Analyzing Digital Literacy Demands, Practices, and Discourses within a Library Computer Programming Club for Children

by

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ABSTRACT

Among researchers, educators, and other stakeholders in literacy education, there has been a growing emphasis on developing literacy pedagogies that are more responsive to the ways young people experience literacy in their everyday lives, which often make use of digital media and other technologies for exchanging meaning. This dissertation project sought to explore the nature of these digital-age literacies in the context of children learning through and about new technologies. Conducting a year-long, multimethod observational study of an out-of-school library-based program designed to engage students in self-directed learning around the domain of computer programming, this project was framed around an analysis of digital-age literacies in design, discourse, and practice. To address each of these areas, the project developed a methodology grounded in interpretive, naturalistic, and participant-observation methodologies in collaboration with a local library Code Club in a metropolitan area of the Southwestern U.S between September 2016 and December 2017. Participants in the project included a total of 47 students aged 8-14, 3 librarians, and 3 parents. Data sources for the project included (1) artifactual data, such as the designed interfaces of the online platforms students regularly engaged with, (2) observational data such as protocol-based field notes taken during and after each Code Club meeting, and (3) interview data, collected during qualitative interviews with students, parents, and library facilitators outside the program. These data sources were analyzed through a multi-method interpretive framework, including the multimodal analysis of digital artifacts, qualitative coding, and discourse analysis. The findings of the project illustrate the multidimensional nature of digital-age literacy experiences as they are rendered “on the screen” at the content level, “behind the screen”

at the procedural level, and “beyond the screen” at the contextual level. The project contributes to the literature on literacy education by taking an multi-method, interdisciplinary approach to expand analytical perspectives on digital media and literacy in a digital age, while also providing an empirical account of this approach in a community-embedded context of implementation.

DEDICATION

To those who have dedicated themselves to transforming our society through teaching and learning. And to those who help others see that the power of literacy lies beyond reading the word, but in shaping the world that we all share. Thank you.

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CHAPTER 1

DIGITAL-AGE LITERACIES IN THEORY, METHOD, AND PRACTICE

Background and Purpose

Increased access to digital communication technologies in the 21st century is changing what it means to take an active role in a modern literate society (Cope & Kalantzis, 2009; Leu, Kinzer, Coiro, Castek, & Henry, 2013; McVee, Bailey, & Shanahan, 2008). Despite these changes, widely-adopted models of formal literacy instruction can feel disconnected from the ways that young people experience literacy in their everyday lives, which often make use of digital media for exchanging meaning (Avila et al. 2013; Lankshear & Knobel 2011; Serafini & Gee 2017).

Meanwhile, among researchers, educators, and other stakeholders in literacy education, there has been a growing emphasis on developing literacy pedagogies that are more responsive to these multifaceted literacy experiences (Gee, 2004; Moje, 2004; The New London Group, 1996; Walsh, 2010). Among the most seminal of these perspectives is the work of the New London Group (1996), who argued for a pedagogy of multiliteracies that recognized the dynamic nature of literacy practices in a rapidly-changing, globally-connected, and technologically-mediated society. These literacy contexts involve multiple modes of representing, communicating, interpreting, and acting on meaning across a variety of media. Such socially-constructed, situated, and multimodal literacies involve combinations of text, image, movement, sound, and other modes of communication in both digital and face-to-face environments (Jewitt, 2008; Kress, 2001; Serafini, 2012). As students in contemporary society begin to shift their access of such multimodal literacy experiences to digital and online contexts, the need for

understanding the literacy demands, practices, and experiences of students in these spaces becomes even more salient (Gee & Hayes, 2011; Jenkins, Purushotma, Weigel, & Clinton, 2009; Lemke, 1998). While not the only indicator, the proliferation of standards and policy documents emphasizing such notions as "21st-Century Skills," "Digital Literacy," "Information Literacy," and "Research and Media Skills" from across a variety of stakeholders - educational, political, and even commercial - serve as an illustration of this growing interest (Common Core Initiative, 2012; Colin Lankshear & Knobel, 2006; OECD, 2013).

The purpose of this project is to explore the literacy experiences of students within a context that has come to be associated with movements around so-called "digital literacies:" the domain of computer programming. Specifically, the project develops an empirical account of an out-of-school library-based program called a "Code Club," which is designed to engage youth aged 8-14 to engage with computer programming concepts through a variety of activities. Through a series of interconnected, interpretive studies of artefactual, observational, and interview data collected over the course of one year of implementation of one such program in a local public library, I highlight the various literacy demands, social practices, and linguistic resources that participants engage with throughout the process, as well as implications for digital-age literacy research and pedagogy. I contend that such an analysis of rich qualitative data collected over time can expand our understanding of possibilities and challenges in understanding and supporting children's literacy development in a digital age.

Theoretical Framing

This project is grounded in a perspective of literacy as a situated, sociocultural, and multimodal phenomenon (Gee, 2010; Gee & Hayes, 2011; Rowsell, Kress, Pahl, & Street, 2013; Serafini, 2013). Literacy is situated in that it involves cognitive capacities (e.g. decoding and processing written letters), social practices (e.g. reading a bedtime story), 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 (Gee, 2010; Gee & Hayes, 2011; 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; Warschauer, 1997). 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, 2012b). In this sense, "literacy" may be more appropriately framed as "literacies," in the plural, to recognize the multiple ways of being and becoming literate that different people bring to different situations (Serafini & Gee, 2017; 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 (Zimmerman & Salen, 2003).

Key Concepts and Definitions

Beginning with this framing, which aligns with the work of the New London Group (1996, Serafini & Gee, 2017), scholarship in the New Literacy Studies (Gee, 2015;

Mills, 2010; B. Street, 2003), and social-semiotic perspectives on literacy (Gunther Kress, 2009; Pahl & Rowsell, 2012; Rowsell, Kress, Pahl, & Street, 2013), I will now outline several concepts that will be used throughout this manuscript to frame the goals and outcomes of the overall project, as well as the three studies that constitute the project.

Literacy demands. The study I will present in Chapter 2 focuses on the concept of "literacy demands," which is meant to extend notions of "text complexity" (Common Core Initiative, 2012; Pearson & Hiebert, 2014) beyond a purely language-based, or logocentric view of literacy. The complexity of printed language in a text has been demonstrated to influence the ways that students decode, make meaning with, use, and critique these texts (Luke & Freebody, 1999). At the same time, the multimodal dimensions of text suggests that students may be drawing on different practices and resources for navigating, interpreting, interrogating, and designing visual and multimodal artifacts such as the interactive web applications analyzed for this project (Serafini, 2012). Throughout this manuscript, though I will use the term 'literacy demands' (Lemke, 1998) to describe a more comprehensive view of 'the expanding cognitive resources, social practices, and material tools that users of digital media artifacts must draw from to participate in the exchange of social meanings around these artifacts.' This definition is meant to encompass both the receptive (reading / viewing / listening) and the productive (writing/ designing/ speaking) dimensions of print-based and multimodal literacies (Lemke, Lecusay, Cole, & Michalchik, 2015), while still leaving enough room to account for evolving forms of literacy using digital technologies. Historically, Lemke (1998) has used the term "literacy demands" in his analysis of the multimodal literacy practices students in school were tasked with engaging in as they navigated a formal

science curriculum. In the present analysis, we can consider these literacy demands as they might be applied to digital media artifacts across the dimensions of content, procedure, and context outlined in the chapter.

Literacy practices. The study presented in Chapter 3 focuses on the idea of literacy practices, which we can understand as the social exchanges of meaning in which people engage around print-based or digital artifacts. The academic literature that has focused on literacy as a social practice has typically been grouped under the family of scholarship known as the New Literacy Studies, or the NLS (Gee, 2010; Serafini & Gee, 2017). Among the foundational work in this body of scholarship is Heath's concept of a literacy event as "any occasion in which a piece of writing is integral to the nature of participants' interactions and their interpretive processes" (Heath 1982, p. 50). Street (1984; 1998; 2005) expanded this concept into the idea of literacy practices, to account Heath's conception of "events" while emphasizing the social practices people bring to bear upon those events and give meaning to them. Thus, the development of the NLS marked a shift in focus from the idea of literacy as an autonomous neutral set of skills or competencies that people acquire through schooling and can deploy universally, to a more ideological view of literacies as local, situated, and thus inextricable from questions of identity, power, representation, and other issues of sociocultural origin (Street 1984; 2006).

Literacy in discourse. Revisiting the relationships between language, literacy, and everyday experience, the study I present in Chapter 4 focus primarily on an analysis of participants' discourses about literacy. While the concept of "discourse" is closely related to the concept of language, the nuanced relationship between the two is an important

distinction that underpins this discussion. Simply stated, discourse refers to the idea of "language-in-use." As opposed to a systematic study of how language works in some theoretical, abstract sense, discourse analysts emphasize the study of language - spoken and written - in actual contexts of use, that is, as people use language in specific situations to do different things (Cruickshank, 2012; Rogers, 2011). This definition of discourse draws from the fundamental premise that language isn't just used to say things about the world, but to do things in the world (Austin, 1975; Searle, 1979). While traditionally-established models of language have suggested that is done through the "packaging and sending" of meanings, Gee (2014b) asserts that a more productive metaphor for (some of) the work that language does is the "building and designing" of structures and meanings. As Gee further argues, one key building task that people engage in is using language to give special status to (or privilege) various sign systems, while also criticizing or taking status away from (disprivileging) other communication systems and ways of knowing the world. In the context of this project, I will emphasize that the ways that participants describe literacy through their discourse reflects both their own experiences as well as broader conversations about the role of literacies in society.

Digital-age literacies. Prior efforts to conceptualize digital-age literacies have drawn from a variety of disciplinary perspectives and research traditions (Lankshear & Knobel 2008). While some have focused on skills for accessing, interpreting, and critiquing digital content, others have emphasized the role of literacy as social practice across contexts of digital connection and communication (Bawden 2008; Mills, 2010). Still others have framed aspects of digital media production, computer programming, and software design, through the lens of literacy (Bogost 2005; Mateas 2005; Vee 2013).

Understanding how these multiple perspectives might be brought together to complement and complicate one another has the potential to expand the "interpretive repertoires" of researchers, educators, and students living and learning in a digital age (Serafini 2015). As Albers (2008) asserts, scholarship that may not always be directly associated with literacy can provide further insight into how literacy learners make sense of their worlds, and we can better support them in this.

Building on these foundations, I will conceptualize digital-age literacies across three overlapping and interconnected lenses of analysis (Aguilera, 2017). Focusing on the content dimension, I will highlight aspects of the multimodal content rendered on the screens that have become a ubiquitous part of our daily lives (Holmes, 2012). Within the procedural dimension, I 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 users (Murray, 1997; 2016). Finally, I turn my attention "beyond the screen," toward the contexts of production, dissemination, and use of digital media technologies - not just as a means for accessing information, but as ways of exchanging meaning (Avila & Pandya, 2013). Such a multidimensional framing of these literacies is important for expanding our analytical perspectives on what "counts" as literacy in a digital age (Stewart, 2017).

Following the logic of Serafini's (2010) tripartite framework for reading multimodal texts, I recognize that these dimensions cannot exist in isolation. At a practical level, it is very much the underlying digital technologies "behind the screen" that render the digital media, such as websites and video games, as we perceive them "on the screen." (Borsook, Higginbotham-Wheat, & Nancy, 1992; Djonov, Knox, & Zhao,

2015). And as technologies and media can be understood as material instantiations of social meanings, the sociocultural context "beyond the screen" cannot be ignored in such an analysis (Pauwels, 2012). However, just as Serafini demonstrated the value of multiple perspectives as affording alternative viewpoints and analytical tools, I contend that separately theorizing these three "lenses" through which we can look at digital-age literacies can expand the interpretive repertoires of students, educators, and researchers. In Chapter 2, I will detail each of the analytical lenses in further depth, illustrating their application through an interpretive analysis of contemporary digital texts.

To briefly summarize, my particular emphasis on "digital-age" literacies reflects less on any particular technological platform on which these literacies are being engaged, and is instead meant to emphasize the multi-dimensional nature of literacy demands, practices, and discourses in the rapidly-changing, digitally connected contexts through which we exchange meaning in the modern world (Lankshear & Knoebel, 2008). The site being proposed for this study, a library-based computer programming club for children, is one instantiation of such a context.

Digital-Age Literacies in the Context of Computer Programming

Across its evolving definitions and conceptualizations over time, the construct of literacy has broadly been recognized as fundamental to a wide range of activities that define what it means for people to be part of a complex social order (UNESCO Education Sector, 2004; UNESCO Institute for Statistics, 2016). In addition, the idea of an "autonomous" and decontextualized notion of literacy has long been put into question by scholarship emphasizing the highly situated, ideological, and mediating role of literacy in the lives of individuals and societies over time (Gee, 2015; Graff, 1979, 2010; Street,

2006). Simply put, what counts as "literacy" and "being literate" has been shown to vary greatly across social, historical, and cultural contexts (Purcell-Gates, 2007; Street, 2006). Building on the New London Group's (1996) emphasis on the notion of multiliteracies becoming increasingly salient in a rapidly-changing, globalized society, scholarship examining literacy in science education has argued for a recognition of multiple literacies that extend well beyond the printed text (Kress, 2001; Lemke, 1998; Lemke, 2004). This expanded understanding of literacies includes ways of representing, communicating, interpreting, critiquing and acting on symbolic meaning that are distributed across multiple semiotic modes as well as the increasingly diverse media forms across which these meanings are disseminated (Gunther Kress, 2009; Rose, 2012; Serafini, 2013).

The domain of computer programming, couched within the broader field of computer science, represents a useful context for the study of literacy development for a variety of reasons. Among these are the similarities that computer programming shares with the various academic, scientific, and artistic disciplines. Equally important, however, are aspects of computer programming that set it apart from other potential contexts for studying literacy. The sections that follow provide an overview of these shared and divergent aspects.

Discourses, social languages, & situated literacies. Like other academic, scientific, and artistic disciplines, the domain of computer programming, along with its associated competencies and practices, is marked by particular ways of communicating, doing, being, thinking, and acting - that define what it means to to be part of the broader community of computer programmers. (Gee, 2014a) has referred to these combinations of language, community, activity, identity, and practice as (D)iscourses, with the

capitalization used to distinguish from the concept of (d)iscourse, the latter of which primarily emphasizes the linguistic aspects of communicative exchange between people. Part of the Discourse of computer programming involves the ways that programmers use language to communicate with those considered either "insiders" or "outsiders" to their practice. As in other professions or affinity groups, programmers speaking to one another may include references to technical language without much introduction or parenthetical explanation, or even subvert conventions of technical language to develop hybridizations. One example of this can be seen in the reference to URLs - short for "uniform resource locators" - using the quasi-phonetic pronunciation of "yerls" rather than spelling out the acronym, when "insider" programmers recognize they are in conversation with one another (Young, 2017). When speaking with an "outsider" to the practice of computer programming, which may include what is termed the "end-user" or target audience of a piece of software, the URL may simply be referred to as a "web address." While both ways of speaking are couched within what is typically referred to as "the English language," these practices reflect the diversity of social languages (Gee, 2015) that partly constitute the Discourse of computer programming. To extend this theory of Discourse to literacy practices, the domain of computer programming, in its technical, academic, and lay documentation, can also be seen as reflecting particular ways of written communication that broadly distinguish it from other domains.

Human-computer languages & literacies. Beyond the social languages that define interactions between "insiders" and "outsiders" of the domain, computer programming is also defined by an expanding corpus of languages designed to facilitate communication between human beings and computers. These include what are called

programming languages, which were developed to allow humans to directly give directions to a computer. The Java programming language, for example, underlies much of the infrastructure of Android smartphone operating systems. A subset of these, known as scripting languages, were developed to automate tasks that would otherwise be performed by a human; search engines such as Google and Yahoo make extensive use of such scripts to facilitate internet searching. Markup languages represent another distinct category of human-computer languages, which have historically been used to annotate digital documents (such as web pages) with information about the structure and display of those documents. One commonly recognized example is "hypertext markup language" (HTML), often understood as the "building blocks" with which the more widely accessible parts of the internet - websites and web pages - are built. Broadly referred to under the heading of assembly languages, these human-to-computer languages were largely designed with the express intent of being comprehensible by both human and computer entities.

While it is beyond the scope of this discussion to review this history and range of programming, scripting, and markup languages that have become central to the domain of computer programming, the point is that such a dual emphasis on both social (human-human) languages and assembly (human-computer) languages represent one central departure of computer programming from other contexts through which literacy might be examined.

Computer programming as "reading" and "writing." Throughout its evolution, the concept of literacy has been often utilized in logics of analogy to extend to a variety of areas. This analogizing has, at least in part, contributed to the proliferation of literacy-like

constructs that have come to define discourses around literacy and literacy education. Thus, we now regularly encounter terms such as "financial literacy" (Lusardi & Mitchelli, 2007), "cultural literacy," (Hirsch, Kett, & Trefil, 1988), and "health literacy" (Nutbeam, 2000), though these analogies may bear little resemblance to the more traditional notions of "reading" and "writing" that commonly come to mind in informal conversations about literacy. In the domain of computer programming however, the capacity and practice of both reading and writing computer code have been recognized as fundamental to the identity of a programmer - that is, you would only be considered a programmer per se if you have developed the ability to both understand how to read programming languages, as well as write your own code in those languages (Rooksby, Martin, & Rouncefield, 2006).

We have established that social languages, among other things, are also used in the co-construction, recognition, and transformation of one's identity as a programmer. In this way, the ability to read and write code can be considered a necessary, but perhaps not entirely sufficient condition. Still, this explicit attention to both the receptive and productive dimensions of literacy in the context of computer programming may help to distinguish it from other kinds of literacy-analogous activities. One might even argue that coding involves a kind of dual-level literacy - on one hand, one is learning to communicate with a machine through specialized symbolic language; on the other hand, one must also be able to envision what the experience of a user on the other end of the software might be like - thus echoing the kind of authorial imagination writers themselves must engage in when composing for an audience.

Examining Digital-Age Literacies in Context: Three Studies of a Library Code Club

This project seeks to explore the notion of digital-age literacies within the context of an out-of-school library-based program designed to engage students in self-directed learning around the domain of computer programming. Referred to as "Code Clubs," these casually-structured weekly sessions invite students aged 8-14 into a public library computer space to engage in a variety of online "kid-friendly" learning platforms for developing computer programming skills and understandings. As both seminal and contemporary research has emphasized the variety of contexts in which literacy practices develop outside of formal schooling, the Code Club environment is particularly interesting because it exists as a site in which no direct literacy instruction is immediately evident; instead the Club appears to be grounded in an increasing interest in computer science education and computational thinking across a variety of stakeholders (Barr & Stephenson, 2011; Papastergiou, 2009; Wing, 2006). Despite the lack of an explicit literacy focus, a closer examination of both the physical and digital engagement of students in the Code Club reveals a complex tapestry of literacy demands (Lemke, 1998), literacy practices (Street, 1988, 2006), and situated learning opportunities (Gee, 2004; Gresalfi, 2009; Lave, 1991; Sadler, 2009) inherent in the Code Club experience. Thus, I contend that a more extensive and systematic analysis of rich qualitative data collected over time can expand our understanding of possibilities and challenges for understanding and supporting children's literacy development in a digital age.

To address this broader goal, I framed this overall project around three core research questions:

- What literacy demands are evident in the design of the digital learning platforms students engage with during the Code Club experience?
- In what ways do students appear to draw on literacy resources and practices, across

  physical and digital environments to meet the literacy demands evidenced in the experience of the program?
- How do participants use language to construct their perspectives on literacy as part of the Code Club experience?

The first question of this project draws on Lemke's (1998) work to examine the multimedia literacy demands of a high school science curriculum; here, the concept is applied to literacy in a multimodal sense, and grounded in the context of students' experiences across the digital and physical learning environments of the Code Club. The second question foregrounds the ways that students in the Code Club appear to address these demands, examined particularly through the lens of the different literacy-supporting resources students draw on (Luke & Freebody, 1999; Serafini, 2012), and the practices around literacy that students engage with (Lankshear & Knobel, 2008; Street, 2006). The third question speaks more directly to ways participants in the Code Club used language to construct their perspectives on literacy as part of the Code Club experience. Taken together, these questions are grounded in a commitment to highlight the pedagogical implications for educators that might be drawn from the experience of observing students engaged with digital media in informal learning contexts over time.

To address these questions, I developed a series of studies grounded in interpretive, naturalistic, and participant-observation methodologies in collaboration with

a local library Code Club in a metropolitan area of the Southwestern U.S between September 2016 and December 2017. Participants in the project included a total of 47 students aged 8-14, 3 librarians, and 3 parents. The students of the Code Club met in a children's library computer space once per week for 45-minutes at a time, accompanied by a library facilitator and engaging in various activities related to computer programming such as game play, puzzle-solving challenges, and online tutorials. Data sources for the project included (1) artefactual data, such as the designed interfaces of the online platforms students regularly engaged with, (2) observational data such as protocol-based field notes taken during and after each Code Club meeting, and (3) interview data, collected during qualitative interviews with students, parents, and library facilitators outside the program.

To analyze the literacy demands evident in the designed online interfaces of the Code Club (Research Question 1), I developed an interpretive framework of analysis by combining Pauwels' (2012) "Multimodal Framework for Analyzing Websites as Cultural Expressions," with my own conceptual framework of digital media across content, procedural, and contextual dimensions (Aguilera, 2017). I then applied this multidimensional analysis to two web-based application interfaces commonly used by students on Khan Academy and Code.org. To analyze students' literacy practices (RQ2), I applied first and second cycle qualitative coding methods to the field notes constructed during my observations of one summer season of the Code Club (June 2017 - August 2017). Finally, to analyze participant perspectives on literacy (RQ3), I conducted qualitative interviews with a subsample of students, parents, and librarians, examining their responses through the lens of discourse analysis (Gee, 1999).

