical games literacy. *E-Learning and Digital Media, 10*(1), 1–12.

Apple, M. W., & Jungck, S. (1990). "You don't have to be a teacher to teach this unit": Teaching, technology, and gender in the classroom. *American Educational Research Journal*, *27*(2), 227–251.

Baker-Doyle, K. J. (2017). *Transformative teachers: Teacher leadership and learning in a connected world*. Cambridge, MA: Harvard Education Press.

Bali, M. (2017, October 23). Where is the humanity in the computer science curriculum? Retrieved from https://dmlcentral.net/humanity-computer-science-curriculum/

Barab, S. A., Gresalfi, M., & Ingram-Goble, A. (2010). Transformational play: Using games to position person, content, and context. *Educational Researcher*, *39*(7), 525–536.

Beede, D. N., Julian, T. A., Langdon, D., McKittrick, G., Khan, B., & Doms, M. E. (2011). *Women in STEM: A gender gap to innovation* (U.S. Department of Commerce ESA Issue Brief No. 04-11). Retrieved from ERIC database. (ED523766)

Belman, J., & Flanagan, M. (2010). Designing games to foster empathy. *International Journal of Cognitive Technology*, *15*(1), 11.

Buechley, L., & Hill, B. M. (2010). LilyPad in the wild: how hardware's long tail is supporting new engineering and design communities. In *Proceedings of the 8th ACM Conference on Designing Interactive Systems* (pp. 199–207).

Buechley, L., Peppler, K., Eisenberg, M., & Kafai, Y. (2013). *Textile messages: Dispatches from the world of e-textiles and education*. London, UK: Peter Lang Publishing Incorporated.

Bullough Jr, R. V., & Pinnegar, S. (2001). Guidelines for quality in autobiographical forms of self-study research. *Educational Researcher*, *30*(3), 13–21.

Clandinin, D. J., Pushor, D., & Orr, A. M. (2007). Navigating sites for narrative inquiry. *Journal of Teacher Education*, *58*(1), 21–35.

Coleman, E. G. (2013). *Coding freedom: The ethics and aesthetics of hacking*. Princeton, NJ: Princeton University Press.

Connelly, F. M., & Clandinin, D. J. (1990). Stories of experience and narrative inquiry. *Educational Researcher*, *19*(5), 2–14.

Cope, B., & Kalantzis, M. (2009). "Multiliteracies": New literacies, new learning. *Pedagogies: An International Journal*, *4*(3), 164–195.

Filipiak, D., & Miller, I. (2014). Me and the D: (Re) Imagining literacy and Detroit's future. *English Journal*, *103*(5), 59.

Fisher, K. E., Martens, M., Peterson-Kempf, A., & Meyers, E. M. (2017). "Ray of sunshine happiness gun" and other apps in pursuit of social justice: Teens' designs from Philadelphia. *iConference Proceedings*, Wuhan, China. Retrieved from https://www.ideals.illinois.edu/handle/2142/96765

Flanagan, M., Howe, D. C., & Nissenbaum, H. (2005). Values at play: Design tradeoffs in socially-oriented game design. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 751–760).

Flanagan, M., & Nissenbaum, H. (2007). A game design methodology to incorporate social activist themes. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 181–190).

Freire, P., & Macedo, D. (2005). *Literacy: Reading the word and the world*. London, UK: Routledge.

Garcia, A., Cantrill, C., Filipiak, D., Hunt, B., Lee, C., Mirra, N., ... Peppler, K. (2014). *Teaching in the connected learning classroom*. Irvine, CA: Digital Media and Learning Research Hub.

Gee, J. (1999). *The New Literacy Studies and the "social turn."* Retrieved from ERIC database. (ED 442118)

Gee, J. (2003). What video games have to teach us about learning and literacy. *Computers in Entertainment*, *1*(1), **20–20.????**

Gee, J. P. (2008). Video games and embodiment. *Games and Culture*, *3*(3–4), 253–263.

Gutiérrez, K. D. (2008). Developing a sociocritical literacy in the third space. *Reading Research Quarterly*, *43*(2), 148–164.

Hayes, E. R., & Games, I. A. (2008). Making computer games and design thinking: A review of current software and strategies. *Games and Culture*, *3*(3–4), 309–332.

Hsu, H.-Y., & Wang, S.-K. (2010). Using gaming literacies to cultivate new literacies. *Simulation & Gaming*, *41*(3), 400–417.

Hull, G. A., & Schultz, K. (2002). *School's Out: Bridging out-of-school literacies with classroom practice*. New York, NY: Teachers College Press.

Ito, M., Gutiérrez, K., Livingstone, S., Penuel, B., Rhodes, J., Salen, K., ... Watkins, S. C. (2013). *Connected learning: An agenda for research and design*. Cambridge, MA**:** MIT Digital Media and Learning Research Hub.

Ito, M., Soep, E., Kligler-Vilenchik, N., Shresthova, S., Gamber-Thompson, L., & Zimmerman, A. (2015). Learning connected civics: Narratives, practices, infrastructures. *Curriculum Inquiry*, *45*(1), 10–29.

Jenkins, H. (2006a). Confronting the challenges of participatory culture: Media education for the 21st century. Chicago, IL: John D. and Catherine T. MacArthur Foundation.

Jenkins, H. (2006b). *Fans, bloggers, and gamers: Exploring participatory culture*. New York, NY: NYU Press.

Jenkins, H. (2012). *Textual poachers: Television fans and participatory culture*. London, UK: Routledge.

Jenkins, H., & Zimmerman, A. (2016). *By any media necessary: The new youth activism*. New York, NY: NYU Press.