As I will detail in the chapters that follow the findings of the project revealed a wide variety of complex literacy demands across digital hypermedia artifacts, such as web-based applications, that could be utilized by educators to further support the multidimensional literacies of students growing up in a digital age. Further, while a wide variety of literacy practices can be observed while students engage with digital content on screens, other practices may be obscured unless we pay specific attention to the ways that students are engaging with the "behind-the-screen" (procedural) dimension of digital media, including the technological tools that render this this content visible on our digital devices (Aguilera, 2017). Additional insight to students' literacy practices can also be gained from an examination of students' engagement with the "beyond-the-screen" (contextual) dimensions of their digital-age literacy experiences, including the social situations that simultaneously give rise to and are shaped by sites of production, dissemination, and everyday use (Rose, 2012). Finally, the project helped to reveal how participants' perspectives about their literacy experiences are both situated and co-constructed, simultaneously reflecting wider societal conversations while at the same time grounded in the details of individual experience (Avila et al., 2013; Gee, 1999).

I will argue these findings illustrate the multidimensional nature of digital literacy experiences as they are rendered "on the screen" at the content level, "behind the screen" at the procedural level, and "beyond the screen" at the contextual level. The project contributes to the literature on literacy education by taking a multi-method, interdisciplinary approach to expand analytical perspectives on digital media and literacy in a digital age, while also providing an empirical account of this approach in a community-embedded context of implementation. While additional research can help to

refine the claims made and to expand the empirical basis of the perspectives presented, the findings of the project can help inform decisions of teachers, literacy professionals and administrators seeking to support literacy learning in a digital age.

In the chapters that follow, I will detail each of the three studies designed to address each of the research questions. In Chapter 2, I will present a study that develops an interpretive "toolkit" across three dimensions of digital-age literacies and applies this toolkit to reveal the multidimensional literacy demands of the online platforms being used by students in the Code Club. In Chapter 3, I will describe a study focusing on the literacy practices engaged by students across the content, procedural, and contextual dimensions of digital-age literacies. In Chapter 4, I will turn my analytical focus to the discourse used by participants to characterize their experience of literacy as part of the Code Club experience. Finally, I will close this manuscript with a discussion of findings across the three studies; an examination of the rigor, "validity," limitations, and future directions of this work; and a reflection on implications of this project for literacy research, theory, and pedagogical practice.

CHAPTER 2:

WHAT EDUCATIONAL WEB APPLICATIONS CAN TEACH US ABOUT LITERACY IN A DIGITAL AGE

Among researchers, educators, and other stakeholders in literacy education, there has been a growing emphasis on developing more responsive ways to support students' literacy experiences in the contexts of their everyday lives (Gee, 2004; Lankshear & Knobel, 2011; Moje, 2002; National Writing Project, DeVoss, Eidman-Aadahl, & Hicks, 2010). These everyday literacy experiences often involve multiple "modes" of exchanging meaning - visual, aural, gestural, etc. - across a variety of media (Lankshear & Knobel, 2011). This is perhaps truer than ever, in an age when digital media and networked technologies like video games, mobile device applications, and internet websites are taking up a larger share of people's everyday literacy experiences than ever before (Perrin & Duggan, 2015).

However, most educational research in this area has focused on primarily text-based notions of complexity, often relegating image and multimedia to a secondary role in supporting the words on a page (Pearson & Hiebert, 2014). Historically, these approaches have used quantitative predictors of text complexity or qualitative analysis of the linguistic features of texts. Such approaches emphasized the structure of text itself over the role of the reader or other factors. In more recent years, work from the field of multimodal literacy studies has helped to reveal deeper insight into complexity of media artifacts when represented across a multiplicity of modes of meaning-making (Serafini, 2012).

Less work in the field of literacy research to date has focused on applying these approaches to better understand the literacy demands of the digitally-connected media

artifacts that are increasingly impacting many of the literacy experiences of youth in the 21st Century: interactive web applications, video games, picturebook apps, and other artifacts termed by Aarseth (1997) as ergodic - that is, requiring a "non-trivial effort" in their traversal by users. These multimodal, digital, and networked texts place different kinds of "demands" on users, including the ways they must organize cognitive resources, social practices, and contextual understandings to navigate, interpret, design, and interrogate texts in a digital age (Serafini, 2012b).

Purpose and Research Questions

The purpose of this project is to expand educators' understanding of the complexity of these digital-age texts by analyzing the literacy demands evident in the designed user interfaces of several online learning platforms. Specifically, this project seeks to address the following overarching question and related sub-questions:

What literacy demands are evident in web applications as multimodal artifacts designed to engage novices in computer science education?

- In what ways do these literacy demands draw from content rendered "on the screen" for successful navigation, interpretation, design, and interrogation by users?
- In what ways do these literacy demands draw from computational procedures "behind the screen" - that is - with regard to the technical affordances and constraints that give rise to what is rendered on the screen?
- In what ways do these literacy demands draw from broader situated contexts, consequences of use, and embedded ideologies that inform experiences of these artifacts "beyond the screen?"

The overarching question of this project will be approached from an interpretive stance - in particular, one which asserts that "interpretation is central to all kinds of educational research and enters into it at every stage of the process," from the formulation of research questions to the presentation of findings drawn from empirical analysis (Smeyers, Bridges, Burbules, & Griffiths, 2015, p. 3). The analysis proposed for this project can be

even more specifically located within a "family" of approaches that defines interpretation as a product of research - as an argument, grounded in evidence, which demonstrates to an audience the significance of something that may not be readily apparent.

As I established in the previous chapter, the present analysis is grounded in a perspective of literacy as a situated, sociocultural, and multimodal phenomenon (Gee, 2010; Gee & Hayes, 2011; Rowsell, Kress, Pahl, & Street, 2013; Serafini, 2013). Literacy is situated in that it involves cognitive capacities (e.g. decoding and processing written letters), social practices (e.g. reading a bedtime story), 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 (Gee, 2010; Gee & Hayes, 2011; 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; Warschauer, 1997). 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, 2012b). This view of literacy 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 (Zimmerman & Salen, 2003).

This project seeks to contribute to the broader practical challenge of identifying the features of digital-age texts that might warrant special attention for students reading, writing, and learning in environments that blend face-to-face and virtual experiences.

Such an analysis of these digital media artifacts can help expand our understanding of the possibilities and challenges for understanding and supporting children's literacy development in a digital age.

Hard to Read? Historical Attempts to Rate the Difficulty of Texts for Students

Access to digital media and networked technologies grown significantly in the last several decades. Broad economic, political, and societal changes have been often attributed to this so-called "digital revolution" (Collins & Halverson, 2009). Along with these large-scale changes, the shift toward a more digitized culture has given rise to new social practices, artifacts, identities, spaces, and relationships (Gee, 2010; Jenkins, Purushotma, Weigel, & Clinton, 2009). Among these new developments are shifts in are the ways that people exchange meaning around socially-shared symbol systems - collectively referred to as literacy practices (Serafini & Gee, 2017). As digital media technologies evolve, so too to the digital-age literacy practices that often arise around them (Rowsell et al., 2013).

Despite these changes, researchers, educators, and others involved in literacy education have identified major points of disconnection between the ways the literacy is taught in schools and the ways that people experience literacy in their everyday lives (Gee, 2004; Gee & Hayes, 2011; Paradise & Rogoff, 2009; Street, 2006). For example, while written language systems continue to be privileged in formal instruction, evaluation, and policy, scholars have recognized that "everyday" literacy experiences actually involve high degrees of multimodal complexity across a variety of print and digital media (Lankshear & Knobel, 2011). Nevertheless, in the context of institutionalized literacy education, the primacy of written language can be seen in a

variety of ways. One of these ways is in the approaches to analyzing the ease or difficulty of text for readers - typically by quantitative or qualitative methods, but always with central focus on printed language.

The idea of quantitative, or statistical measures of readability was that statistical formulas could be used to determine how difficult a text might be to read. What are now considered more "traditional" measures of readability were designed to account for variables such as sentence length, word length, frequency of unique words, use of pronouns, and grammatical structures, such as prepositional phrases. Widely recognized among literacy curriculum developers, these include the Fry Readability Graph (Fry, 1963), the Dale-Chall Formula (Dale & Chall, 1948), the Fleish-Kincaid formula (Kincaid, Fishburne, Rogers, & Chissom, 1975), the Gunning fog formula (Gunning, 1968), and the SMOG (McLaughlin, 1969) formula. Over time, and as technologies improved, more complex measures of readability have been developed that took into account other dimensions of a written text (Graesser, McNamara, & Louwerse, 2003). The main contribution of quantitative approaches such as readability formulas for literacy educators and researchers was in offering systematic means to understanding the literacy demands of written text.

Criticisms of quantitative readability analysis typically focus on three overlapping limitations of the approach: (1) a seemingly "mechanistic" treatment of culturally complex artifacts (Sirico, 2007), (2) lack of explicit attention given to conceptual, or meaning-based, complexity of texts (Davison & Kantor, 1982), and (3) challenges to consequential validity based on empirical research (Blau, 1982; Pearson, 1974). Given

the criticisms and limitations of readability formulas, it became clear to some that additional approaches focusing more on reader than text, needed to be envisioned.

Developing partly in parallel, and partly in response to these quantitative approaches to readability, were more qualitative approaches to analyzing text complexity - that is, based on the interpretive analyses of the qualities of texts themselves. One strand of qualitative text complexity analyses took the form text-leveling systems, which relied on expert judgment to systematically group different texts into increasing levels complexity (Pearson & Hiebert, 2014). A second approach was in the form of rubric-exemplar systems, in which existing texts (exemplars) are selected to "anchor" different ends of a scaled rating system (a rubric) for judging the sophistication of text features (DiPardo, Storms, & Selland, 2011). Finally, there are text-mapping systems, which examine the conceptual structures of text, first by focusing on outlining the key ideas, then displaying them visually in some sort of diagram that highlights the relationships among those key ideas (Bruce, Osborn, & Commeyras, 1993). As Pearson and Heibert summarize, all types of qualitative text complexity analyses can serve to "vet, validate, or/or adjust the recommendations of quantitative systems." (2014, p. 20).

While recognized as moving the field of literacy education forward, qualitative approaches to analyzing text complexity are not without their limitations. One key issue challenging the adoption of qualitative text complexity analysis is their apparent reliance on subjective judgment, at least in comparison to readability formulas – whose quantitative nature is often ascribed with the idea of "objectivity." However qualitative analyses of text complexity may address the limitations of readability formulas, they still must be able to garner a level of trust and accountability to enjoy widespread use among

literacy practitioners. With particular regard to rubric-exemplar systems, there is the tendency of interpreting exemplar texts as encompassing a kind of canon or works that all students need to understand and master. Further, such approaches can lead to assumptions about homogeneity, that is, that all students should be able to read a particular text at a given level of text complexity.

Recent efforts such as the U.S. Common Core State Standards (CCSS) have recognized the importance of integrating qualitative and quantitative approaches to determine developmental appropriateness of texts in an English/Language Arts Curricula (Common Core Initiative, 2012). Additionally, the CCSS includes a third dimension of text complexity analysis under the label of "reader and task" considerations. In official documentation, these are left up to local determination based, ideally, on the professional judgment of teachers and administrators enacting the standards in local contexts.

More than Words: Multimodal Approaches to Literacy

A key limitation that cuts across both quantitative analyses of readability and qualitative analyses of text complexity is a privileging of language-based modes of communication, that is, written text. Quantitative readability formulas, typically designed to account for sentence and word length, typically ignore all other features of written text, including visual images and features such as tables, charts, and graphs, thus weakening their applicability to the ever-expanding range of texts that rely on multimedia for communicating meaning. Qualitative text complexity analyses have at least recognized the presence and role of media artifacts, but typically relegate the role of visual imagery and media to a secondary one: supporting the verbal meanings of written text.

While the existence and role of illustration and graphics in written text has been at least recognized by adopted systems of text complexity, these approaches have placed less emphasis on the primacy of multimodality (Jewitt & Kress, 2003; Kress, 2009)- that is, how a variety of modes of communication work together to represent meaning in the media that students encounter in and out of school. To address this issue, a growing number of scholars working in the field of multimodality have developed a variety of approaches for understanding textual artifacts such as comics and sequential art (McCloud 1993); children's picturebooks (Serafini 2010); websites (Djonov et al. 2015); and video games (Gee 2015). These approaches to multimodal texts deliberately address the socially-situated, meaning potentials of these artifacts, and may provide important insights into the multimodal digitally-networked texts increasingly encountered by readers of all ages in contemporary society.

Many perspectives on multimodal literacy are founded on the core premise that every textual artifact we encounter is about much more than just language (Jewitt, 2009a). As opposed to language-based, or logocentric views of literacy, multimodal approaches seek to address the full range of communicational forms that people use: visual, auditory, gestural, etc., as well as the relationships between them. While the idea of multimodality, can be seen as an overarching term unifying a variety of different approaches, perspectives on multimodality can be understood as grounded in a common set of assumptions.

The first of these assumptions, as outlined by Jewitt (2009a), is that language is part of a multimodal ensemble - that is, an integration of a variety of modes for communicating and representing meaning. These modes draw from a variety of semiotic

resources for meaning-making, which can include color (G. R. Kress & Van Leeuwen, 2001), voice and music (Martinec, 2004), space, gesture and movement, gaze, and sequencing. Baldry and Thibault (2006) refer to this idea as the resource integration principle, which "views a semiotic resource as something used for the purposes of making meaning and which accordingly functions in the texts in which these resources are used to this end." (p. 18). In short, whenever people seek to exchange meaning, we always do so through a variety of modes, including language, and drawing from a variety of semiotic resources for making meaning.

Related to this is a second foundational assumption underpinning multimodality: that "each mode in a multimodal ensemble is understood as realizing different communicative work" (Jewitt, 2009a, p. 15). Key to this premise is the assertion that all modes, including language, have been shaped through different cultural, social, and historical uses to realize particular social functions. Because these functions are not fixed, but instead situated in particular social contexts, different modes of communication have been utilized for a variety of purposes by people in different social situations. Unlike more "traditional" perspectives on literacy that might view non-linguistic modes of meaning-making as simply supporting written or spoken language, multimodality views different modes as doing different kinds of work to communicate different kinds of meaning as part of a multimodal ensemble.

A third foundational premise of multimodality is that people orchestrate meaning in their selection and configuration of modes (Jewitt, 2009a). Connecting back to the first and second foundational assumptions, this suggests that it is not just the separate modes, but the interaction between them that is significant for meaning-making. As scholars in

this field are readily recognize, multimodal communication is not a new phenomenon - 20,000-year-old cave paintings in France offer some of the earliest evidence of this (Jewitt & Kress, 2003; Serafini, 2013; Stöckl, 2004). However, the possibilities of combining modes in 'new' media made possible through digital technologies have prompted scholars to consider how these combinations can shape meaning-making in modern contexts (Serafini, 2012b; Ventola, Charles, & Kaltenbacher, 2004). Contrasting the Common Core's perspective on "non-essential" media in text, meanings made in any mode are inseparable from the meanings made with all other modes co-present and co-operating in a multimodal ensemble or communicative event (Jewitt, 2009a)

Finally, multimodality is founded on an assumption about the social nature of signs created from multimodal resources. Like language, they are shaped by the norms and rules present at the moment of sign-making, influenced by the intentions and identity of a particular person or sign-maker, and always situated in a specific social context (Jewitt, 2009a). This emphasis on the social helps to connect scholarship in multimodality with perspectives in the New Literacies studies that define literacy primarily as a social practice, rather than a cognitively pre-determined set of processes (Rowsell et al., 2013).

While the above core assumptions can be seen as unifying the varying perspectives on multimodality, scholarly approaches to studying multimodal phenomena have taken on a variety of forms over time. Rather than detailing the varying approaches to research in the field of multimodality more generally (Such an overview can be found in Jewitt, 2009b), the following section examines these approaches as they have been

applied to contemporary websites and related educational digital media, which are the focus on this study.

Multimodality, Hypermedia, and the Web

Before moving forward with the analysis, it may be helpful to clarify some of the terms surrounding the objects of the analysis. The terms websites, webpages, and web applications are commonly used in the research, professional, and popular to describe the different elements of the World Wide Web. At its core, a website can be understood as a unified collection of webpages - hyperlinked documents that can be accessed by users through software used to access the internet called web browsers. Earlier scholarship on the hypertextual nature of these digitally-networked documents has conceived of them primarily from a language-based perspective, hence terminology such as hypertext and ergodic literature (Aarseth, 1997). As digital technologies developed capacity for rendering more multimodal experiences, scholars began to propose notions of hypermodality to describe how combining hypertextuality and multimodality could multiply meaning-potentials of these artifacts (Lemke, 1998; Lemke, 2002). Other scholars elected to expand the focus of the term hypertextuality to consider the increasing nature of multimedia that could also be linked together - digital games, videos, and books for example, thus yielding the term hypermedia (Borsook, Higginbotham-Wheat, & Nancy, 1992; Djonov, Knox, & Zhao, 2015).

As of this writing, digital technologies developed even beyond the display of static websites to more dynamic and interactive ones, a distinction is sometimes drawn between a website and a web application, or "web app." While there are technical distinctions, this discussion focuses on the degree of interactive potential that has been

designed into a web app, as opposed to a more static web-page display (Nations, 2016). This may be more concretely understood through example: email readers such as Microsoft Outlook, online word processors such as Google Docs, and online games that can be played through internet browsing software are considered web apps due to the degree of functional and explicit interactive potentials designed into them. Considering this definition, we might note that within the domain of education, content is increasingly being disseminated through these dynamic web apps (including Learning Management Systems like Blackboard) than through static web-pages (Ferlazzo, 2016).

For the purposes of this discussion, I will refer collectively static webpages, dynamic web apps, and the broader websites that these are hosted on as digital hypermedia artifacts, following identification across disciplines of the World Wide Web as the largest hypermedia system ever created (Berners-Lee et al., 1994; Borsook et al., 1992; Djonov et al., 2015; Eshet-Alkalai, 2004; Gallagher & Freeman, 2011). Distinctions in this manuscript will mainly be made between these elements when they are more informatively discussed separately from another.

Three Ways to Look at Digital Media: On, Behind, and Beyond the Screen

The sub-questions guiding this interpretive analysis are organized around three dimensions of understanding the meaning-making potentials of websites and digital media more broadly. The three dimensions, or "lenses" for analysis, consider the meaning-potentials of these artifacts as constructed (1) on the screen, (2) behind the screen, and (3) beyond the screen.

Following the analytical logic of Serafini's (2010) tripartite framework for reading multimodal texts, I recognize that these dimensions cannot exist in isolation. At a

practical level, it is very much the underlying digital technologies "behind the screen" that render the digital media, such as websites and video games, as we perceive them "on the screen." (Borsook et al., 1992; Djonov et al., 2015). And as technologies and media can be understood as material instantiations of social meanings, the sociocultural context "beyond the screen" cannot be ignored in such an analysis (Pauwels, 2012). However, just as Serafini demonstrated the value of multiple perspectives as affording alternative viewpoints and analytical tools, I contend that separately theorizing these three "lenses" through which we can look at these websites, and perhaps digital media more generally, can expand the interpretive repertoires of students, educators, and researchers. In the following sections, I outline each of these perspectives, which will define the conceptual framework guiding this analysis.

What's On the Screen?

In our contemporary world of digital media, the computer, tablet, or smartphone screen represent the main interface through which users engage with networked digital media such as computer applications (apps) and video games. Thus, this proposed framework begins with an analysis of what is displayed, or rendered on the screen. The majority of scholarship in multimodal analysis of digital artifacts as hypermedia sites has provided several well-articulated approaches that focus on meaning as it is constructed on the screen. These approaches encompass a range of fields and disciplines, including semiotics, visual communication, professional web design, linguistics, and literacy studies (Djonov et al., 2015; Gee, 2015; Lemke, 2002; Pauwels, 2012; Serafini, 2010; The New London Group, 1996). The value of such an interdisciplinary approach is summarized by Albers (2008), who asserts that scholarship that may not always be

directly associated with literacy can provide further insight into how readers make sense of their worlds, and we can better support them in this.

Focusing primarily on the visual aspects of multimodal artifacts, Serafini (2010) argues that before images can be interpreted in their social contexts of production, reception and dissemination, qualities of these images must first be perceived, distinguished, and processed. In addition to these static images, multimodal websites and related digital media are increasingly drawing on dynamic images, such as animations, and aural elements, such as sound effects and narration (Pauwels, 2012) as modal resources for representing meaning. Thus, one key aspect of an on-the-screen understanding of these digital media artifacts is recognizing their perceptual qualities.

Perceptual qualities of a website include what is presented to the eye or ear by the digital technologies that render images, text, animation, and sound for the users of that site. As Serafini (2010) clarifies, Our perceptual system "simultaneously limits and calls attention to what we are able to perceive and understand," and thus before we can engage in any act of interpretation, we must first be able to perceive whatever there is - words, images, or sounds - to be interpreted (p. 93). An important distinction between print and digital media, however, are the digital technologies such as computers, smartphones, or tablets that act as intermediaries in rendering elements such as text, static images, dynamic images, video, and audio on a website.

Regardless of how these elements are rendered, no act of perception can be considered objective, "innocent," or naive. Instead, research has demonstrated that even our perceptual systems are guided by our prior knowledge and experiences, social norms, and cultural expectations (Gombrich, 1977; Graham, Grugeon, & Pepper, 1990;

Richardson, Berger, & Goodheart, 1974; Stafford, 2008; Zeki & Nash, 1999). As Serafini (2010) summarizes, “We attend to what we notice, and what we notice depends on what we understand. Readers cannot interpret that which is not perceived, and what is perceived can change based on what is understood” (p. 93). Focusing primarily at the digital media that is rendered on the screen suggests that factors such as the presence of multimodal elements (e.g. What is here to be perceived?), the qualities of the elements themselves (e.g. How large or small are elements in relation to one another? How distinguishable are they from one another?) and their composition, arrangement, or design (e.g. How are elements laid out on the screen?) (Pauwels, 2012; Serafini, 2010). Considering the literacy demands that might be placed on a user for perceiving, distinguishing, and processing what is on the screen, these factors might be grouped into a set of questions that can serve as a tool to guide a formal analysis.

Perceptual Demands Tool: What is here to be perceived? What are the salient features of the elements present - in size, color, shape and more? How distinguishable are different elements from one another? How are elements “laid out” or organized - in relation to one another and across the artifact?

As no act of perception can be considered objective, we can identify an additional analytical tool that focuses on what meanings are being represented by the perceptual elements being rendered in these artifacts. As Kress and Van Leeuwen state, “"Any semiotic mode has to be able to represent aspects of the world as it is experienced by humans. In other words, it has to be able to represent objects and their relation in a world outside the representational system" (1996, p. 42). What multimodal scholars have come to know as the representational metafunction is meant to describe this meaning, and draws from Halliday’s conception of the ideational metafunction in language (Halliday, 1978). In his own analysis of the ways meaning is multiplied when when multimodality

is combined with hypertextuality, as in the design and traversal of online websites, Lemke (2002) described this semiotic function as presentational, as it presents some state of affairs, typically through a combination of multiple modes of meaning. Regardless of the label one chooses, the focus here shifts toward questions of how meaning and/or ideas being represented, how semiotic resources are being drawn upon to represent this meaning, and how multimodal elements come together to represent meaning together. The literacy demands that might be placed on a user in this case center on for identifying, categorizing, and interpreting, what is on the screen, as summarized by the following questions:

Representational Complexity Tool: How is meaning / are ideas being represented? What semiotic resources are being drawn on to represent this meaning? How do multimodal elements represent meaning on their own? How do they represent meaning together?

Expanding on the idea of representation, one might argue that "things don't simply mean something in and of themselves; they mean in order to be used for some purpose" (Holmes, 2013). Applying this logic to the domain of videogames, Holmes argues that part of the design of the semiotic "work" of these digital media artifacts is to orient user to the purposes and potential uses of these artifacts. As another side to Serafini's assertion about the human perceptual system, this line of argument posits that the design of multimodal texts, including videogames and websites, an inform, or cue our perceptual systems to the different purposes or uses of these artifacts. Holmes uses the term orientation to describe these designed perceptual cues. In the case of the digital hypermedia artifacts considered in this analysis, we can consider on-the-screen features that are designed to orient users to the purposes and functions of the artifacts, features such as composition, arrangement, color, salience, and others. In this sense, the literacy

demands placed on a user of these artifacts may be mediated by these orientational supports, as summarized by the following questions:

Orientational Support Tool - What features on the screen orient users to what the site means and how it works? How is perception and representation limited, constrained, or guided through the use of composition, arrangement, or design? How are users oriented to what they can functionally do within the space of the artifact?

To realize the meaningful purpose - that is to use these digital hypermedia artifacts requires more than just observing the features rendered on-the-screen, however. Websites, mobile applications, and digital games must all be "acted on" by a user to realize their designed meaning potentials. In the case of digital technologies, this requires us to shift our focus away from just what is on the screen, but toward an understanding of the underlying technologies that give rise to digital media as we perceive, interpret, and orient ourselves to it. In short, to continue the analogy of our lenses of analysis, we need to learn to look "behind the screen" as well.

What's Behind the Screen?

In the same way that scholars have recognized multimodality as the "late discovery of the obvious" (Stöckl, 2004), multi-tiered perspectives on digital media are not new. Baldry and Thibault (2006) for example, characterized three hierarchical levels of analysis that could be used to conceptualize websites. What they call the "L" level corresponds to the multimedia (screen, audio) interface itself that a human user engages with, as well as the dynamic assembling of a web page as a multimodal text. I have referred to this as the "on-the-screen" dimension of digital hypermedia artifacts. At the "L+1" level, they address the context of culture, or the "system of interpretance in, and through which, meanings are recognised and interpreted." (p. 111). This roughly corresponds to the concept of the "beyond-the-screen" dimension further discussed in this chapter. Finally,

they identify the "L-1" level, as the virtual combinations of bytes, as well as their dynamic assembling as data to be read by a computer program.

However, while Baldry and Thibault conceptualize these as hierarchical levels, I contend that they are more productively understood as overlapping dimensions as I propose this analysis will demonstrate. The work of Bhatt and De Roock (2014) for example, has identified digital literacy events as encompassing a kind of sociomateriality, which makes it difficult to practically separate the social, digital, and material aspects of these experiences from one another. Salen and Zimmerman (2003) also call into question the construct of the virtual dimension as a singular "level," as even computer software itself is comprised of multiple layers besides "combinations of bytes," from applications and files, to operating systems, to machine-language code, to binary information, and all the way down the electronic signals.

Further, Baldry and Thibault argue that "bytes per se and their combinations on Level L-1 are neither accessible nor directly potentially meaningful to us on our human scale," (2006, p. 112) a claim that has come to be refuted by scholars in the area of Critical Code Studies. The counter argument states that computer code is ultimately understandable by humans, because it is humans that have designed it be read by both human and machine (Montfort et al., 2012). These scholars further assert that code can be understood as a cultural resource, bound up in the same cultural contexts of other semiotic resources used by people to represent meaning. Finally, this line of argumentation underscores the fundamental relationship of code to its cultural implications. Montfort and colleagues (Montfort et al., 2012) illustrate this claim in a more "high-stakes" example that nevertheless might be applied to a variety of situations:

> For instance, in order to fully understand the way that redlining (financial discrimination against residents of certain areas) functions, it might be necessary to consider the specific code of a bank's system to approve mortgages, not simply the appearance of neighborhoods or the mortgage readiness of particular populations. (2012. p. 6).

It is along these related lines of reasoning that I contend that the behind-the-screen dimension, comprised of the many layers of sociomaterial meaning discussed above, should be considered a core dimension of the analysis of digital hypermedia artifacts. The following sections discuss three analytical tools that may help make productive meaning of the multimodal literacy demands of this dimension.

As I have alluded to in a previous section, the concept of interactivity is often identified as what separates "new" media such as websites, mobile device applications, and video games, from "nonresponsive" media such as printed textbooks (Gee, 2015). In the case of this analysis, degree of interactivity is often cited to distinguish static web pages from web applications, their more dynamic, interactive cousins. However, interactivity in itself is a broad and vague term, and its definition has often been taken for granted by enthusiasts and critics of digital media alike (Aguilera, Kachorsky, Gee, & Serafini, 2016). Salen and Zimmerman (2003) provide a useful framework for understanding interactivity from the perspective of game studies. They describe four broad types of interactivity in relation to a materially-mediated, meaning-making experience: (a) cognitive interactivity, or the ''in-the-head'' interpretations of the ''content'' of a text, (b) functional interactivity, or interactions with an digital media artifact that are utilitarian, such as how a button press functions, (c) explicit interactivity, consisting of what the users actually do the functional interactivity of an artifact, and (d) meta-interactivity, which goes beyond individual use of an artifact to how users might

interact with other people around it. Salen and Zimmerman note that these types of interactivity are not mutually exclusive and can take place simultaneously and are common in some form to all of our media experiences, not just within games.

In the context of website analysis Adami (2015) defines interactivity as the affordance of a (digital) text being acted upon, which expands on the notion of hypertextuality to include, for example, the ways that users of a website can rate, comment on, or share content. Her three-part conception of website interactivity consists of 1) an interactive site/space (anchor), 2) the action of a user (input) required to 'activate' the anchor, and 3) an optional 'effect' that is realized upon that user action. Is against the backdrop of these framings that I summarize a tool for analyzing the interactive potentials of these digital hypermedia artifacts:

Interactive Potentials Tool: What sites/spaces of interactivity comprise the artifact? What user actions are required to "trigger" effects? What effects are produced as a result of user actions? To what degree do functional and explicit interactivity relate to one another in the designed user experience?

Building further on the work of Salen and Zimmerman, we can further conceptualize at the behind-the-screen dimension that digital hypermedia artifacts are governed by different sets of rules, some materially tied to the technological platforms they are accessed through, others designed by creators of the artifacts. Rules, from the perspective of these scholars, are fixed, binding, and repeatable constraints on user actions. While some of the "rules" constraining user action, or functional interactivity with these artifacts, is tied to technological elements such as computer code, rules more broadly comprise an experience beyond the constraints of programming languages - this experience emerges as a result of a user's interactions. A tool for understanding these rules might be framed as follows:

Rules and Limitations Tool: What constraints or limitations are placed on user interactivity with the site? How do these constraints work together to frame user experience? To what degree are these rules explicitly stated, and to what degree are they implied or "discoverable?"

Rounding out our analysis at the behind-the-screen level are a consideration of the technologies that these digital hypermedia artifacts are accessed through, what they afford users, and how they might inform the experience of users at the on-the-screen level. These technologies range from material hardware, such as a computer, through the varying layers of the software experience alluded to in our previous discussion. From the perspective of literacy demands, it stands to reason that a deep knowledge of all inner technological workings may not be necessary for users to make meaning from these artifacts. However, if users as to develop in their digital literacies from a productive dimension, not just a receptive one, then some degree of understanding of the technologies and affordances becomes essential. In other words, if students are to move beyond passive consumers of digital media content to remixers, curators, and designers, they will need to develop an understanding of how technologies themselves can be used to give rise to social meanings through digital media. To inform this analysis, we may consider the following questions:

Technologies and Affordances Tool: What do the technologies that these artifacts are accessed through afford users in their experience? How do they inform the experience? What support is available for the effective abilities of users?

A consideration of the design of these artifacts, whether at the on-the-screen on or behind-the-screen dimension, leads us to the question of about the designers, of these artifacts, as well as those they imagine they are designing for, for what purposes, in what contexts, and toward what ends? To respond to these and other related questions, we must

turn our attention away from rules, tools, and technologies, and toward social and material realities "beyond the screen" that may also inform these experiences.

What's Beyond the Screen?

For the purposes of this analysis, considering issues "beyond the screen" means emphasizing the broader social contexts and consequences that are bound up in these digital hypermedia artifacts, including ideologies, perspectives, or points of view that are embedded with varying degrees of transparency (Serafini, 2010). Considering these issues, we can examine questions about the sites of production, contexts of audiencing and dissemination, consequences/ implications of use, and ideological transparency of the artifacts in question.

The conditions - material, social, historical, and economic - that any text is produced in have the shape the meaning-potentials of that text. Applied to the context of digital hypermedia artifacts, these different sites of production should be considered when evaluating the potential experience of a user with that artifact (Rose, 2012). Further, decades of research in literacy education have demonstrated that prior understandings and background knowledge also shape the experience of a textual artifact, be it material or digital (Wolf, 2017). Contexts of use can also shape these experiences, as reader-and-tasl considerations in widely-adopted standards have formally recognized (National Governors Association Center for Best Practices & Council of Chief State School Officers., 2010). For these reasons, the following questions may be useful for interrogating the sites and contexts that these artifacts are produced, disseminated, and utilized in.

Sites and Contexts Tool: How might sites of production, contexts of use, and broader social/cultural/historical factors have influenced the creation of the artifact What outside

understandings/experiences might shape understanding/use of site? To what degree is a user's experience dependent on these broader contexts?

As digital technologies become more networked and the collection of information on users (sometimes under the umbrella term of "big data") becomes more contentious, understanding the potential consequences of using digital tools is becoming more and more essential. Different websites, for example, may require transactions such as the creation of user accounts, which trades personal information for access to different areas of a site. Certain online games may include embedded advertisements that may target young users. And ultimately, engagement itself with different applications such as social media networks may impact the way a user understands and experiences the world, online and off. Thus, an analytical tool focusing on these consequences and implications of use may ask the following questions:

Consequences and Implications Tool: What are the potential outcomes/ repercussions/ implications of engaging with this artifact? What transactions might occur as a result of this engagement, and who benefits from these? How might this engagement impact the way a user sees/experiences other related artifacts or practices in the world?

Finally, as all of textual artifacts, digital or material, are produced by humans in society, they are embedded with ideologies, perspectives, views of audiencing, and agendas that may shape the production, dissemination, and use of the artifact in different ways (Serafini, 2010). What may vary among different artifacts is the degree to which these ideologies are made clear or obscured by the design of the artifact or related media. Additionally, the design of these artifacts may position users with different degrees of agency, though these positionings can be taken up, rejected, or transformed by users of a certain mindset in ways sometimes unanticipated by the designer (Santo, 2013). Thus, to

understand literacy demands from an ideological perspective, we may consider the following questions:

Ideological Transparency Tool: How transparent are ideologies, perspectives, points of view, embedded audiences, and agendas that shape the artifact? How are these made clear or obscured by design? How are users positioned to take up, reject, or transform these ideologies or agendas?

As Serafini summarizes, considering the "cultural, historical, and political or ideological ramifications of the production and reception of visual images and multimodal texts is an important consideration in understanding multimodal texts in contemporary society." (2010, p. 99). If the digital hypermedia artifacts such as those analyzed here are to be systematically examined, this analysis must include explicit attention to these beyond-the-screen considerations as well.

From Meaning Potentials to Literacy Demands

The complexity of printed language in a text has been demonstrated to influence the ways that students decode, make meaning with, use, and critique these texts (Luke & Freebody, 1999). At the same time, considering the multimodal dimensions of texts suggests that students may be drawing on different practices and resources for navigating, interpreting, interrogating, and designing visual and multimodal artifacts such as the interactive web applications analyzed for this project (Serafini, 2012a). For the purposes of this analysis, I will use the term "literacy demands" (Lemke, 1998) to describe a more comprehensive view of the expanding cognitive resources, social practices, and material tools that users of digital media artifacts must draw from to participate in the exchange of social meanings around these artifacts. This definition is meant to encompass both the receptive (reading / viewing / listening) and the productive (writing/designing/speaking) dimensions of print-based and multimodal literacies Lemke, while still leaving enough

room to application to evolving forms of literacy using digital technologies. Historically, Lemke (1998) has used the term "literacy demands" in his analysis of the multimodal literacy practices students in school were tasked with engaging in as they navigated a formal science curriculum. In the present analysis, we can consider these literacy demands as they might be applied to digital media artifacts across the three dimensions outlined above.

Analytical Procedure

We have established a multi-dimensional framework of the literacy demands of contemporary web applications as encompassing what is on the screen, behind the screen, and beyond the screen. We can combine these dimensions with the logic of a more "general purpose" framework such as Pauwels' (2012) Multimodal Framework for Analyzing Websites as Cultural Expressions to develop a more specialized analytic approach applicable to the interactive web applications examined for this study. The original approach highlighted the following steps:

1. Preservation of first impressions & reactions
2. Inventory of salient features and topics
3. In-depth analysis of content and formal choices
4. Analysis of POV & implied audiences & purposes
5. Analysis of information organization & spatial priming
6. Contextual analysis, provenance, & inference

Following Pauwel's logic, we can move from what is more immediately apparent "on the screen," to an analysis of the rules and tools acting "behind the screen," and finally to a contextual analysis of what lies "beyond the screen" regarding message senders and recipients, embedded ideologies and perspectives, and consequences and implications of

use. We can assemble the analytic "tools" outlined above to form a series of "toolkits" that allows us to approach the literacy demands of these artifacts in a more unified way.

"On the Screen" Toolkit: This set of analytical tools emphasizes multimodal elements that are rendered for users for perception and interpretation through digital platforms, as well as features designed to orient users in local contexts of use. Included here are the perceptual demands tool, the representational complexity tool, and the orientational support tool.

"Behind the Screen" Toolkit: This set of analytical tools describes the interactive potentials of digital media artifacts, the underlying rules that constrain their functionality, and the affordances offered by the particular technologies that these media are accessed through. It is through this toolkit that interactive potentials, rules/limitations, and technological affordances are addressed.

Beyond the Screen Toolkit: This set of tools emphasizes the broader social contexts and consequences that are bound up in these digital media artifacts, including ideologies, perspectives, or points of view that are embedded with varying degrees of transparency. Using this toolkit, we can examine questions about the sites of production, contexts of audiencing and dissemination, consequences/implications of use, and ideological transparency of the artifacts in question.

These toolkits form the core analytical framework through which the two digital hypermedia artifacts hosted on different online websites: Khan Academy's Introduction to Drawing with JavaScript: Simple Snowman Challenge (Khan Academy, 2006-2017) and Code.org's Hour of Code Classic Maze (Code.org, 2013-2017).

Each of these artifacts was regularly used by students participating in the larger observational study in which this current analysis is situated. Each resembles, to different degrees, a dynamic and interactive experience more akin to the web application or "web app," as opposed to a static web page. Each artifact focuses on teaching computer science content, particularly in the area of algorithms and computer programming, and is targeted toward novice audiences. The artifacts and websites they are a part of all appear designed for independent access outside of an institution, as evidenced by an automated account creation system not requiring a school-based identification. Finally, the artifacts are drawn from sites with a well-established user base outside of the research context, and are owned by well-known organizations that have existed for at least 3 years. These selection criteria were adopted to ensure that the websites analyzed were representative of recent trends in interactive educational websites, yet offered enough variety to yield comparative insights that could be applied to the analysis of other networked digital media artifacts.

To conduct the on-the-screen analysis, the two artifacts were first identified through an extended period of participant observation on the site of a library-based computer programming club in an metropolitan public library in the American Southwest. The sites were accessed at varying points between May 2017 and October 2017 via direct URL using a Google Chrome internet browser (Version 61.0.3163.100, 64-bit official build). The browser was installed and run from a 13-inch 2014 Macbook Air laptop running on the Mac OS Sierra Operating System (Version 10.12.4) on a 1440 x 900 pixel resolution. I directly inspected each site based on what was initially rendered on screen upon full page loading (as indicated by the browser) and across any scrolling

that needed to be done to display the full length and width of the page. For determining elements such as font size, color palette, and media file types, the in-browser "Inspect" feature was used to reveal the source code underlying each page. Interpretive analysis at the On-the-Screen level then proceeded according to the questions framing the on-the-screen toolkit (Holmes, 2013; Lemke, 1998; Serafini, 2010):

> **Perceptual Demands Tool:** What is here to be perceived? What are the salient features of the elements present - in size, color, shape and more? How distinguishable are different elements from one another? How are elements "laid out" or organized - in relation to one another and across the artifact?
>
> **Representational Complexity Tool:** How is meaning / are ideas being represented? What semiotic resources are being drawn on to represent this meaning? How do multimodal elements represent meaning on their own? How do they represent meaning together?
>
> **Orientational Support Tool** - What features on the screen orient users to what the site means and how it works? How is perception and representation limited, constrained, or guided through the use of composition, arrangement, or design? How are users oriented to what they can functionally do within the space of the artifact?

Analysis at the behind-the-screen level was conducted partly in conjunction with the on-the-screen analysis, using the same technological platforms to access the sites. Functional interactive potentials for each site were identified according to the (a) presence of distinguishable interactive sites/spaces, (b) user input or actions required to realize the optional effects of interactivity, and (c) effects produced through user actions on the interactive sites/spaces (Adami, 2015; Zimmerman & Salen, 2003). The underlying rules guiding and constraining the functional and explicit interactivity of each artifact was analyzed by activating all identified interactive potentials and categorizing these rules as explicitly identified or implicitly "discovered" through use of the artifact. Finally, technological affordances of each site were identified by exploring the bounds of these

rules as they related to the technological platforms - both hardware and software - that the artifacts were accessed through (Gee, 2015). Again, interpretive analysis proceeded through application of the behind-the-screen toolkit questions framed in the preceding section:

> **Interactive Potentials Tool:** What sites/spaces of interactivity comprise the artifact? What user actions are required to "trigger" effects? What effects are produced as a result of user actions? To what degree do functional and explicit interactivity relate to one another in the designed user experience?
>
> **Rules and Limitations Tool:** What constraints or limitations are placed on user interactivity with the site? How do these constraints work together to frame user experience? To what degree are these rules explicitly stated, and to what degree are they implied or "discoverable?"
>
> **Technologies and Affordances Tool:** What do the technologies that these artifacts are accessed through afford users in their experience? How do they inform the experience? What support is available for the effective abilities of users?

Analysis at the beyond-the-screen level of each artifact was conducted iteratively throughout the on-the-screen and behind-the-screen phases of analysis, using the same technological platforms to access the sites. For this dimension of the analysis, a more extensive traversal of the websites hosting each artifact was conducted to identify the following: the organizational entities claiming ownership, date of establishment of each site, terms of service, and embedded perspectives and ideologies that might resonate throughout the site (Lemke, 2002; Pauwels, 2012). Additionally, secondary materials including online articles, encyclopedia entries, externally hosted source code (e.g. GitHub repositories), and research documentation, were consulted to provide a broader frame of the social/cultural/political/historical/economic issues surrounding each artifact. Interpretive analysis guided by questions from the beyond-the-screen toolkit was informed by both primary and secondary sources:

Sites and Contexts Tool: How might sites of production, contexts of use, and broader social/cultural/historical factors have influenced the creation of the artifact? What outside understandings/experiences might shape understanding/use of site? To what degree is a user's experience dependent on these broader contexts?