Jewitt, C. (2008). Multimodality and literacy in school classrooms. *Review of Research in Education*, *32*(1), 241–267.

Kafai, Y. B., Lee, E., Searle, K., Fields, D., Kaplan, E., & Lui, D. (2014). A crafts-oriented approach to computing in high school: Introducing computational concepts, practices, and perspectives with electronic textiles. *ACM Transactions on Computing Education*, *14*(1), 1.

Kanpol, B. (1997). *Issues and trends in critical pedagogy*. Creskill, NJ: Hampton Press, Inc.

Kellner, D., & Share, J. (2005). Toward critical media literacy: Core concepts, debates, organizations, and policy. *Discourse: Studies in the Cultural Politics of Education*, *26*(3), 369–386.

Kow, Y. M., Young, T., & Tekinbas, K. (2014). Crafting the metagame: Connected learning in the StarCraft II community. *Connected Learning Working Papers*, 1–46.

Larson, K., Ito, M., Brown, E., Hawkins, M., Pinkard, N., & Sebring, P. (2013). *Safe space and shared interests: YOUmedia Chicago as a laboratory for connected learning*. Pennsauken, NJ: BookBaby.

Latour, B. (1992). Where are the missing masses? The sociology of a few mundane artifacts. In W. Bijker & J. Law (Eds.), *In shaping technology-building society. Studies in sociotechnical change* (pp. 225–259). Cambridge, MA: MIT Press.

Luke, A. (2012). Critical literacy: Foundational notes. *Theory into Practice*, *51*(1), 4–11.

Malone, M. (2015, September 16). How I got on board with RideW/Me. Retrieved from http://hivechicago.org/got-onboard-ridewme/

Mawhinney, L., & Petchauer, E. M. (2013). Coping with the crickets: A fusion autoethnography of silence, schooling, and the continuum of biracial identity formation. *International Journal of Qualitative Studies in Education*, *26*(10), 1309–1329.

Mirra, N., & Garcia, A. (2017). Civic participation reimagined: Youth interrogation and innovation in the multimodal public sphere. *Review of Research in Education*, *41*(1), 136–158.

Morrell, E. (2012). 21st-century literacies, critical media pedagogies, and language arts. *The Reading Teacher*, *66*(4), 300–302.

Pelletier, C., Burn, A., & Buckingham, D. (2010). Game design as textual poaching: media literacy, creativity and game-making. *E-Learning and Digital Media*, *7*(1), 90–107.

Peppler, K. A., & Kafai, Y. B. (2007). *What videogame making can teach us about literacy and learning: Alternative pathways into participatory culture*. Proceedings of DiGRA 2007 Conference, Tokyo, Japan. Retrieved from ERIC database. (ED521155)

Peppler, Kylie A, Maltese, A., Keune, A., Chang, S., & Regalla, L. (2015). *The Maker Ed Open Portfolio Project survey of maker spaces, Part 1* (Open Portfolio Project Research Brief Series). San Francisco, CA: Maker Education Initiative.

Resnick, M., Maloney, J., Monroy-Hernández, A., Rusk, N., Eastmond, E., Brennan, K., ... Silverman, B. (2009). Scratch: Programming for all. *Communications of the ACM*, *52*(11), 60–67.

Roque, R., Kafai, Y., & Fields, D. (2012). From tools to communities: Designs to support online creative collaboration in Scratch. In *Proceedings of the 11th International Conference on Interaction Design and Children* (pp. 220–223).

Rushkoff, D. (2010) *Program or be programmed: Ten commandments for a digital age.* New York, NY: OR Books

Salen, K. (2008). Toward an ecology of gaming. *The Ecology of Games: Connecting Youth, Games, and Learning*, 1–20.

Schrier, K. (2014). *Learning, education and games. Volume 1: Curricular and design considerations*. Pittsburgh, PA: ETC Press.

Searle, K. (2016, April). *Making activities with electronic textiles in an American Indian community schoo*l. Paper presented at the American Educational Research Association Annual Conference, Washington DC.

Sheridan, K., Konoplasky, A., Williams, A., & Wingo, G. J. J. (2016, April). *Resourceful and inclusive: Toward design principles for makerspaces*. Paper presented at the American Educational Research Association Annual Conference, Washington DC.

Sicart, M. (2009). The banality of simulated evil: designing ethical gameplay. *Ethics and Information Technology*, *11*(3), 191–202.

Simkins, D. W., & Steinkuehler, C. (2008). Critical ethical reasoning and role-play. *Games and Culture*, *3*(3–4), 333–355.

Smith, A., West-Puckett, S., Cantrill, C., & Zamora, M. (2016). Remix as professional learning: Educators' iterative literacy practice in CLMOOC. *Education Sciences*, *6*(1), 12. https://doi.org/10.3390/educsci6010012

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

Thomas, E. E., & Stornaiuolo, A. (2016). Restorying the self: Bending toward textual justice. *Harvard Educational Review*, *86*(3), 313–338.

Vasudevan, L. (2006). Making known differently: Engaging visual modalities as spaces to author new selves. *E-Learning and Digital Media*, *3*(2), 207–216.

Walsh, C. (2010). Systems-based literacy practices: Digital games research, gameplay and design. *Australian Journal of Language and Literacy*, *33*(1), 24.

Walsh, C., & Apperley, T. (2009). Gaming capital: Rethinking literacy. In *Changing Climates: Education for sustainable futures. Proceedings of the AARE 2008 International Education Research Conference*, Queensland University of Technology, Australia.

Zimmerman, E. (2007). Gaming literacy. *Harvard Interactive Media Review*, *1*(1), 30–33.