Consequences and Implications Tool: What are the potential outcomes/ repercussions/ implications of engaging with this artifact? What transactions might occur as a result of this engagement, and who benefits from these? How might this engagement impact the way a user sees/experiences other related artifacts or practices in the world?

Ideological Transparency Tool: How transparent are ideologies, perspectives, points of view, embedded audiences, and agendas that shape the artifact? How are these made clear or obscured by design? How are users positioned to take up, reject, or transform these ideologies or agendas?

The analytical procedure concluded with a comparison of features of each site across the three dimensions of analysis. Comparisons included quantitative summaries of categorized features, as well as qualitative dimensions of textual complexity and multimodal analysis.

Applying the Toolkits: Two Sites Across Three Lenses

The focus of this project was to closely examine three networked digital media artifacts designed to teach computer programming to novice users to draw inferences about potential literacy demands of each artifact. Unlike static webpages, these artifacts might be more accurately understood as "web applications" in their degree to dynamic functionality and interactivity, though this varies across sites. While scholars such as Pauwels (2012) have emphasized frameworks that examine entire sites, this analysis takes an approach more akin to Zhao's (2012) in-depth analysis of multimedia interactives within children's websites. As outlined above, the analysis will proceed across artifacts, beginning with an analysis on the screen, moving behind the screen, and

finally, expanding beyond the screen. I will frame findings from this analysis as a comparison of these dimensions across the different sites, and then situate these in the broader context of research and practice in digital literacies today.

Khan Academy: The Simple Snowman Challenge

Khan Academy is a non-profit educational organization created by Salman Khan in 2006 and dedicated to the provision of online resources across a wide variety of subject areas. These resources began through the form of video lectures for students hosted on the YouTube platform, but has expanded to include supplementary practice exercises and materials for educators. This analysis will focus on the Simple Snowman Challenge, which is located within the broader Khan Academy Computer Science subject area, as part of the Introduction to JavaScript: Drawing and Animation. JavaScript is a computer programming language commonly associated with the development of interactive sites and online applications, and in this Challenge, is used to introduce concepts of "drawing" on the screen using computer programming commands.

Simple Snowman: What's On the Screen?

On visiting the URL for the Snowman Challenge, users are presented with a mostly white screen, with black, sans-serif text. The screen is bordered by a green menu across the top of the page and a list of labeled icons on the left side, and a dark blue menu with white text at the bottom. Taking up the largest part of the central panel is a set of connected white boxes, empty but for a numbered line annotation and a few buttons that appear faded in color. A black and white square and circle appear with a string of letters, symbols, and numbers in the upper-right hand corner under the letters "Hint." Text appears relatively small throughout the page (14 pixels from the examination of the

page's source code). Language and visual elements appear easily distinguished from one another in an overall grid-like layout. With a simple, primarily white color palette, an uncluttered visual layout, and text interspersed across headings, icons, and buttons throughout the page, one might judge a relatively low-level of perceptual demand, at least in comparison to rich multimodal ensembles that characterize children's educational materials in print and online.

Quantifying the number of distinguishable media elements present supports this qualitative interpretation. The page combines two clusters of continuous text with three main section headings, the third of which heads a list of hypertext links. Non-continuous text includes 19 words/phrases arranged throughout the page. Five green and grey icons line the left-side of the page, with an additional heart-shaped icon adorning a username at the bottom. In addition to the 5 labeled icons, 5 other snippets of text are accompanied by other multimodal features, including the Hint image in the top right corner and elements styled as "buttons," which appear as text contained within a colored block or other shape. A total of 10 colors are rendered on this page, with several being different shades of green and grey, and the majority of the page rendered in white.

Moving from perceptual elements to multimodal representation, meaning on the screen is being communicated through combinations of visual and textual elements throughout the displayed webpage. These elements can be considered relatively static, as their lack of animation suggests they are not drawing from gestural or motion-based semiotic resources. The central text under the heading Simple Snowman Challenge appears to be a set of instructions for users to follow to progress in the tutorial. These instructions represent strings of letters, numbers, and other keyboard symbols that must

be entered into a blank input area, or "scratchpad" in the center of the page. As strings that are recognized by the computer program are typed into the space using a physical or virtual keyboard, an adjacent area displays the "output" of the computer programming commands in an area labeled the "canvas." The icons on the left side of the page, along with their corresponding hyperlinks, denote different areas of the Introduction to JavaScript: Drawing and Animation module. These icons include a right-facing triangle reminiscent of the "play" button in electronic media, which links users to an embedded video page with more explicit instruction about programming in Javascript. A star-shaped icon denotes interactive challenges that users can complete, which include the current Simple Snowman Challenge and a more advanced Waving Snowman Challenge. Finally, a "page" icon labeled "Quick Tip: Number Scrubbing" leads users to a text-based webpage with a dynamic image known as a GIF.

Finally, considering orientational supports designed into the Simple Snowman Challenge, we turn our attention to the features that orient users to how the Challenge works and how to complete it. These include syntagmatic elements, which are displayed on the Challenge's landing page, as well as parasyntagmatic elements, which direct users to other pages of the site (Adami, 2015). On the page itself, headings divide segments of text on the page and orient users to the overall task, as well as which part of the task they are completing (creating the bottom, middle, or head of the snowman). Instructional text that provides directions for completing the challenge, though some room for interpretation is suggested in the language used ("We've suggested some...but you can change…"). The hyperlinked list of module components on the left side of the page points users to on-site resources that further contextualize the challenge, including an

introductory video and tips for using the development environment (central input/output area) that the Challenge is meant to simulate. Finally, a "Hint" area in the upper-right corner of the page's central section displays an image of the "ideal" output of the user's programming, as well as the string of code used to generate that output.

As users begin to write strings of code into the scratchpad, a small cartoon image of a face at the bottom of the area appears to change expressions. When clicked, the face enlarges to provide corrective feedback based on the users' input. Depending on the nature of the users' input, this feedback can also take the form of orange, bolded text that appears above the development environment. If the user has entered the "ideal" string of code, or a string with close numerical values, affirmative feedback appears in the form of a smiling yellow cartoon animal, and the button for "Next Step" saturates with a dark green color. Until this state is achieved, the button is de-saturated and unclickable.

Since an "ideal" string of code is provided in the Hint section, savvy users may be tempted to use a computer's copy/paste function to enter this into the scratchpad of the development environment. However, upon attempting this, users are met with an error message that states "To make sure you get the most out of these challenges, we've disabled pasting code from outside. Studies show that typing code helps our brain solidify the concepts more." While not initially stated, this represents one of many "rules" constraining users actions within the Challenge, and leads us to an examination of what is happening "behind the screen" of the Simple Snowman Challenge.

Simple Snowman: What's Behind the Screen?

The functional interactive potentials of the artifact fall primarily into two categories of user input/action, following Adami's (2015) typology. In first category are hypermedia

anchors which can be activated by users with a mouse click, and which trigger various syntagmatic effects, such as the closing or opening of a message box, or parasyntagmatic effects, such as linking users to external pages or resources. Quantifying these anchors yields 16 potentially interactive anchors in the main Snowman Challenge page, 8 anchors in the navigational menu on the left side of the screen display, and 5 anchors in the site header menu at the top of the page. Each of these anchors can be activated by a similar user action (mouse click), though each activation is tied to a single effect.

The second category of interactive potentials concerns the keyboarding input options by the user. While the "Search" bar in the header menu follows similar stylistic (magnifying glass icon) and functional (type the term(s) you want to search for), the development environment that users engage with is more complex. While any letter, number, or symbol accessible to the user via a keyboard can be inputted into this area, only particular sequences, or "strings" of letters, numbers, and symbols can be "read" by the computer program rendering user "inputs" in as visible "outputs" in the designated space of the development environment. Based on the title of the overall module this challenge is selected from, users must input strings of code from the programming language JavaScript for an output to be rendered. Further, only a small range of JavaScript commands (in this case, the command for drawing an ellipse of a certain position and proportions) will trigger a "completion" message for the current step of the process and "unlock" the Next Step button in the tutorial.

Considering these and other "rules" that are designed into the tutorial, we can shift the attention of our analysis between what rules are "explicitly" stated for users, and which are implicit, or designed to be discovered by the user through use and

experimentation. In the case of the Simple Snowman Challenge, explicit "rules" for how the coding scratchpad and canvas tools function are distributed across several videos and documents elsewhere on the Khan Academy website, while many more are implicitly discoverable by users. A sample of the explicitly stated rules that govern the function of the coding scratchpad/canvas are as follows:

Explicit Rules:

1. Every time a user enters a programming command, it has to be followed by parentheses and a semi-colon for it to be rendered properly on the canvas.
2. If a user enters the "ellipse" commands, four numerical values must be entered in between the parentheses.
3. These numerical values need to be separated by commas.
4. Each value controls a different aspect of the ellipse to be drawn:
    a. The first value is the horizontal location, or x-coordinate of the ellipse.
    b. The second value is the vertical location, or y-coordinate.
    c. The third value is the width of the ellipse, or w-value.
    d. The fourth value is the height of the ellipse, or h-value.
5. Missing values or punctuation marks, such a semicolon, will result in an incomplete or incorrect (from a user's perspective) rendering on the canvas.

In addition to these, however, a wide range of more implicit rules also governs the functionality of the scratchpad/canvas tool, as well as progression through Snowman Challenge overall. Some have been alluded to above, but are included in the sample summarized below:

Implicit Rules:

6. Users must enter strings of text, numbers, and symbols in the scratchpad area that conform to commands in the JavaScript library used for the project in order for an "output" to be rendered in the canvas area.
7. A user can enter commands other than the ellipse() command, and, if accurately specified (from the computer's perspective), will render an output in the canvas area.
8. If a user wants to progress to be recognized in the tutorial, the user must enter the ideal ellipse command specified in the Hint area, or a close approximation of the values within that command.
9. If an unrecognized string is entered by the user, an error message results.
10. If the correct string is entered by the user, an affirmative message results, and the next step of the tutorial is unlocked.

11. Contrary to the tutorial video entitled “Making Drawings With Code,” users that attempt to use the copy/paste function of their computers will be met with an error message.
12. Users can skip forward and back in the tutorial by clicking on small grey bars at the bottom of the scratchpad area, but will be met by error messages.

While these rules only provide an example of the many levels of rules (e.g. What “counts” as JavaScript command? How do JavaScript commands go from user input to computer output?) designed into the artifact, they provide an illustration of the complexity of tasks inherent as a user attempts to complete the “Simple” Snowman Challenge.

Finally, we can turn our attention of this behind-the-screen analysis toward the affordances and limitations of the technologies that give rise to the user’s experience of the Simple Snowman Challenge. Though this analysis was conducted through a laptop computer, a similar experience might be inferred if the artifact was accessed through a desktop computer, with on-the-screen renderings facilitated by tools such as a monitor and speakers, and user activation of interactive potentials facilitated by tools such as a keyboard and mouse. Across these devices, however, the Simple Snowman Challenge requires an internet connection to access, as the data and code that create it are stored on computers owned by the proprietors of Khan Academy. Further, a sufficiently strong internet connection is required for downloading, processing, and rendering multimedia such as videos, text, GIF images, and the scratchpad/canvas tool which comprise the artifact. This experience may be further affected by the prior experiences of users with hardware tools such as computers and keyboards, along with software such as internet browsers, educational websites, or similar programming environments. These issues

invite us now to explore the some of the behind-the-screen literacy demands that might inform users' experiences of this digital media artifact in different ways.

Simple Snowman: What's Beyond the Screen?

Khan Academy, the website on which the Simple Snowman Challenge is hosted, was registered as an organization in 2006 by Salman Khan, a few years after tutorial videos that he had released on YouTube had begun growing in popularity (Dreifus, 2014). The videos Khan produced initially grew out of family tutoring sessions with his cousins. While publically recognized by individuals such as Bill Gates, critics of the site have questioned the lack of teaching credentials and experience of its founder, potentially prompting Khan to hire additional support in the form of content area and pedagogical specialists (Danielson & Goldenberg, 2012; Strauss, 2013). Following the 'About' link at the bottom of the site, users can learn that the organization has grown to over 150 individuals, including people responsible for producing and maintaining content such as the Simple Snowman Challenge on the site.

Despite the interactive potentials discussed in the prior sections, it stands to reason that students' experience with reading instructional or procedural texts may impact their experience of the Simple Snowman Challenge. Briefly reviewing the entire Intro to JavaScript: Drawing Basics, module of which Simple Snowman is a part, the structure of the experience appears as follows:

1. Watch video;
2. Read tip sheet;
3. Complete procedural activity;
4. Watch video;
5. Complete more complex procedural activity.

Users' prior experience with / disposition towards such an approach may also impact the way they engage with the module. Despite the location of the Simple Snowman Challenge as part of the introductory experience, other factors that may impact this experience could include: students' comfort with keyboarding, dispositions on learning, initial interest in domain area, and the context of use - for example, in a home setting vs. as part of a more formalized school-like approach.

Considering potential consequences and implications of engaging with the artifact, we can first turn to issues indexed by features that appear on the screen itself. Below the main scratchpad/canvas area of the Challenge, and About section credits the artifact to user 'pamela (KA teacher ♥)'. Text below this states that "All code is owned by its respective author and made available under the following license: MIT license" while "All non-code (such as writing, drawings, images, etc.) are also owned by their respective author and made available under the following license: Creative Commons Attribution License." Each of these license names is hyperlinked to a page that describes the terms of use and reuse, under the Creative Commons and Open Source Initiative, respectively. While users have the ability to remix and reuse the content, legal issues of ownership and intellectual property are explicitly connected to these practices.

As the site's "About" page indicates, content on Khan Academy is free for users to access, though users must create and account and be logged in to "save" their progress. Creating an account yields a profile page that displays progress data, as well as posted user content, which is addressed in the site's "Terms of Service," gives the organization the legal right to "host, transfer, display, perform, reproduce, distribute, prepare derivative works of, use, make, have made, sell, offer for sale, import, and otherwise

exploit" original content posted by users. Following a link within the "Terms of Service" to the site's "Privacy Policy," users can learn that Khan Academy collects the following information about registered users:

- **Personal Information, "**such as your full name, email address, or a photograph of yourself."
- **Information from Integrated Services like Facebook or Google.**

  Information about your use of the site, "such as the number of problems you have attempted, the number of videos you have viewed, and the amount of time spent to complete a problem."
- **Information obtained from other Users,** such as child information provided by a parent.
- **Location Information,** such as the country from which a user access the site, though the site does not collect "the precise geolocation of you or your device."
- **Information from Third Party Sources, including** personally identifying information from donation or recruitment sites.

The Privacy Statement also specifies that the organization does not sell personal information to third parties, takes extra precautions to protect users under the age of 13, and does not host advertisements on their site. Among these are parental approval and monitoring controls for under-13 accounts. In making these points, they foreground their identity as a non-profit organization with an educational mission, which is embedded throughout the site in aspirational language, images, statistics of learners served, and displays of association with like-minded organizations.

Returning to the ideologies and worldviews embedded in Simple Snowman and its associated module, we can consider the ways that perspectives on the target domain - computer programming - are presented to users. An earlier video in Khan's Computer

Programming curriculum seems to present the domain in a positive, pragmatic light, stating that "you can use programming for almost anything," and citing examples of programming applications from education, to space exploration, to game design (Fox, 2015). Perhaps to contrast the perception of computer programming as a male-dominated field, the "What is Programming?" and "Making Drawings with Code" videos are narrated by a female voice and credited to Pamela Fox. The "What is Programming?" video goes on to claim that learning the programming language JavaScript will make learning other programming languages easier, as they all follow similar underlying principles.

The Simple Snowman Challenge follows the formula for a class of Khan Academy content known as "step-by-step coding challenges," which often include video "talk-throughs," hints and tips, and a set of procedures for learners to follow that lead to a completion state, typically evaluated by an automated system. While another class of Khan content takes the form of more open-ended projects, some with peer-evaluation features, step-by-step challenges such as the Simple Snowman Challenge may suggest the perception of computer programming as based on following a set of procedures, though other experiences such as MIT's Scratch and Code.org's Classic Maze present other models of what it means to program. Finally, the inability for users to copy/paste text due to "research on learning" seems to jive with a perception in computer science that "copy-and-paste programming" implies a lack of experience and is generally used pejoratively in communities of computer programming practice (Yarmish & Kopec, 2007).

So, how transparent are these ideologies made for users, and how are users positioned in relation to them? On the Simple Snowman Challenge itself, users are presented with

links to descriptions of various intellectual property licenses, the creator ‘pamela (KA teacher ♥)’s’ profile, the Terms of Service, and a site map at the bottom of the page with links to the About Page, a Help Center, and Donation/Volunteer options. The Privacy Policy can be accessed directly through a small (12px) link at the very bottom of the page. Overall, Khan Academy’s links to its public mission statement, terms of service, creative licensing, and privacy policies appear to be displayed in plain sight of users and easily accessible. However, a formal display of the Terms of Service of Privacy Statement appears to be lacking as part of the account creation process. Users can comment on particular challenges, “flag” for issues, and engage in discussions with content creators. On the other hand, as stated in the terms of service, all uses of this content grant “worldwide, non-exclusive, transferable, assignable, fully paid-up, royalty-free, perpetual, irrevocable” rights to the Khan Academy organization.

As we have seen, an understanding of sites of production and contexts of use can inform user experience of artifacts such as the Simple Snowman Challenge on Khan Academy. Engagement with the content carries consequences and implications, which appear available for users to explore on the site, but demand at least a cursory understanding of those consequences for fully informed use. Finally, particular ideologies embedded in Simple Snowman and the content that surround it may not only inform users’ experience within the activity, but perceptions of the broader domain of computer programming. To further contextualize the literacy demands on, behind, and beyond the screen of Simple Snowman, we can turn to an examination of another hypermedia artifact, one also addressing the domain of novice computer programming, but in some notably different ways.

Code.org: The Hour of Code Classic Maze Code.org is a website and eponymous non-profit organization launched in 2013 by siblings Ali and Hadi Partov designed to encourage students, particularly those in the U.S. to learn computer science. In addition to providing freely accessible coding resources for learners online, the site includes resources for educators and administrators interested in providing more computer science offerings as part of their classes and schools. This analysis will focus on the "Classic Angry Birds Maze," which is located within the broader Hour of Code section of the Code.org website (http://code.org/learn). While the Code.org's Hour of Code offerings have expanded to a searchable database of varied activities, navigating via URL to the original Hour of Code section (http://studio.code.org/hoc) leads users to the Classic Angry Birds Maze that comprised one of the earlier Code.org offerings. The Classic Maze features a series of puzzles that users must solve by arranging colored "blocks" together in different sequences. These blocks comprise elements of visual programming language "Blockly," and is meant to provide a simplified approach to learning text-based programming languages like JavaScript. The Classic Maze Module itself is comprised of a total of 20 different puzzles, though for this analysis, the first puzzle will be the primary digital hypermedia artifact of focus.

Classic Maze: What's On the Screen?

On visiting the URL for the Classic Maze module, users are first met with a Code.org produced video that provides an introduction to the concept computer programming, as well as an overview of how the Classic Maze works. On closing this video, users are faced with the main screen of the Classic Maze, which appears to be divided into several areas. Across the top of the screen is a teal border with the text "Classic Maze" most

prominently displayed in a sans-serif white typeface. On the left of this header is a black-and-white icon comprised of the letters “C,” “O,” “D,” and “E.” In the center is a grey rectangle with small white circles, the first of which is enlarged and labeled with the number 1.” White text that states “I’ve finished my Hour of Code” appears to the right, followed by a white-bordered rectangle labeled “Sign In” and an icon comprised of three white horizontal lines.

On the left side of the screen are images of a stylized, red-colored cartoon bird, and a similarly styled green-colored pig character, surrounded by orange blocks on a green background. Below this bird-pig-block image is an orange button with the text “Run” displayed next to a right-facing white triangle, and below that, a smaller image that appears to have been taken from the introductory video, and labeled with the text “Need Help? See these videos and hints.” At the very bottom of this area is a white rectangle labeled with the text “English ⬍” To the right of this is blue text labeled “Privacy Policy,” and grey text labeled “Copyright,” and “More ▲.”

Adjacent to this left-most area is a large (60% of the page) central area bordered by a grey background. A white square with a purple heading divider are labeled with the text “Workspace 2/3 blocks,” while a smaller division of this area (labeled “Blocks”) contains teal-colored blocks , each labeled with text and icons. Each “block” element gains a yellow border when a user hovers the cursor over the element. Within the purple section divider, two lighter rectangles with rounded edges are labeled “↻ Start Over” and “</> Show Code.” These turn a shade of blue when a user’s mouse hovers over them. Finally, the red bird character appears again over the Workspace area, with a white-colored bubble of text appearing next to it that states “Can you help me to catch the

naughty pig? Stack a couple of "move forward" blocks together and press "Run" to help me get there." The visuals on the page draw from a wide variety of modal resources, suggesting a different set of perceptual demands for than, for example the Simple Snowman challenge.

Quantifying the number of distinguishable media elements present can proceed with a consideration of visual elements laid out on the Classic Maze's main screen. The page combines four clusters of continuous plain text with four main section headings. Non-continuous text includes 4 words/phrases arranged throughout the page as hyperlinks. 9 icons are interspersed throughout buttons, hyperlinks, and section headers on the page. Excluding the still-image of the tutorial video at the bottom-right corner of the screen a total of 22 colors are rendered on this page, with several being different shades of teal, green, orange, and purple, and the large sections of the page rendered in white and shades of grey. While it takes some interaction with the artifact, a total of 7 sound effects can also be elicited in this first page.

As in the Simple Snowman challenge, the meaning of these perceptual elements is being communicated through combinations of visual and textual elements on the displayed webpage. These elements can be understood as static when they are displayed on the page without animation or state change, dynamic when they are animated or move between different states of display, or as interactive effects, when they come as a result of user input or action with different elements of the artifact. An example of interactive effects are the sound effects that are triggered when a player has arranged the blocks in a recognized "correct" pattern and presses the "Run" button to display an execution of the code commands.

One representational feature that may be easily recognizable by school-age students engaging with the Classic Maze are two cartoon characters from the Angry Birds video game series. These characters are "Red," a red bird who serves as a player-controlled in the series, and a "Minion Pig," who appears as a green pig face and represents the player's enemies in the game series. These characters appear in the left-most "Maze" display area surrounded by orange blocks that are arranged in different ways to comprise the maze element of the puzzle. According to the introductory video, the goal of each "level" in the module is to connect sequences of programming blocks such that, when the "Run," button is pressed and the program executed, will instruct the Red Angry Bird character to successfully move to the Green Minion Pig character.

The "Workspace" area on the page is akin to the "scratchpad" input area of Khan Academy's Simple Snowman Challenge. A key difference in the Classic Maze's design, however, is that rather than inputting text commands via a keyboard, users solve the Classic Maze puzzles by dragging the colored blocks from the "Blocks" area into the "Workspace," attaching blocks to one another to form a sequence of programming commands. The "Maze" area in which the Angry Birds characters area are located is analogous to the Khan Academy's output, or "canvas" area, with the difference here being that visual elements (such as the characters and maze blocks) are pre-rendered, and the user's block-based coding inputs only modify certain elements; the Red Angry Bird can be moved, but the Green Minion Pig cannot, and neither can the maze environment be rearranged.

The programming blocks themselves also appear to represent different meanings. A block labeled "move forward" is likely used to control the position of the Red Angry

Bird, while the two blocks labeled “turn left ↺” and “turn right ↻” will likely control the direction that the character faces. As a user progresses through the Classic Maze’s 20 levels, additional blocks appear in the “Block” section of the page, including a grey “repeat until…” block, and a pink “if [condition met], then do [action], else do [alternative action]” block. Returning to the first level, “starter” code blocks appear pre-rendered in the workspace, including an orange “when run” block attached to a teal “move forward.”

Different colored throughout the page appear to be linked to different functions, including a “Run” button which transforms into a “↻ Reset” button when clicked, a “↺ Start Over” button, and a “</> Show Code,” which displays how the programming blocks can be converted into the JavaScript programming language. The 20 circles that line the top of the screen appear to correspond to the 20 different levels of the Classic Maze module, and players can click a circle at any time to be re-directed to the corresponding level.

Considering orientational supports designed into the Classic Maze include the introductory video which appears on a user’s first visit of the module, plain text that appears as “dialogue bubbles” overlaid across several elements, the overall layout of the page, and the combinations of color, shape, and text that comprise the blocks and buttons users can interact with. The introductory video provides users with an overview of the purpose of the Classic Maze puzzles (to learn computer programming), how to interact with puzzle (drag colored blocks into the workspace area and attach them to one another), and how to address mistakes or failures to complete the task (different ways to start over). Dialogue bubbles include text displayed next to a static image of the Red Angry Birds

character which states “Can you help me to catch the naughty pig? Stack a couple of "move forward" blocks together and press "Run" to help me get there.” Of note here is the ambiguity inherent in these directions. Rather than explicitly stating how to solve the puzzle, users must infer or experiment to discover what constitutes “a couple” of blocks for the purposes of solving the puzzle. Additional dialogue appears here if the player Runs a series of commands that do not lead to the ideal outcome of the puzzle. Finally, combinations of colors, text, and shapes that comprise different buttons and blocks on the page can also serve as orientational supports. Different colors appear to indicate different “classes” of blocks, while text and symbols on blocks and buttons appear to orient users toward their functionality or use.

Classic Maze: What’s Behind the Screen?

Turning our analysis toward the functional interactive potentials of the Classic Maze Challenge, we can see some key differences from the overall interactive structure of the Simple Snowman Challenge, though certain interactive potentials may be similar. For instance, Classic Maze also makes use of hypermedia anchors activated by mouse clicks that close and open message boxes or even recall the introductory video for users to revisit. Other syntagmatic effects include executing the user’s programmed commands with the “Run” button, removing user-added code blocks from the Workspace with the “Start Over” button, and opening a sub-window that converts blocks into JavaScript commands with the “Show Code” button.

However, in contrast to the text input “canvas” of Khan Academy, Code.org’s site includes a category of interactive potentials based on a user’s “dragging” of programming blocks (by clicking, holding down, and moving a mouse or other cursor controller) into

the workspace area. While providing a much smaller selection of elements for the user to manipulate than a text-based input area, this “block dragging” function is also guided by a set of rules, among which are the explicit rules discussed in the introductory video:

> The goal of your first program is to get an Angry Bird through a maze to hit a Green Pig. Each block in the toolbox corresponds to a command. The left side is the maze where your program is run. The middle toolbox has the commands for the Angry Bird. You'll use these to build your code. On the right is your workspace where you'll drag blocks from the toolbox to build your program. To delete a block, drag it to the trash in the corner. Each block is one instruction. If you drag a "move forward" block to your workspace and press "Run Program", the bird moves one space on the maze. To do more than one action, you can drag many blocks to your workspace and attach them together. The bird will do the commands from top to bottom. If you run a program and want to fix it and try again, press the "Reset" button.

In addition to these, however, users will also discover other rules governs the functionality of the Classic Maze Challenge, including:

1. Blocks must be dragged into workspace area adjacent to other blocks until a yellow border indicates they can be “connected.”
2. Only chains of blocks connected to the “when run” block will be recognized.
3. New “move” blocks must be connected to the middle and the end of existing chains, but not the top.
4. When the “Run” button is pressed, code commands are executed from the top block in the “when run” chain to the bottom.
5. Even if the player used a large amount of extraneous code blocks, as long as the final outcome of the code commands leads the Red Angry Bird to the Green Minion Pig, the challenge will be considered complete.

Similar to the Simple Snowman Challenge, the Classic Maze challenge evidences a high degree of implicit rules that add complexity to the experience of the explicitly stated rules.

With regard to technologies that the Classic Maze artifact is accessed through, an internet connection is also required for to engage with the artifact, which is hosted on Code.org servers. Further, a sufficiently strong internet connection is required for downloading, processing, and rendering multimedia such such as videos, text,

animations, images, and the toolbox/workspace which comprise the artifact. This experience may be further affected by the prior experiences of users with hardware tools such as computers and mice, along with software such as internet browsers, educational websites, or similar programming environments. The affordance of being able to start over or attempt a puzzle as many times as a user likes contrasts with the constraints of much input a user is able to have in the workspace area. These may, in part, index the ideologies and perspectives beyond-the-screen that may inform the production, dissemination, and use of the artifact.

Classic Maze: What's Beyond the Screen?

Much younger as an organization than Khan Academy, Code.org was launched in January 2013 by Hadi and Ali Partovi, as a non-profit focused on making computer science more accessible to a wide variety of people. While their initial focus was on creating a database of all computer science classrooms in the United States, the site gained an immense following after releasing a video featuring Mark Zuckerberg, Bill Gates, and other recognized figures, prompting a fundraising effort by Hadi that yielded $10 million. A year later, Code.org posted a one-hour tutorial series around customizing the video game Flappy Bird, which eventually expanded to other educational content, including the Classic Maze artifact that is focused on in this study.

Resembling more of a puzzle-based experience than Khan Academy's procedural tutorials, and indexing popular digital media characters recognizable to younger audiences, use of Code.org's Classic Maze may be more impacted by users' prior experiences with games and digital puzzles than reading procedural texts. For example, like games, the Classic Maze module:

1. Features a rich multimedia environment that focuses more on "showing" than "telling;"
2. Appears designed to reveal understandings through exploration and experimentation;
3. Facilitates "safe" failure - in fact, no fail state exists, only a "win" state;
4. Provides visual feedback and representation of user progress;
5. Presents more open-ended solution sets with multiple pathways to success.

Users' prior experience with / disposition towards such an approach may also impact the way they engage with the module. Other factors that may impact this experience could include: students' comfort with using tools like mice and touchpads, tolerance for ambiguity, initial interest in domain area, and the context of use - for example, as a required assignment vs. an optional activity.

Considering potential consequences and implications of engaging with the Classic Maze, we can first engage in an examination of the stated Terms of Service of Code.org, as well as its Privacy Policy. Similar to Khan Academy, users can freely access content on Code.org, including the Classic Maze module, but also must create an account and be logged in to "save" their progress. The site's Terms of Service, which are nested inside the "More" menu at the bottom of the Classic Maze page include a provision granting the organization, among other rights, a worldwide, non-exclusive, transferable, assignable, fully paid-up, royalty-free, perpetual, irrevocable right and license to host, transfer, display, perform, reproduce, modify, distribute and re-distribute, adapt, prepare derivative works of, use, make, have made, import, and otherwise exploit your User Content, under all intellectual property rights therein, in whole or in part, in any media formats and through any media channels.

The site does provide a direct link to its Privacy Policy on the Classic Maze page, which includes a table summarizing data that is stored by Code.org when a user creates an account which include:

- Display Name (eg. “Cool Coder” or “John”) and username (eg "coolcoder7")
- User age (Not birthdate)
- An encrypted version of student email address, called a “hash”
- Login time, IP address, and other technical data
- Progress through Code.org courses
    - Date/Time each stage is tried
    - Number of tries to solve a puzzle, and whether it was solved successfully or optimally
    - Information on how the student solved the puzzle including time to completion and whether they used hints
    - The code that the student submitted
    - Student-provided answers to simple assessments (e.g. multiple-choice questions)
- Student Projects - apps, animations, stories, or code-art
- Student-uploaded images, sounds, or videos (for App Lab, Game Lab, and Web Lab Projects)

The table also details what stored data is mandatory, optional, or automatically generated, as well as how Code.org uses the data. A separate table details similar information for users who have created accounts as teachers. The Privacy Policy specifies that the organization does not sell personal information to third parties, takes extra precautions to student data such as information provided by a school district, and does not host advertisements on their site.

Returning to the ideologies and worldviews embedded throughout the Classic Maze module, we can consider the ways that perspectives on computer programming are presented to users. The introductory video for the module features appearances & spoken reflections from a number of entrepreneurs from the world of computer software, including Bill Gates of Microsoft and Mark Zuckerberg of Facebook. This may lend an air of credibility to the Code.org, as well as frame a kind of aspirational identity for

viewers: Perhaps, if they learn to code, they can become just as rich and famous as these individuals. A number of female programmers from established computer software companies including Janete Perez of the mobile game company Zynga, and Paola Minaya of Microsoft also make an appearance, perhaps to address concerns of gender and minority representation in the computer programming field. The instructional portion of the video itself is narrated by a young woman who introduces herself as Tanya, a computer science student. Tanya's casual speaking style and dress may index the intention on making programming seem down-to-earth and accessible to users of diverse backgrounds.

Contrasting the "programming as procedure" model that appears to characterize Khan Academy's Simple Snowman Challenge, the Classic Maze model appears to adopt a different approach of "programming as puzzle-solving." As previously discussed, this approach, which presents programming concepts through a series of puzzles to be solved, includes a more open-ended solution set, though it is still bounded by a specified outcome (get the red bird to the green pig). While Blockly, the visual programming language used in the Classic Maze can indeed be converted to JavaScript, the "Show Code" feature renders this code as plain text, which means users are unable to edit it or use it to solve the puzzle. As most professional programming is not done through visual languages like Blockly, but text-based languages, students who do not have exposure to other approaches to computer programming education may develop a perspective that is somewhat incongruous to the way programming is done in communities of practice beyond the visual programming domain.

Details about the historical development, consequences of use, and embedded worldviews in the Classic Maze module appear be readily accessible throughout the Code.org site. However, echoing elements of Khan Academy's beyond-the-screen dimensions, users may need additional support to access and understand documentation such as the Terms of Service and Privacy Policy. While these terms and policies may indeed be "industry-standard" for nonprofit organizations such as Khan Academy and Code.org, students use of other proprietary software, such as social media networks and search engines may indeed be informed by a deeper understanding of these issues.

Findings Across the Two Sites

This interpretive study set out to respond to the following question: What literacy demands can be inferred from an interdisciplinary analysis of web applications as multimodal artifacts positioned as teaching & learning objects in the domain of computer science education? The analysis of the two educational web applications in this study suggested a wide variety of literacy demands distributed across dimensions on the screen, behind the screen, and beyond the screen.

Considering the variety of on-the-screen literacy demands across Simple Snowman and Classic Maze Challenges, it stands to reason that solely text-based measures of literacy demands, such as quantitative readability and qualitative text complexity analyses, may be greatly enhanced by the use of multimodal approaches such as the conceptual framework and analytical procedure utilized in this study. Even with limited amounts of text displayed on the screen, analysis of each of these digital hypermedia artifacts suggested a range of perceptual demands, representational complexity, and orientational supports that could inform user experiences of these

artifacts. However, individual user abilities, perceptions, prior experiences, and contexts of use also powerfully inform the experience of the artifacts, and thus should also be a primary consideration for providing students with differential supports as they engage with these artifacts.

Behind the screen, the websites that host these digital media artifacts provided explicit statements about some of the rules that guided the functional and explicit interactivity designed into the experiences. However, this analysis also revealed a host of implicit rules that had to be discovered through use, suggesting layers of complexity that may not be immediately evident to student users or the educators invested in supporting them. The analysis also supported a framing of interactivity around the notion of "potentials" rather than fixed affordances or features (Adami, 2015). From a social semiotic perspective, signs have meaning-potentials rather than fixed meanings, and these potentials are highly sensitive to contexts of production, audiencing, and dissemination. In a similar fashion, digital hypermedia artifacts might be more accurately conceived of as having different degrees of interactive potentials, with effects optionally realized through user actions, but suggesting a less deterministic view of digital media and the technologies that give rise to it.

Beyond the screen, both of the sites and organizations that produce, disseminate, and maintain content such as the artifacts analyzed in the study have established a presence as non-for-profit educational organizations, and reflect this identity in the terms of service and privacy policies posted on the respective sites. Both sites take special precautions to protect data collected from use of the sites by students and those under the age of 13, though the organizations maintaining the sites also stand to benefit from the

users' engagement with this content. Users can comment on existing content, remix other users' content, and produce original content using tools developed by each site, providing some interpretive space for negotiating some of the ideologies and perspectives embedded in the current design of the sites. Ultimately, the sites make their policies and consequences of use available for users to access, though in some cases the complex and legalistic nature of this language may necessitate further support, especially for younger users, in understanding what happens beyond the screen as they access, engage, and remix these artifacts.

Implications, Limitations, and Further Research

On first glance, it may be easy to dismiss many of the digital media artifacts with which young learners are engaging today as overly-stimulating, simplistic, and more well-equipped to support play than learning, if such a distinction can even be drawn between the two. However, a closer and more systematic analysis of even a small sampling of these artifacts suggests their potential use as texts that can engage a variety of multimodal literacy practices. Further, the complex literacy demands identified across these digital hypermedia artifacts suggest that they can be utilized by educators to engage in conversations that further support the developing literacies of students in a digital age.

This study has illustrated how these literacies encompass users' navigation, interpretation, interrogation, and design of what is on-the-screen, as other scholars in the field have demonstrated. The study moves from supporting to extending these findings, however, by suggesting that these digital-age literacies can also encompass what is behind-the-screen, in terms of the rules and tools that give rise to the interactivity, functionality, and features of digital media artifacts. These literacies can even extend

beyond-the-screen, to engagement with the embedded ideologies, broader social contexts, and consequences of use embedded in digital media that connects users to the wider social world through the internet.

However, several limitations of the present analysis invite further exploration of these issues through additional scholarly efforts. First, though the project represented an in-depth, multi dimensional analysis of multimodal literacy demands, only two sites were presented for illustration of these points. Further research efforts may consider expanding the analysis to other digital hypermedia artifacts to examine whether the conceptual framework sufficiently theorizes related artifacts. Secondly, the project utilized an analytical toolkit proposed by the primary researcher and drawing from existing research across a variety of disciplines, but represents only one possibility in a range of interpretive approaches. Additional research utilizing an alternate set of interpretive tools may yield further insights into these and other digital hypermedia artifacts. Finally, and perhaps most crucially, this analysis focused almost exclusively on what Rose (2012) identified as the site of the text itself, without extensive analysis of the sites of production, dissemination, and audiencing that would warrant a more thorough examination of the digital hypermedia artifacts in a broader social context.

The next chapter of this manuscript, then, represents an attempt to extend the research into the sites of dissemination and audiencing by presenting a study of the contexts of use of these sites in a local library club for young adolescents.

CHAPTER 3:

YOUTH LITERACY PRACTICES IN A COMPUTER PROGRAMMING CLUB

This chapter details the second phase of a project designed to explore digital-age literacy practices through the close observation of a library-based computer programming club for youth, known colloquially as a Code Club. Drawing from the conceptual framework introduced in the previous chapter, this chapter 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 in the Code Club, which met for two separate sessions on Thursday afternoons, along with a library facilitator. I also served to co-facilitate these sessions throughout the research process. 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 patterns and discrepancies that could inform an understanding of the ways students drew on literacy practices to meet the various literacy demands they encountered as they navigated, interpreted, interrogated, and designed their learning experiences across virtual and face-to-face contexts (Serafini, 2012b).

Findings from this study suggest that while a wide variety of literacy practices can be observed while students engage with online content on screens, other practices may be obscured unless we pay specific attention to the ways that students are engaging with 'behind-the-screen' dimensions of online content, including the technological tools that render this content visible on our digital devices. Additional insight to students' literacy practices can also be gained from an examination of students' engagement with the 'beyond-the-screen' dimensions of their digital-age literacy experiences, including the

social contexts that simultaneously give rise to and are shaped by sites of online content production, dissemination, and everyday use. This study contributes to the broader literature base underpinning literacy education 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 literacies in a digital age.

Looking Beyond the Screen

In the previous chapter of this manuscript, I outlined a framework for interrogating the literacy demands of digital hypermedia artifacts such as interactive web applications and video games. I demonstrated how such a framework could be used to develop a set of analytical toolkits for understanding the meaning potentials of such networked digital media, addressing dimensions of content displayed on the screen, tools and technologies behind the screen, and broader social contexts beyond the screen. A key limitation of that work, however, was that my analysis focused almost exclusively on what Rose (2012) identified as the site of the text itself, without extensive analysis of the sites of production, dissemination, and audiencing that would warrant a more thorough examination of the digital hypermedia artifacts in an actual context of use.

The present chapter of this manuscript is an attempt to extend my research into the Rose's sites of dissemination and audiencing by presenting a study of a local library club for young adolescents learning through and about new technologies. Specifically, this study sought to address the following question: In what ways do students draw on literacy resources and practices as part of their experience in a computer programming club?

Literacy Resources and Literacy Practices

As I discussed in the preceding chapter, this project is grounded in a perspective of literacy as a situated, sociocultural, and multimodal phenomenon (Gee, 2010; Gee & Hayes, 2011; Rowsell, Kress, Pahl, & Street, 2013; Serafini, 2013). Literacy is situated in that it involves cognitive capacities (e.g. decoding and processing written letters), social practices (e.g. reading a bedtime story), 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 (Gee, 2010; Gee & Hayes, 2011; 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; Warschauer, 1997). 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, 2012b). This view of literacy 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 (Zimmerman & Salen, 2003).

The study presented in this chapter focuses on the idea of literacy practices, which we can understand as the social exchanges of meaning in which people engage around print-based or digital artifacts. The academic literature that has focused on literacy as a social practice has typically been grouped under the family of scholarship known as the New Literacy Studies, or the NLS (Gee, 2010; Serafini & Gee, 2017). Among the

foundational work in this body of scholarship is Heath's concept of a literacy event as "any occasion in which a piece of writing is integral to the nature of participants' interactions and their interpretive processes" (Heath 1982, p. 50). Street (1984; 1998; 2005) expanded this concept into the idea of literacy practices, to account Heath's conception of "events" while emphasizing the social practices people bring to bear upon those events and give meaning to them. Thus, the development of the NLS marked a shift in focus from the idea of literacy as an autonomous neutral set of skills or competencies that people acquire through schooling and can deploy universally, to a more ideological view of literacies as local, situated, and thus inextricable from questions of identity, power, representation, and other issues of sociocultural origin (Street 1984; 2006).

Despite these emerging views of literacy as an ideological and social practice, debates continued in the field of literacy education about the "best" ways to help young students become literate, commonly known as the "Reading Wars" in the U.S. (Pearson, 2004). In Australia, a related, but separate set of debates focused on the most appropriate way to approach the concept of "genre" in schools (Gee, 2017). Emerging from these embattled pedagogical and philosophical debates were models of literacy that attempted to avoid an "all-or-nothing" approach, including Freebody and Luke's (1990) Four Resources model of literacy. In its initial framing, this perspective emphasized four interrelated and interdependent "roles" that readers took on when engaging with written text:

- **The Reader as Code-Breaker** role emphasized the importance of engaging with the "technology" of the written text - letters, symbol-sound relationships, word recognition and other perceptual and cognitive dimensions of literacy that have since taken a prominent place in reading curricula today (Anderson et al., 1988).
- **The Reader as Text Participant** role emphasized developing the resources to engage with the meaning systems of the textual discourse itself - commonly

referred to under the umbrella term of "comprehension." (Freebody & Luke, 1990).

- **The Reader as Text User** role focused on the social context of literacy as a means for exchanging meaning with other people through written language. As Freebody and Luke summarize, "being a successful text user, then, entails developing and maintaining resources for participating in 'what the text is for, here and now'" (1990, p. 10). Finally,
- The **Reader as Text Analyst** role underscores the importance of understanding texts as crafted objects, written by persons with specific perspectives, agendas, and purposes, regardless of how "objective" these texts attempt to be; often this perspective is framed around the more familiar idea of "critical reading."

Revisiting these concepts in later work, the authors clarified that rather than fixed roles, these Four Resources were meant to represent a map of possible practices that readers could engage in as they made meaning of texts in social contexts (Luke & Freebody, 1999). Further, the authors have maintained that rather than seeing these practices in any kind of hierarchy, each should be viewed as necessary but insufficient on its own. In other words, nurturing the different families of practices, as well as combining them in different ways, should lead us to away from questions of whether one method is better than another for developing literacy, and toward questions of how different approaches foster different kinds of literacy practices, in different contexts, and toward different purposes.

Learning to "Read" the Visual

An important contribution of the Four Resources model was its emphasis on a plurality of socially-situated literacy practices, as well as its presentation to audiences in a way that was both theoretically rich and pedagogically actionable. However, the model's apparent emphasis on language-based perspectives of literacy and its focus on print-based texts have led other scholars to critically examine its applicability to the more multimodal texts that have come to dominate our contemporary literacy landscape.

One effort to extend these perspectives can be seen in the work to specifically address the unique challenges posed by visual and multimodal texts (Serafini & Gee, 2017). As outlined in the previous chapter, multimodal perspectives on literacy emphasize that, beyond written language, people draw from a wide variety of modal resources - composition, typeface, color visual images, and more - to create and exchange meaning through designed artifacts (Jewitt & Kress, 2003). In Serafini's (2012) Expanded Four Resources model, the concept of a text is re-defined to "address the multimodal aspects of communication and to include research and theories from visual culture (Barnard, 2001), semiotics (Scholes, 1982; Smith-Shank, 2004), critical media studies (Semali, 2003), grammars of visual design (Kress & van Leeuwen, 1996) and multi-modal analysis (Baldry & Thibault, 2006; Bateman, 2008; Jewitt, 2009)." In doing so, Serafini also expands the notion of reader to reader-viewer to better account for the perceptual, structural, and ideological aspects of visual and multimodal texts (Serafini, 2010). Thus, for Serafini, families of literacy practices expanded to include the following:

- **Reader as Navigator.** Beyond decoding, concepts of print, directionality, and sequencing, visual and multimodal texts often require readers to navigate the grammar of visual design (Kress & Van Leeuwen, 1996). Today's visual and multimodal texts, whether print or digital, can also involve non-linear structures, visual images compositional features that draw on different kinds of literacy resources and practices than purely language-based texts.
- **Reader as Interpreter.** The term "interpretation," while often used interchangeably with "comprehending," "understanding," "constructing meaning" and "making sense," aligns more closely with the philosophical position that no single "truth" exists in a text, but instead a range of possible interpretations (Rorty, 1979; Serafini, 2012a). Visual images, like written texts, do not exist in a vacuum, and so reader-viewers must learn to develop interpretive repertoires that address the features of multimodal texts within broader social contexts.
- **Reader as Designer.** As Serafini asserts, "readers of multimodal texts not only construct meaning from what is depicted or represented, but also design the way the text is read, its reading path, what is attended to and, in the process, construct a unique experience during their transaction with a text." (Serafini, 2012a, p. 158, emphasis mine). In addition, reader-viewers also construct, or design frames

around experiences with multimodal texts to consider them in the contexts in which they are realized.

- **Reader as Interrogator.** To interrogate visual and multimodal texts requires readers to consider the sociocultural contexts in which these texts are produced, as well as those in which they are received. Visual images are one means through which ideologies are produced and projected; thus learning to interrogate these texts for their embedded ideologies is an important consideration in today's educational environment (Rose, 2012; Serafini, 2012b; Sturken & Cartwright, 2001).

While not without its own challenges, Serafini's Expanded Four Resources model affords literacy researchers and educators an expanded perspective through which to consider the social practices and cognitive processes involved when people make meaning with multimodal texts. This perspective pushes us to reconsider what "counts" as a text, how we can more inclusively understand literacy practices, and most importantly, how we support others in developing ever-deeper interpretive repertoires with which to navigate, interpret, design, and interrogate the textual world around them.

New Media, New Literacies?

Both the Four Resources model and its multimodal expansion have pushed literacy scholarship forward through their emphasis on reading as social practice. But what happens when the texts we engage with begin to involve more than "just" reading? This idea is one of the underpinnings of the New Media Literacies Studies, or NMLS (Gee, 2010). This perspective asserts that as multimedia texts such as videogames, social media networks, and collaboratively developed websites involve more and more participation from users, so too should we reconceptualize the literacy practices in the participatory cultures that develop around them (Jenkins, Purushotma, Weigel, & Clinton, 2009). Jenkins and colleagues (2009) refer to the idea of "participatory cultures" as defined by:

1. relatively low barriers to artistic expression and civic engagement;
2. strong support for creating and sharing one's creations with others;

3. some type of informal mentorship whereby what is known by the most experienced is passed along to novices;
4. members who believe that their contributions matter; and
5. members who feel some degree of social connection with one another.

In a sense, the concept of participatory cultures overlaps somewhat with the idea of affinity spaces - virtual or physical spaces in which informal teaching and learning are orchestrated around a shared interest, or affinity (Gee, 2004; Gee & Hayes, 2011; Holmes & Gee, 2016).

Regardless of whether we term these social phenomena as "communities," (Lave, 1991) "cultures," (Jenkins et al., 2009) "spaces," (Gee, 2004), or even "ecologies" (Horst, Herr-Stephenson, & Robinson, 2009), the NMLS argues that the participatory media (Ohler, 2009) that are increasingly shaping social practices and experiences in the modern world require new kinds of competencies and skills for full involvement. Among the literacy practices identified by champions of the NMLS are:

> **Play** — the capacity to experiment with one's surroundings as a form of problem-solving; **Performance** — the ability to adopt alternative identities for the purpose of improvisation and discovery;
> **Simulation** — the ability to interpret and construct dynamic models of real-world processes;
> **Appropriation** — the ability to meaningfully sample and remix media content;
> **Multitasking** — the ability to scan one's environment and shift focus as needed to salient details.;
> **Distributed Cognition** — the ability to interact meaningfully with tools that expand mental capacities;
> **Collective Intelligence** — the ability to pool knowledge and compare notes with others toward a common goal;
> **Judgment** — the ability to evaluate the reliability and credibility of different information sources;
> **Transmedia Navigation** — the ability to follow the flow of stories and information across multiple media;
> **Networking** — the ability to search for, synthesize, and disseminate information; and
> **Negotiation** — the ability to travel across diverse communities, discerning and respecting multiple perspectives, and grasping and following alternative norms (Jenkins et al., 2009).

Gee (2010) argues that much of the NMLS co-evolved with the rise and proliferation of digital tools. Thus, perspectives on new media literacies have often (though not always) been considered in relation to digital media such as interactive websites, mobile software applications, and social networking platforms (Ohler, 2009). The present study builds on and extends these perspectives to develop an understanding of how these literacy practices can be enacted on, behind, and beyond the screens as students learn through and about new technologies.

Exploring Youth Literacy Practices in the Code Club

I turn now to a specific application of this framework of digital-age literacy practices as they are enacted by youth participants in a library-based computer programming club. The driving question of the study, as previously stated, is focused on the ways that students draw on literacy resources and practices as part of their experience in the Code Club. Guided by the conceptual framework developed in the previous chapter, this study of the Code Club experience will also be guided by attention to the following areas:

- The ways that participants' literacy practices appear to engage aspects of digital media content displayed on the screen;
- The ways that participants' literacy practices appear to engage aspects of digital literacies behind the screen, such as the rules that constrain the interactive potentials of digital media; and
- The ways that participants' literacy practices appear to engage aspects of digital literacies beyond the screen, such as the broader contexts of production, dissemination, and use of this digital media by wider audiences.

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, Barnett, & Squire, 2002; Denzin & Lincoln, 2008; Erickson, 1986; Guba & Lincoln, 1994; Lincoln

& Guba, 1985). While conventional approaches to empirical research may attempt to control for factors or variables that might affect the outcomes of a study, naturalistic approaches instead aim to capture the complexity of social contexts that may be "explainable only in terms of multiple interacting factors, events, and processes that give shape to it and are part of it." (Lincoln & Guba, 1986, p. 17).

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). These perspectives reject the notion that a researcher, or inquirer, can necessarily maintain a completely objective distance from participants or the phenomena of study, and instead should learn to embrace the importance of the interactive nature of participant-observer relationships, as it may be because of these relationships that both participants and researchers can meaningfully engage in learning together through the inquiry process (Lincoln & Guba, 1986). Sometimes referred to as "ethnographic" in nature, these relationships are often considered a central part of studies in the tradition of naturalistic and interpretive inquiry, including ethnographic approaches to educational research (Cavanagh, 2016).

Context and Participants

The present study 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 at 3:00-3:45pm, and one from 4:15-5:00pm) on Thursday afternoons, along with a library facilitator.

About 26% of the Code Club's participants identified as female, with the remaining 74% identifying as male. 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 in background experiences and interests outside of Code Club, which will be detailed later in this manuscript.

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 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 which included a youth computing area with 15 operating desktop computers. A donation to the library's program also provided 10 additional laptop computers.

As part of the design of Code Clubs, designated facilitators of each site - typically librarians - are not expected to create formal lessons or deliver a curriculum about particular coding languages or computer science concepts; rather, the stated goal of the experience, according to the program's online guidelines, is to extend opportunities for students to learn to computer programming even when a specialized computer science teacher is not available. As such, each site appears designed to distribute the teaching and learning experience across formal online tutorial programs (e.g. Code Studio, Khan

Academy, and MIT's Scratch platform), informal production experiences (e.g. experimenting with their own creative projects), and emergent interactions between Code Club participants (both online and "in real life"). The messiness of such a context thus lends itself to an approach to gathering data, interpreting meaning, and presenting findings in such a way that honors the complex and interwoven relationships between teaching, learning, and meaning-making in which participants are engaged. The Code Club featured in this project gathers once per week, for sessions of 45-minutes at a time. I have conducted observational work since September of 2016, when I first began working with the local Code Club, and have remained a facilitator-observer on site ever since.

I initially identified the local library Code Club as a site for research through a pilot study initially conducted as part of coursework in educational ethnography. The purpose of the project was to engage in a process of participant-observation at a local site that we (as students) hypothesized might have implications for the study of education. Through connections with leaders in the local non-profit and social entrepreneurship sectors, I was introduced to Code Clubs as a statewide initiative led by a local software development group invested in bring programming and computer science education to children and youth through library and afterschool programs.

Purporting to have designed an approach that blends the best elements of face-to-face and online learning, this organization works to develop software, including the online learning platform that Code Club students use to track their progress across multiple sites of learning, that is meant to support the self-directed and distributed model of education championed by the organization's founders. After this introduction, I became curious about what the program looked like "on the ground," and following a

visit to a Code Club in a neighboring city, found out that a similar Code Club met locally in the library not far from where I lived. Ultimately, this site was selected not necessarily for the purposes of representativeness, but rather as an illustration of a site of teaching and learning alternative to a traditional school setting, in order to explore the ways that phenomena of learning, literacy, and technology might be intertwined and illustrative of processes and practices that occur outside of more structured or formalized educational contexts.

Data Sources & Collection Procedures

Since the Fall of 2016, I have been serving to co-facilitate Code Club sessions along with local library facilitators. This partnership began as part of a course assignment in educational ethnography which I eventually developed into the present study. For the present study, I collected observational, survey, and audio-recorded data over the course of a 10-week summer session of the Code Club (June 1, 2017 - August 4, 2017). As some categories of data included several sources, each category is outline in the sections that follow.

Observational Data. The main source of observational data used in this study were post-session field notes that I composed after both Code Club sessions had ended, shortly after the closing of the library at 5:00pm, via audio-recording. I constructed field notes for nine of the ten sessions. I did not construct field notes during the first session, as much of my time and attention was spent orienting new participants to the Code Club experience. These field notes contained a more detailed narrative of my observations as a researcher/facilitator in the space. I composed these post-observation notes by speaking into Apple's natively installed Voice Memos app on an iPhone, and captured through a

wireless headset. I had the notes transcribed through a third-party service bound by a non-disclosure agreement, and then revised the transcriptions for accuracy and clarity while listening to each recording. The construction, revision, and analysis of these field notes were supported by in-session field jottings, survey data, and audio-recorded data as described in the following sections.

For eight of the ten sessions, I also collected observational field jottings during each meeting I was present in the Code Club space. I did not collect jottings during the first session, as much of my time and attention was spent orienting new participants to the Code Club experience. I was also absent for one session (July 27, 2017), and thus was unable to collect data for that day. For all of the other sessions, I used a mobile software application called Notebooks running on an iPhone 6 iOS 10 operating system to type my observations about the different websites and virtual spaces I observed displayed on the students' computers.

While I approached first two sets of field jottings (June 8 and June 15) in a more idiosyncratic fashion, the remainder of the field jottings followed a more structured observation protocol. Following the example of Hetkner, Schmidt, & Cziksentmihalyi (2007), I structured a time-based experience sampling approach into my observational jottings, taking stock of students' on-screen activities at the beginning (~5-10 minutes into the session), middle (~20-25 minutes into the session) and end (~35-40 minutes into the session) of each meeting time. These more structured "micro-observations" typically took the form of displayed page + website + detail for each student. Across cohorts, participation ranged from 7-15 students per session, with an average of 12 students per session, and 13 students as the most frequently reported across both cohorts.

Additionally, students' names and the number of the computer at which were sitting were also recording. For example, one entry into the notes app entered at the beginning of a session (3:04pm) read as follows (students' identities have been masked):

Desk 4	Riri	Flappy Code	Code.org	Level 14
(computer #)	(student pseudonym)	(displayed page)	(website)	(detail)

Similar entries were completed at the middle and end of the sessions for this student, and repeated for all other students present in the space. This yielded a total of 468 micro-observations (3 per student, per session) and an average of about 35 micro-observations per session.

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. Additionally, these surveys were used to help me identify focal participants to further focus my post-session field notes. These participants were selected to represent a range of ages, schooling experiences, Code Club experiences, and interests outside of Code Club. I initially selected 6 focal participants. However, due to attendance issues, I ended up focusing my post-session reflections on 4 students. A selection of the survey responses, including focal participants selected, can be found in Appendix A.

Audio-Recorded Data. To aid in the construction of post-observation field notes, I began collecting audio-recordings from June 15th, 2017 until the end of the session. These audio-recordings were captured using through an iPhone 6 device and a bluetooth headset. Each week of recording, for both the 3:00pm and the 4:15pm cohorts, I wore the headset around my neck, while running the voice recorder software for the entirety of the meeting. While these recordings were not transcribed and coded for the purposes of this project, they helped inform the overall construction and analysis of the post-session field notes.

Qualitative Coding as Analytic Approach

I approached the central question of this study from an interpretive stance - in particular, one which asserts that "interpretation is central to all kinds of educational research and enters into it at every stage of the process," from the formulation of research questions to the presentation of findings drawn from empirical analysis (Smeyers, Bridges, Burbules, & Griffiths, 2015, p. 3). The analysis proposed for this project can be even more specifically located within a "family" of approaches that defines interpretation as a process of research - as an argument, grounded in evidence, which demonstrates to an audience the significance of something that may not be readily apparent.

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 students' drew on literacy practices to meet the various literacy demands they encountered as they navigated,

interpreted, interrogated, and designed their learning experiences across virtual and face-to-face contexts (Serafini, 2012b). As Saldana summarizes, "qualitative codes are essence-capturing and essential elements of the research story that, when clustered together according to similarity and regularity (a pattern), they actively facilitate the development of categories and thus analysis of their connections." (2015, p. 8). Qualitative coding as a broad analytical approach has informed a wide range of studies in interpretive educational research, including studies of digital literacy practices (Avila & Pandya, 2013; Lankshear & Knoebel, 2008; Saldana, 2015; Smeyers et al., 2015). These cycles of coding provided an important starting, anchoring, and reference point for analyzing and drawing conclusions from my own corpus of qualitative data.

I used the NVivo software to upload and store revised copies of the field note transcriptions; apply, categorize, & manage codes; run "queries" for code frequency and cross-code references; and generate and store analytical research memos throughout my process.

I began my First Cycle of coding by generating and applying attribute codes (Bazeley, 2003; DeWalt & DeWalt, 2011; Gibbs, 2008; Lofland, 2006) to the each set of field notes I analyzed. These codes named various attributes of each documents, 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. An example of such a set of attribute codes, taken from the June 8th field notes, is as follows:

> Observation Date: June 8, 2017
> Location: Easton Public Library
> Sessions: Both (3:00pm cohort and 4:15pm cohort)

Time: 3:00pm - 5:00pm
Participants Mentioned: Dana, Hannah, Natasha, Abigail, John, Oliver
Activities: Playing, YouTube, Scratch Games, Problem Solving, Socializing, Asking for Help

Drawing on the conceptual framework outlined in the previous chapter, I then engaged in a process of structural coding (Guest, MacQueen, & Namey, 2011; MacQueen, McLellan-Lemal, Bartholow, & Milstein, 2008; Namey, Guest, Thairu, & Johnson, 2008), 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 three dimensions of the framework (Aguilera, 2017). Observations of students engaging with various literacy practices around digital content displayed "on the screen" were coded as such. Observations of students engaging in practices to interpret, interrogate, or manipulate game mechanics, programming code, or digital tool functionality were coded as {Behind the Screen}. Finally, observations of students engaging with the social dynamics of the Code Club space, including interactions with adults and one another, were coded as {Beyond the Screen}.

At times (actually, many times), I found myself double- or even triple-coding when I identified students' literacy practices that appeared to cut across all three dimensions. I avoided coding sections of the field notes that shifted in language and tone away from "observation" and more toward my own "reflections" or "analytical asides" as a researcher, as well as sections that primarily addressed observations of parents or facilitators in the space, as my main focus for this study was on student participants. A

summary of the codebook entries I generated as part of this process can be found in Table 3.1.

Table 3.1
Structural codes that used in the initial coding pass, with descriptions and examples.

Structural Code	**Description**	**Examples (date - rationale)**
On-the-Screen (74 instances coded)	Observations of students engaging with various literacy practices around digital content rendered as "output" (visually displayed on monitor or rendered through computer speakers/headphones).	"Switching over to a game on Scratch in particular a fidget spinner" (June 8th - A student appears to be primarily engaged with navigating different kinds of content on a website called Scratch.) "...flipping between YouTube and a music video" (June 8th - a student appears to be engaging with audio and video based content sites) "The one on-screen clue related directly to this was about matching order of operations..." (June 29th - a student was navigating through the content of an order-of-operations tutorial on the Khan Academy website).
Behind-the-Screen (79 instances coded)	Observations of students engaging in practices to interpret, interrogate, or manipulate game mechanics, programming code, or digital tool functionality.	"In particular the HTML of the image, within the image height giving percentages. She seemed to pick it up fairly quickly, and was jumping right into editing the images on her own." (August 3 - I discussed with a student the ways that the HTML markup language could control the appearance of an image on a website; she experimented with these features on her own)

		"...a lot of the work we did together, focused on very particular instances of Javascript coding and essentially the cleanliness overall of the code." (July 20 - a student and I talked together about a programming language called Javascript as she worked through a game-based learning platform called Code Combat).
Beyond-the-Screen (49 instances coded)	Observations of students engaging with the social dynamics of the Code Club space, including interactions with adults and one another	"...because they code together, as brother and sister. The thing that I noticed in particular today about them was how much of their work seemed to be happening in parallel." (July 13 - a brother and sister appear to be working on the same projects at the same time, when questioned, the younger sister suggests that she is following her brother's lead, though he expressed some annoyance at this). "...But, he worked primarily in Scratch today either on his own original project or playing the games and experiencing the projects of others on the platform." (July 20 - a more experienced student in the program spent much of his time during the sessions playing and commenting on projects that other students had created) "I remarked to her that she had completed an original game, although she questioned whether or not the game was

		original because it was based on a Flappy Bird template." (June 22 - a student appears to question the originality of her work in light of the work produced by other designers)

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 an approached called process coding (Bogdan, 2012; Charmaz & Belgrave, 2012; Corbin & Strauss, 2008), 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 (Gee, 2004; Jenkins et al., 2009; Luke & Freebody, 1999; Serafini, 2012a), as discussed earlier in this chapter, as well constructed from reviews of the literature and my own prior experience (conversations, coursework, lectures, etc.). However, as I recorded in analytic memos during my First Cycle coding, I did not yet make a particular effort to align my own codes with labels from the literature, to mitigate the tendency toward "fitting the data" around existing theoretical perspectives. These codes included {remixing}, coded from observations of students re-arranging or modifying aspects of an existing piece of digital media, such as a game or animation, {experimenting}, coded for when a student seemed to be engaging in cycles of planning, action, reflection, and iteration in a rapid fashion, and {following procedure} for instances in which students applied procedural steps from

a virtual resource (i.e. an online tutorial) or a face-to-face experience (i.e. a facilitator's explanation of a process). Examples of these process codes are summarized in Table 3.2.

Table 3.2
A sample of process codes that I developed and applied across observational notes.

Process Code (frequency)	**Description**	**Example (date - rationale)**
Remixing (8 instances across 4 sessions)	References to the practice of modifying existing media or reassembling elements of existing media in one's own style or for one's own purposes.	"...one of our returners was working on a Plants vs. Zombies remix." (July 22 - many projects on the Scratch platform appear to draw inspiration from Plants vs. Zombies, an existing videogame franchise; in this example, a student is developing his own version of one of these projects)
Experimenting (6 instances across 4 sessions)	References to engaging in cycles of planning, action, reflection, and iteration in a rapid fashion.	…"there were moments where I was with him that he was experimenting and troubleshooting, breaking things in the scripts and trying to figure out exactly what was broken." (July 13 - a student appeared to be testing the limits of functionality by intentionally modifying elements or variables in a computer programming script that would cause it to function erratically, or "break.")
Following Procedure (8 instances across 5 sessions)	References to instances in which students applied a well-defined series of steps from a virtual resource (i.e. an online tutorial) or a face-	"...following a tutorial for a gravity game challenge." (June 22 - A student is following a step-by-step tutorial for creating a game

	to-face experience (i.e. a facilitator's explanation of a process).	on the Scratch platform)
Game-playing (22 references across 8 sessions)	References to instances of a "formalized interaction that occurs when players follow the rules of a game and experience its system through play" (Salen & Zimmerman, 2004).	"She primarily seems to be spending a good deal of her time on Code Combat… [in which] players progress through different dungeons on a quest where there avatars follow the commands in order to navigate the dungeons and emerge successfully." (July 6 - a student engages with a designed game as an object of play, as opposed to engaging in remixing or creating games).
Asking adult facilitators (21 references across 7 sessions)	References to instances of a student signaling, verbally or otherwise, that they would like to engage with an adult facilitator - either myself or the youth librarian - around a challenge experienced with digital media during the session.	"She mentioned something about having difficulty on a level that I didn't fully comprehend." (July 6 - a student has called me over to discuss a challenge on the Code.org platform)
Reading (7 instances across 4 sessions)	References to observations of students navigating text-based media forms.	"...having to flip between the platform seemed to make it difficult for her to be able to understand and apply certain instructions." (June 8 - a student was switching between a browser window that included procedural instructions and another window that contained the programming environment to which the student was expected to apply the

		instructions.
Programming (35 instances across 7 sessions)	References to observations engaging with either "visual" or "text-based" computer programming.	"There was a moment where she expressed difficulty or some frustration perhaps, when she had accidentally deleted a line of her code." (July 6 - In this instance, a student was working with a text-based computer programming language)

During a Second Cycle of coding, I reorganized and re-examined 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 the original field notes themselves. These codes were generated based on "families" of literacy practices (Luke & Freebody, 1999; Serafini, 2012a) that I identified as I reviewed and revised codes from the First Cycle processes. Thus, {game-making}, {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). Other families of literacy practices that I grouped under pattern codes included {Navigating and Networking Practices} (Jenkins et al., 2009; Serafini, 2012a), {Design and Creative Practices} (Serafini, 2010; Serafini & Gee, 2017; The New London Group, 1996), and {Problem-Solving Practices} (Association for Computing Machinery, Code.org, Computer Science Teachers Association, Center, &

National Math and Science Initiative, 2016; Fisher & Frey, 2013). Examples of the codes grouped into each of these categories can be found in Table 3.3.

Table 3.3
Pattern codes with descriptions and associated process codes.

Pattern Code	**Description**	**Associated codes (frequency)**
Big "G" Gaming Practices	Process codes reflecting social practices of symbolic meaning making within and around games	Game-playing (22 instances) Game-making (16) Game-modding (5) Watching game videos (1)
Navigating and Networking Practices	Process codes reflecting students moving through and across social and semiotic spaces (virtual and face-to-face).	Asking adult facilitators (21) Sharing experiences (15) Evaluating Behavior (6) Navigating across websites (17) Account management (5) Multitasking (5)
"Traditional" Literacy Practices	Process codes reflecting students engaging in literacy practices typically recognized by institutions such as school	Typing & Writing (17) Listening (8) Reading (7)
Design and Creative Practices	Process codes reflecting students engaging in literacy practices typically associated with creation and design	Designing media (21) Remixing (8) Tinkering (3) Prototyping and Testing (8)
Problem-Solving Practices	Process codes reflecting students engaged in developing a solution to a perceived or presented problem or challenge to be overcome	Puzzle-solving (13) Troubleshooting (11) Following Procedure (8) Experimenting (6) Hacking (2)

Literacy Resources and Practices: Cross-Cutting Themes

Following the work of Luke and Freebody (1999), and Serafini (2012), I have aimed to map a range of literacy practices and resources students appeared to engage with as they

learned through and about new technologies. Specifically, this study sought to address the following question:

In what ways do students draw on literacy resources and practices as part of their experience in a computer programming club?

Throughout my own process of analysis, I became struck by how often I multiply-coded words, phrases, passages in my First and Second Cycles of coding. While in the early stages of coding, part of this may be attributed to an initial period "breaking into" (Saldana, 2015) a relatively unfamiliar data corpus, I found that such coding patterns persisted through to my final coding passes. Thus, rather than attempt to separate out themes as final "categorizations," as part of my formalized analytic procedure, I will describe and organize these themes around the concept of what physicists have come to know as "entanglements." As Saldana (2015) has argued, "a theme is an outcome of coding, categorization, and analytic reflection, not something that is, in itself, coded" (p. 175). Thus, these cross-cutting themes should be understood as my own interpretation of the process and products of my coding and categorization, informed by my own analytic reflection and review of the relevant literature.

In quantum mechanics, the concept of entanglement refers to a physical phenomenon that occurs when pairs or groups of particles are generated or interact in ways such that the state each particle cannot be described independently of the others, even when they are separated by a large distance—instead, an entangled, or "quantum" state must be described for the system as a whole. Wilzcek (2016) states that "entanglement arises in situations where we have partial knowledge of the state of two systems," although "information about one improves our knowledge of the other." (n.p.). While an explication of the particulars of quantum entanglement is beyond the scope of

this discussion, I will present a thematic interpretation of my findings around the analogy of "entanglements," to reflect my own challenges in separating certain qualitative aspects of my observations from even seemingly contradictory concepts.

Entanglement #1: Virtual and Material Literacy Experiences. Looking across my First and Second Cycle iterations of coding, I found myself incredibly challenged to separate literacy practices that appeared to be enacted within physical spaces, and those enacted in virtual ones. A coding matrix query run in NVivo mapping the codes {On the Screen}, {Behind the Screen}, and {Beyond the Screen} yields the following percentages of overlap, suggesting the extent of this entanglement throughout my coding scheme:

	On the Screen	Behind the Screen	Beyond the Screen
On the Screen	100%	85%	45%
Behind the Screen	83%	100%	37%
Beyond the Screen	67%	57%	100%

An illustrative example of such an entanglement can be seen in field notes constructed from observations on August 3rd, 2018, which describes a focal participant, a homeschooled 9-year old boy named Peter:

> Initially he was playing / Ultimate Minecraft Quiz on Scratch / which I get is actually something that other students had / played around with before / but in this particular case // he was working on remixing it / And when I asked him what specifically he wanted to remix? He mentioned he wanted to make it better / and also mentioned that he wanted to / actually have the character right from Minecraft in the game itself.

In this particular passage, I identified his playing with the "Ultimate Minecraft Quiz" on the Scratch platform as content displayed {On the Screen}, that is, rendered in a virtual

space. However, his work to remix the game suggested he was altering game content or mechanics (and thus elements of the game's programming) that lie {Behind the Screen}. Additionally, his desire to include a "character right from Minecraft" indexed his familiarity with a popular video game franchise outside of the immediate context of the virtual Scratch platform and the physical Code Club meeting context, which he nevertheless seemed to be drawing upon to inform what he chose to do with his time in the session.

Rather than attempt to separate out in my coding what seemed particularly tied to literacy practices enacted in physical or virtual environments, I chose to organize this and similar coding patterns under the entanglement of virtual and material literacy practices.

Entanglement #2: "Traditional" and "New Media" Literacy Practices. Throughout my analytical process, I also took note of a wide range of instances where more "traditional" literacy practices, such as reading and following procedural instructions, and "new media" literacies such as designing digital media through programming overlapped with one another . In the following example I describe working with a, focal participant Riri, a 9-year-old female new to Code Clubs that summer, on a virtual greeting card built on the online platform Trinket:

> She had a question about changing the inside image / and we just / had to look through ... find where the divider / or the divisions / separated the inside from the outside in the HTML, / and she was off doing that as well. / I also noticed, / one thing I hadn't taken note of //the last time we were working together / that she had also changed text inside the buttons of her card. (Field notes, August 3, 2017).

Riri's programming in the language HTML, the computational language underlying many websites, would be considered by many to be less of a "traditional," and more of a "new media" literacies practice (Jenkins et al., 2009; Montfort et al., 2012). Yet,

processes of programming are tied up with the more recognizable literacy practices of reading the code, (in this example, the inside/outside of the greeting card is separated by the HTML code), writing sets of commands understandable to a computer, and finally composing text understandable by the people who will be receiving the virtual greeting card, such as the words that will appear on the "buttons" controlling the "opening" and "closing" of the card.

In an earlier session, Natasha, an 11-year old prep. school attendee and Code Club veteran, expressed some frustration with a programming challenge as she played through the game-like Coder Dungeon platform. According to my field notes from July 6, 2017:

> 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.

In this particular case, 'Tash appeared to be challenged not by the reading of the programming language JavaScript, which had been simplified in the platform to a series of limited commands, but instead by the (user-facing) instructions displayed to orient learners to their task. Because of the inferential and context-sensitive nature of these instructions, players, including 'Tash, needed to combine the literal meanings expressed by the instructions, with the situated meanings she was developing as part of her game experience (Gee, 2004). Garcia (2018) would characterize these practices as "reading about" (with regard to the instructions) and "reading within" (with regard to the multimodal content displayed in the game).

These and other instances I observed and noted throughout the analytical process suggested that what are sometimes theoretically separated as "traditional" and "new media" literacies can nevertheless become caught up, or entangled with one another in actual practice. And as Wilzcek (2016) points out, information about one can indeed improve understanding of the other.

Entanglement #3: "Receptive" and "Productive" Literacy Practices. Historical approaches to language and literacy development (see, for example, Krashen, 1982; Harmer, 1991; Common Core Initiative, 2012) emphasized a divide between the "receptive" (sometimes considered passive) competencies such as reading and listening, and the "productive" (sometimes considered active) competencies, such as writing and speaking. However, evidence from the present study instead lends weight to the opposing argument: that these dimensions of literacy are more difficult to disentangle in actual practice. A field note entry from July 7th, 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 loca 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 //

Here, I interpreted Hannah's moving from "stuck" in an ideational phase a project to "jumping back" as mediated by inspiration gained from exploring the animated work of others who have shared on the Scratch platform. And while I labeled her work as

'original,' scholars such as Worton and Still (1991) have reminded us that all designed artifacts are intertextual in some way. Within this study, Hannah's work on her animation one way that receptive and productive practices can become entangled in the practice of working with digital media.

In response to the question that guided this study, I found that the ways that students drew on literacy resources and practices could be best expressed through the concept of entanglements: between virtual and material literacy practices, between "traditional" and "new media" literacy practices, and between receptive and productive literacy practices. Rather than attempting to separate these dimensions from one another, learning to reconcile these conceptual entanglements may contribute to broader understandings about youth literacy practices in a digital age, as I will discuss in the closing section of this chapter.

Implications, Limitations, and Future Research

In the previous chapter, I alluded to the challenge of theoretically separating the dimensions of content on-the-screen, technologies behind-the-screen, and social contexts beyond-the-screen. A key limitation of that project, however, was that my analysis focused almost exclusively on what Rose (2012) identified as the site of the text itself, without extensive analysis of the sites of production, dissemination, and audiencing that would warrant a more thorough examination of the digital hypermedia artifacts in an actual context of use. The study reported in this chapter was meant to address those shortcomings by providing an interpretive analysis of observational data collected over the course of a ten-week summer session of a local library Code Club for young adolescents.

Prior work in the area of the digital-age literacy practices of youth have either focused primarily on young people's engagement with content displayed "on the screen," or have separately examined students' competencies with technologies "behind the screen," or navigation of social contexts "beyond the screen." Building on that research, findings from this study suggest that while a wide variety of literacy practices can be observed while students engage with online content on screens, other practices may be obscured unless we pay specific attention to the ways that students are engaging with 'behind-the-screen' dimensions of online content, including the technological tools that render this this content visible on our digital devices. Additional insight to students' literacy practices can also be gained from an examination of students' engagement with the 'beyond-the-screen' dimensions of their digital-age literacy experiences, including the social contexts that simultaneously give rise to and are shaped by sites of online content production, dissemination, and everyday use.

Ultimately, though, I argued that the concept of entanglements that often characterize digital-age literacy practices - among virtual and material literacies, between "traditional" and "new media" literacies" and between "receptive" and "productive" literacies - can be a useful characterization of the theoretical and practical challenges of separating these dimensions. Moreover, shifting our focus toward how, for example, "traditional" and "new media" literacies can be leveraged together to support the literacy development of learners in a digital age opens up new pedagogical avenues and possibilities for developing repertoires of interpretive practice (Serafini 2012; Holmes 2017; Luke & Freebody 1999)

This study contributes to the broader literature base underpinning literacy education by providing additional evidence into how youth literacy practices are enacted on, behind, and beyond the screen, and subsequently, the ways that teachers, parents, librarians, and other caring adults can support students' developing literacies in a digital age. The study also evidences an empirical application of the conceptual framework outlined in the previous chapter - this time in the context of naturalistic, observational study of literacy practices across virtual and face-to-face contexts.

However, several limitations of the present analysis invite further exploration of these issues through additional scholarly efforts. First, though the project represented a multi-dimensional analysis of digital-age literacy practices in a context of use, an expanded period of observational and systematic data collection may yield additional insights into the development of literacy practices over time. Secondly, while the study applied a systematic approach to qualitative coding of observational data, it still represents only one possibility in a wide range of interpretive approaches. Additional research utilizing an alternate set of coding approaches, or other interpretive tools may yield alternative insights, or further nuance to the claims made in this study. Finally, and perhaps most crucially, this analysis focused almost primarily on researcher-generated data corpus. While field note (re)construction was informed by audio-recordings, photos taken on site, observational jottings, and student-produced artifacts, a stronger shift of focus toward participant perspectives on the experience may lend additional trustworthiness to the claims made in this study.

The next chapter of this manuscript, then, represents an attempt to extend the research in this direction by presenting an analysis of the discourse used by participants to characterize their experience as part of the Code Club.

CHAPTER 4:

DISCOURSES OF LITERACY IN A COMPUTER PROGRAMMING CLUB

This chapter details the third and final phase of a project designed to explore the role of literacy - in design, practice, and discourse - as students learn through and about new technologies. Like the previous chapters, the present analysis draws from data collected as part of an extended, multi-method study of a library computer programming club for local youth, known colloquially as a Code Club. For the present analysis, I draw on a theory and method of discourse analysis developed by Gee (1999; 2004a, 2014a, 2017) to analyze qualitative interviews with parents, students, library facilitators, and designers of the Code Club Program. I conducted a total of 9 qualitative interviews with people connected to the the Code Club in various ways (3 parents, 3 students, and 3 librarian facilitators). In the interviews, I ask about their perceptions of and experience with the Code Club and role that literacy might play as part of it. I then apply the analytic "toolkit" of Gee's discourse analysis to respond the following overarching question:

> How do interview participants use language to construct their perspectives on literacy as part of the Code Club experience?

This question draws from a fundamental premise of discourse analysis that language isn't just used to say things about the world, but to do things in the world (Austin, 1975; Searle, 1979). While traditionally-established models of language have suggested that is done through the "packaging and sending" of meanings, Gee (2014b) asserts that a more productive metaphor for (some of) the work that language does is the "building and designing" of structures and meanings. As Gee further argues, one key building task that people engage in is using language to give special status to (or privilege) various sign

systems, while also criticizing or taking status away from (disprivileging) other communication systems and ways of knowing the world. Other pertinent building tasks for this analysis include activity-building, significance-building, and connection-building.

Literacies, as we have discussed, can be understood as social and situated ways of exchanging meaning through different sign/symbol systems. While much work has explored how multiple literacies can be privileged and disprivileged in different ways on a broad scale (see, for example, Rowsell, Kress, Pahl, & Street, 2013), the focus of the present study is to understand a specific situation in which participants construct their experience of and perspectives on literacies. These perspectives can be understood as combinations of the different "building tasks" listed above. Addressing limitations of the previous chapter, I argued that a stronger shift of focus toward participant perspectives may shed additional understanding on the claims I made about participant literacy experiences in the Code Club. Here, I present an analysis of the discourse used by participants to characterize their experience of literacy as part of the Code Club to help address this issue.

Ultimately, this work seeks to contribute to the broader literature base underpinning literacy education by providing additional evidence into how digital-age literacies, as enacted on, behind, and beyond the screen, can be privileged and disprivileged by those engaging with them. These understandings can then inform the ways that teachers, parents, librarians, and other caring adults teach, learn, and talk about evolving literacy practices in our digital age.

Discourse, Education, and Literacy

Increased attention to the way people do things with language and the implications of these for education can be traced back to the "linguistic turn" in the social sciences (Luke, 1995). In the field of literacy education, studies of these "ways with words" provided some of the groundwork for what is now known as the New Literacy Studies, or NLS (Gee, 2010; Heath & Street, 2008; Pahl & Rowsell, 2012; Street, 2006). Scholars of the NLS extended linguistic perspectives on literacy through an emphasis on its social and ideological dimensions. Over time, their combined efforts helped to address a key criticism of purely "descriptive" approaches to language study summarized by Luke (1995): "...linguistic-based analysis and intervention that fails to consider sociocultural change and conflict could pose serious limitations in the capacity of educators to address what remains a political issue of access and equity" (p. 5). As a growing body of scholarship converged on the idea that schools and other social institutions are constituted through discourse and discursive relations, the importance of systematic study of these discourses and relations became increasingly salient (Gee, 1990; 2015; Luke, 1995, 2012; Rex et al., 2010). The umbrella of theoretical and methodological perspectives that has come to be called "Discourse Analysis," represents such a systematic approach.

While discourse analysis can take different forms, the core idea that unites this "family" of perspectives is the premise that language is not just used to say things about the world, but to do things in the world (Cruickshank, 2012; Gee, 2017; Rogers, 2011). While it is beyond the scope of this discussion for me to thoroughly map out the histories and differences between these perspectives, I believe it will be helpful to outline of some key concepts that guide my own understanding of Discourse Analysis. Some of these

definitions (discourse, text, literacies, applied, and critical) are meant to broadly situate the present study within a broader discussion of Discourse Analysis in literacy education. The other definitions (building tasks, situated meanings, social languages, figured worlds, intertextuality, Discourses, and Conversations) will be more directly tied to the analytic tools that I apply to this study (Gee, 2014b). While these concepts are drawn from a range of disciplinary perspectives, each will become important in clarifying the theoretical and methodological approach that guides my work in this study.

Some Foundational Distinctions. While the concept of "discourse" is closely related to the concept of language, the nuanced relationship between the two is the first important distinction that underpins this discussion. Simply stated, discourse refers to the idea of "language-in-use." As opposed to a systematic study of how language works in some theoretical, abstract sense, discourse analysts emphasize the study of language - spoken and written - in actual contexts of use, that is, as people use language in specific situations to do different things (Cruickshank, 2012; Rogers, 2011).

When we extend the idea of discourse to include both spoken and written language-in-use, scholars sometimes use the word "texts." For the purposes of this discussion, I will refer to texts as social exchanges of meaning that are mediated through sign systems, drawing on the work of social semiotics (Halliday, 1978; Hodge & Kress, 1988; Van Leeuwen, 2005). These sign systems often include written language, but can also be understood to include visual images, sound, gesture, and other ways of representing meaning.

This definition aligns with the way I have described literacy in the previous chapter as situated, sociocultural, and multimodal (Gee, 2010; Gee & Hayes, 2011;

Rowsell et al., 2013; Serafini, 2013). Literacy is situated in that it involves cognitive capacities (e.g. decoding and processing written letters), social practices (e.g. reading a bedtime story), 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 (Gee, 2010; Gee & Hayes, 2011; 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; Warschauer, 1997). 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, 2012b).

From the NLS, we have also learned the value of referring to literacies in the plural, and the framing I have offered above is meant to reflect the multiplicity of literacies that have been identified across a variety of contexts over time (Serafini & Gee, 2017).

Discourse analytic approaches, then, can be understood as the systematic study of discourses (oral) and texts (artefactual) as they are used by people to do things in the world. Some scholars draw a distinction between "descriptive" and "applied" varieties of discourse analysis. Simply stated, the purpose of such "descriptive" approaches are to describe how language for the purposes of better understanding it - that is, for its own sake. An "applied" perspective, on the other hand, aims to use discourse analysis to address "questions, topics, and data that bear on issues and problems important to people, society, and the world" (Gee, 2014b, p. 3). A further distinction has also made between

these and "critical" approaches to Discourse Analysis, which deliberately "move beyond descriptive research and to use discourse analysis to critique and challenge dominant institutional practice" or otherwise address social or political issues, questions, or problems in some way. (Luke, 1995, p. 10).

My own views on these distinctions align with claims made by Gee (2014a), that all language is inherently political, if we take the term "political" to refer to shared social goods, such as status and reputation. If we accept that all language is political (deals with shared social goods), then all discourse analysis can be understood as "applied" or "critical" in some way, in that the claims generated from these studies will have something to say about things are that we deem important in social contexts. Because I take this perspective, I will refer to the theory and method I use in this study under the more general term "discourse analysis," rather than adopting the labels of "applied" or "critical."

Discourse Analysis Terms and Tools Used in This Study

The present study draws from a particular approach to discourse analysis proposed by Gee (2014a), though he is quick to point out that the approach should not necessarily be thought of as "his." What this means, for the purposes of our discussion, is that the analytic "toolkit" assembled by Gee and used in this study has its roots in a variety of research traditions, including cognitive psychology, sociolinguistics, anthropology, literary criticism, history, and philosophy. In the next section of this manuscript, I will briefly outline a set of concepts that Gee draws from these areas and discuss what they can do for us as "tools" in discourse analysis. These terms are: building tasks, situated

meanings, social languages, figured worlds, intertextuality, Discourses, and Conversations.

Building tasks of language. As we have established, approaches discourse analysis are founded on the premise that language is used to do things as opposed to just saying things. One important metaphor for understanding what the kinds of things language can do is the "building and designing" metaphor. The idea is that rather than "packaging and sending" information that already exists in our brains or in the world, we actively construct, build, and design meanings - often times by using language to combine what is "in our heads" with what is "in the world." Gee (2014b) calls these "ways that we design meaning through language," building tasks - a term that will apply to all of the theoretical tools outlined in this section. These building tasks include the ways we use language to build significance (how important things are), relationships (usually between people or groups), identities (ways of being a certain kind of person), activities (ways of doing things that get us recognized as being a certain kind of person), connections (between all kinds of things), politics (in the sense of "shared social goods"), and sign systems and knowledge (ways of communicating and having your knowledge "count" to other people).

So, how do people use language, or discourse (language-in-use) to accomplish these building tasks? Consistent with our "building and designing" metaphor, Gee's (2014b) approach to discourse analysis outlines six theoretical "tools" that people use to accomplish these tasks. Rather than thoroughly explicating the research base that underpins each concept, I will discuss what each concept means in the context of

discourse analysis (For a more in-depth treatment of the theories behind these tools, see Gee, 2014b).

Situated meanings. A growing body of research in the cognitive sciences, now known under the banner of "Situated Cognition Studies," has begun to converge on the idea that thinking is more than just an abstract set of definitions, generalizations, and rules that reside entirely in the brain (Brown, Allan, & Paul, 1989; Erstad et al., 2016; Hutchins, 1995). Instead, scholars associated with this field argue that thinking is connected to, and changes across the actual situations that we experience (Gee, 2010; Vincini, 2004). Bridging this work to a theory of discourse, Gee's (2014a) approach to discourse analysis highlights the difference between literal meanings - general definitions of words such as those we might find in a dictionary - and situated meanings, which are the meanings that words take on in their actual contexts of use - that is, as we actively construct these meanings in different situations. The ways that literal (general) meanings are situated (specified and contextualized) can have implications not just for "everyday talk" but also for issues in national policy, as Bogdan (1976) demonstrated in a study of legislation defining the word "handicapped" for educational programs. Thus, one analytic tool we can use to understand the different building tasks people engage in through discourse is what Gee calls the Situated Meanings Tool, which he frames as a question: "For any communication, ask of words and phrases what situated meanings they have. That is, what specific meanings do listeners have to attribute to these words and phrases given the context and how the context is construed?" (Gee, 2014, p. 159).

Social languages. Just as words can take on different meanings in different contexts of use, so too can broader language practices change based on the social groups that use

them. The field of sociolinguistics, which studies the relationship between language and society, has contributed much to our current understanding of these different social languages (Fairclough, 1992; Gee, 2015; Wardhaugh, 2010). Linguists sometimes use the terms "dialects," and "registers" to describe similar phenomena (Biber & Conrad, 2009). What Gee refers to as social languages can be understood as varieties of language that are significant to different social groups in different ways. These can range from the technical language of lawyers in the United States (Niemi-Kiesiläinen & Honkatukia, 2007), which can seem relatively inaccessible to "general" English speakers, to the English-and-native-language blends of certain ethnically-related communities, such as spoken in some (though not all) Filipino-American households in the U.S (Bautista, 2004). Importantly, different social languages can be mixed in a given span of discourse, sometimes called heteroglossic, or multi-voiced, in nature (Bakhtin, 2010). Gee's Situated Meanings Tool draws on and combines these understandings in a series of questions: For a given communication, what social language(s) appear to be involved? What sorts of grammatical patterns indicate this? Are different social languages mixed? If so, how so? What socially situated identities and practices do these social languages enact? (Gee, 2014a, 2014b).

Intertextuality. In addition to switching between or mixing social languages, texts (written or spoken) can also quote, reference, allude to, or otherwise "borrow" words, phrases, or ideas from another text. In literary studies, this act of "borrowing" is often known as intertextuality (Allen, 2011; Worton & Still, 1991). Expanding this idea into educational research, Bloome and Egan-Robinson (1993) analyzed how intertextuality could be understood as a social construction, rather than residing solely within a text or a

reader. Using the example of a microethnographic analysis of a classroom reading and writing lesson, the authors demonstrated (1) how attempts at establishing intertextuality can go unrecognized and unacknowledged, (2) how cultural norms can mediate how intertextuality is recognized, and (3) how, even in a single communicational exchange, intertextuality can be used by different participants to engage in different kinds of "building tasks" as we have described them above (Bloome & Egan-Robertson, 1993). While Bloome and Egan-Robinson's work focused mainly on students' and teachers' use of intertextuality to build practices and identities (though they describe these concepts in other ways), Gee (2014a, 2014b) argues that intertextuality in discourse can be used to engage in any of the building tasks we have discussed. Gee states the Intertextuality Tool as follows: "For any communication, ask how words and grammatical structures (e.g., direct or indirect quotation) are used to quote, refer to, or allude to other "texts" (that is, what others have said or written) or other styles of language (social languages)." (2014b, p. 172). In other words, how does a given text (written or spoken), borrow words, phrases, or ideas from other sources? What function does this appear to serve?

Figured worlds. Building on the idea of social construction we have just discussed, we can shift our attention to another kind of socially-constructed phenomenon: the stories we tell ourselves and each other that capture what is taken to be typical or normal in a given situation. Cultural anthropologists have referred to these "typical stories" as figured worlds, to emphasize (a) the durability of these typical stories, and (b) their nature as socially constructed (Holland, 2001). Other scholars from a variety of fields have referred to related concepts as "cultural models" (D'andrade, 1984; Strauss, Quinn, & American Anthropological Association. Meeting, 1997), "Discourse models" (Gee, 1999)),

"frames" (Fillmore, 1975), "folk theories" (Johnson-Laird & Oatley, 1992), and "mental models" (Johnson-Laird, 1983). As Gee (2014a) summarizes, the term figured world stresses that these "worlds," or "simulations" are things that exist not only in our heads, but also in the world - in the conversations we have, the media we create and disseminate, and the ways we bring these worlds to life (e.g. the ways that we choose to enact, and thus define-in-practice, what counts as a "wedding ceremony," a "successful reading intervention," or a "parent-teacher meeting"). Earlier work in this area has examined discourse to reveal the figured worlds of "getting ahead" as defined by working class individuals (D'Andrade & Strauss, 1992). Scholars of education have examined the ways that the figured world of "child rearing" may be different between upper-middle-class parents and working-class parents, and, importantly how the dominant practices of schooling at the time were in closer alignment with upper-middle-class perspectives of children's development (Lareau, 2003). To bring the notion of figured worlds to bear on discourse analysis, Gee (2014b) proposes the following questions:

> For any communication, ask what typical stories or figured worlds the words and phrases of the communication are assuming and inviting listeners to assume. What participants, activities, ways of interacting, forms of language, people, objects, environments, and institutions, as well as values, are in these figured worlds?" (p. 117).

Discourses. The examples we have discussed so far have illustrated some of the tools that people use to engage in the building tasks of language. However, the social worlds we live in are complex, and language is just one part of how we build, maintain, or break down things, such as identities, in the world. Further, our ways of speaking, doing, and being, are generally not just pulled out of thin air or reinvented from scratch by individuals - they typically come from somewhere. Gee (2014a; 2014b) refers to these

ongoing ways of talking-doing-being as Big "D" Discourses. In order to "pull off" an identity as a computer programmer for example, I need to be able to talk the talk that is recognized by other programmers. This is because programming as a social and technical practice has persisted over time, and will likely continue to evolve and change (Rooksby, Martin, & Rouncefield, 2006). However, I also need to be able to coordinate my talking-the-talk with walking-the-walk - demonstrating my competence in the domain by sharing working software applications or websites (Vee, 2013), or demonstrating, perhaps through a problem-solving process, the ways that I can think like a programmer (Wing, 2006). Discourses can be mixed and overlapping and can arise, change, and even disappear over time - for example enacting an identity as a female, African-American game developer outside of Silicon Valley may look different than other Discourses more commonly recognized in the mainstream media. At the end of the day, though, Discourses are about being recognized as a person of a certain sort, or demonstrating a socially-recognized identity. When analyzing language using the Big "D" Discourses tool, Gee (2014b) suggests asking the questions such as:

- How the person is using language, as well as ways of acting, interacting, believing, valuing, dressing, and using various objects, tools, and technologies in certain sorts of environments to enact a specific socially recognizable identity and engage in one or more socially recognizable activities?
- If all an analyst has for data is language, what Discourse is this language part of, that is, what kind of person (what identity) is this speaker or writer seeking to enact or get recognized. What sorts of actions, interactions, values, beliefs, and objects, tools, technologies, and environments are associated with this sort of language within a particular Discourse?

Conversations. We have established that the Discourses generally do not "appear out of thin air," that is, they are developed over time and are typically connected with existing groups of people. Along a similar line of thinking, Discourses do not operate in a

"vacuum," which is to say that they are partially defined by how they ally, oppose, or otherwise relate to one another. Consider, for example, the ways that certain people who celebrate digital technology in schools sometimes define themselves in contrast to those who oppose such technologies for different reasons (Chandra, 2014; Toyama, 2015). Gee (2014a; 2014b) refers to the ways that Discourses talk to, with, and against one another using the term Conversations (also with a big "C). Such Conversations can take the form of persistent public debates over issues such as abortion, evolution, and affirmative action. While people may not always be fully aware of the historical clashes, debates, and evolution of Conversations, they may nevertheless use language in such a way that reflects such Conversations, and even associations with particular perspectives in those Conversations. In the context of discourse analysis, Gee (2014b) frames a theoretical tool around Conversations as follows:

> For any communication, ask what issues, sides, debates, and claims the communication assumes hearers or readers know or what issues, sides, debates, and claims they need to know to understand the communication in terms of wider historical and social issues and debates. Can the communication be seen as carrying out a historical or widely known debate or discussion between or among Discourses? Which Discourses? (p. 191)

Taken together, these seven theoretical tools (situated meanings, social languages, figured worlds, intertextuality, Discourses, and Conversations) can be understood as comprising an analytic "toolkit" for interrogating and understanding how people accomplish the building tasks of language. In the context of this project, I will apply toolkit to data collected and constructed through qualitative interviews that I conducted with different Code Club participants. In the sections that follow, I will overview the methodological approach I have taken for this project, from identifying participants, to

conducting interviews, and finally, engaging in a discourse analysis to better understand participants' perspectives on literacy in the Code Club experience.

Discourses About Literacy in the Code Club

Having outlined Gee's framework for understanding how people build things through the tools of language, I now turn to a specific examination of the ways that different participants in the Code Club - children, parents, librarians , and designers - used language to construct their own perspectives on the idea of 'literacy' and the role it plays in their experience of Code Club. The overarching question of this project will be approached from an interpretive stance - in particular, one which asserts that "interpretation is central to all kinds of educational research and enters into it at every stage of the process," from the formulation of research questions to the presentation of findings drawn from empirical analysis (Smeyers, Bridges, Burbules, & Griffiths, 2015, p. 3). In the context of discourse analysis, I will use this project to make empirical claims about the nature of participants' perspectives on literacy, though I recognize that all such claims are subject to scrutiny and revision as alternative analyses or additional evidence is gathered by scholars beyond this project (Gee, 2014a).

Context and Participants

The present study is situated within a larger project designed to examine the role of literacy as students learn through and about new technologies. The larger project involved extended study of the library computer programming club located in an metropolitan area of the U.S. Southwest. The club met for two separate sessions on Thursday afternoons, along with a library facilitator. I also served to co-facilitate these sessions throughout the research process. Parents typically dropped their students off in

the children's computing area and picked them up afterwards. Some parents stayed in the library during the sessions.

To select participants for the interviews, I first informally approached librarians and parents who had students registered in the Code Club, and with whom I had developed ethnographic relationships over time. I scheduled interviews with all three librarians who were connected to the Code Club in different ways. Given the challenge of scheduling parent and student interviews outside of the Code Club program, I elected to use an availability sample of three parents and three students for interviews.

Conducting Participant Interviews

I scheduled and conducted all three librarian interviews in the library itself over a period of one week. These interviews were audiorecorded and transcribed prior to my analysis. I scheduled phone interviews with parents and their children and completed these over the course of two weeks. These interviews were also audiorecorded and transcribed.

The interviews themselves were intended to be semi-structured, and consisted of a total of 5 questions, with scripted follow-up questions or statements asking for clarification or elaboration. The first part of the interview, I called the "Code Club in general" section, which included 4 questions that asked participants about their experience of Code Club overall. The final question I referred to as the "literacy-specific" section, and focused specifically on the role that each participant felt 'literacy' played in the Code Club experience. This question was framed somewhat differently for students, as I will discuss in the analysis.

Analyzing Interview Discourse

Prior to applying the theoretical tools of discourse analysis outlined above, I prepared interview transcripts by dividing continuous text of the transcripts into separate lines based on the "spurts" of language I heard when reviewing the recordings (Gee, 2014a). I also marked up transcripts for final and non-final intonation contours, which I annotated at the end of each line. I then read through the transcripts to group lines into different stanzas that I interpreted as dealing with a unitary topic or perspective. Finally, I divided groups of stanzas into macro-level "parts" that seemed to indicate an episode, motif, or related series of topics.

The core research question for this study was:

> How do interview participants use language to construct their perspectives on literacy as part of the Code Club experience?

The following analysis represents an application of Gee's theoretical tools of discourse analysis to frame my own response to this question, based on the data I will present in the next several sections.

Participants' Perspectives on Literacy as Situated and Co-Constructed

I will begin this analysis with an assertion based on my interviews with adults and students in the Code Club, and then examine some of the data that I believe may support or disconfirm this assertion. In studying teenagers and adults in a school community, Gee (2014a) demonstrated how socially-situated identities are mutually co-constructed in language exchanges such as interviews. In this section, I will argue that what I am calling "participants' perspectives" on literacy are also mutually co-constructed in the context of the interviews I conducted with Code Club participants.

We can see examples of this by examining brief extracts from the transcribed interviews I conducted with different groups of participants. The following excerpts are from interviews conducted with a parent and a student participant of Code Club. In terms of annotation, I use a comma to indicate a non-final intonation contour, and a period (.) to indicate a final intonation contour. I use an ellipsis (...) to indicate both empty speech pauses. Text in brackets [ ] indicates brief responses of one speaker during the "speaking turn" of another. I use capital letters to used highlight words that are emphasized by the speaker. I have only line-numbered the responses of the interviewee.

> **Colleen - parent (female, 2 children participating in Code Club)**
> Interviewer: All right. Um, so for this uh ... Uh, next uh, and final question. Uh, I just wanna quickly preface by saying, there is no right or wrong answer. Um- [Parent: Okay] But, I will ask uh, what role do you think literacy plays in student's experiences of the Code Club, and just as a quick clarification um, USUALLY, people talk about literacy in terms of reading and writing. Uh, but OTHER people talk about it in DIFFERENT ways, such as being able to understand and create different kinds of media uh, such as images, games, animations, websites, and more. Uh, so KEEPING in mind the fact that different people talk about it in different ways, um what role do you think literacy plays in student's experiences of the Code Club?
>
> Colleen:
> 1. I would have to say both.
> 2. Like...you know...like, reading a book and you know ...
> 3. I would have to say both...of those...would be ... are perfect.
> 4. Because they- they correlate with each other,
> 5. They're interlocked.
> 6. ...You canNOT understand coding without...understanding...words.
> 7. So, they're together. Like, um ...
> 8. For you to understand coding,
> 9. you need to understand the written word of...books, of language, whatever, right?

Before examining the parent's response, we should pause to note a few features of my design (as a researcher) of the interview question, and my utterance (as interviewer / conversational partner) in the context of the interview. This "literacy-specific" question

was designed to come near the end of the interview, after several questions that were designed to elicit more general responses about the participants' perceptions about the Code Club experience. To try and minimize the participants' perception of the question as "testing" their knowledge of literacy (they knew they were speaking to a doctoral candidate in literacy education), I wanted to clarify what I meant when I used the word literacy in this context. While it was not part of the formal interview protocol, my prefacing of the fact that there was no expected right or wrong answer was also another way I tried to do this.

We can also note several words on which I place a vocal emphasis (OTHER, USUALLY, and DIFFERENT), and how my presentation of two, perhaps distinct perspectives on literacy might have been taken up by the parent as she responded. One such perspective can be seen in my framing that "USUALLY, people talk about literacy in terms of reading and writing." This aligns with what some refer to as a more "traditional" or "logocentric" perspective on literacy (Serafini, 2013). In contrast, and signalled by the emphasized descriptor "OTHER" and further underscored by my emphatic utterance of "DIFFERENT," describes another view of literacy as "being able to understand and create different kinds of media uh, such as images, games, animations, websites, and more." This framing can be seen as aligning more closely with so-called "new media" perspectives on what counts as literacy (Jenkins, Purushotma, Weigel, & Clinton, 2009). Of course, scholarly debates about the nature of literacy go far wider and deeper than the simple dichotomy I have laid out in my utterance (Brandt, 2001; See, for example, Ong, 1982; Serafini & Gee, 2017; Street, 1984; The New London Group, 1996;

Willingham, 2017). But how does this parent respond to the oversimplification I have presented in this interview question?

The first piece of evidence that suggests Colleen's recognition that I have indeed presented two seemingly contrasting perspectives is her use of the word 'both,' which she repeats several times throughout her response. As the interview continues, the parent goes on to also juxtapose two ways of being literate. One way involves things like "reading a book" (line 2, above), "understanding words," (line 7), understanding "the written word of books...of language" (line 9), "basic language skills of whatever nationality you're from," and "reading and writing." Again, these phrases can be understood as aligning with "traditional," "logocentric," or even "autonomous" (Street, 2006) models of literacy.

While Colleen does not directly refer to a contrasting view of literacy, as I did in my framing, she does present the idea of "coding" as a complement to literacy as "understanding words," as she does in Line 6, "...You canNOT understand coding without...understanding...words" and Lines 8-9, "For you to understand coding, you need to understand the written word of...books, of language, whatever, right?". Her repetition of the deictic (pointing word) "both," (Lines 1 and 3) as well as the collocation of the terms "correlate" (Line 4), "interlocked" (Line 5), and "together" (Line 7) lends further evidence that she considers what I have called "traditional" and "new media" literacies as distinct, but complementary phenomena.

Thus, one can see even in this brief excerpt a kind of situated and co-constructed perspective on literacy. I argue that this perspective is situated in the ways that it is shaped by the participants' understanding of the context of our conversation (e.g. an interview with a literacy researcher, as part of a dissertation, drawing from her prior

knowledge, with "no right or wrong answer, involving a program in which her children take part). I use also use the word co-constructed here to complicate my claims about "interviewees'" perspectives on literacy. The example of Colleen's response appears to incorporate elements of my own framing of the question, her understanding of the context, and finally her own expressed ideas about literacy and its role in the Code Club. While interviews with other parents and library facilitators yielded similar evidence, the situated and co-constructed nature of these perspectives can also be seen in interviews with students, which I structured even more differently.

The following transcript excerpt was constructed from an audio-recorded interview with a student who has been a registered and active participant in Code Club since it began at the library in the summer of the previous year. Lines spoken by the interviewer are annotated with a lower-case letter "i," student lines with a lower-case letter "s."

Natasha - Student (female, 11 years old, Code Clubber for 1 year)
1i. Okay, and here is question number five, the last question, or, um,
2i. It's got a couple of parts.
3i. Are you ready?

1s. Yes.

4i. Okay, uh, do you think that reading and writing are an important part of Code Club?
5i. Uh, why or why not?

2s. I think it is part of Code Club because you can,
3s. You have to read some sites to learn more.
4s. And then that's the reading part,
5s. And then writing, yes, because, um,
6s. You have to like, copy code down to the computer.

6i. Ah, I see.
7i. Um, okay, so WHAT IF I told you, um, that,
8i. Being able to understand and MAKE things,

9i. like PICTURES, animations, games, websites and OTHER stuff.
10i. What if I told you all of that also COUNTED as reading and writing.
11i. Would you say that THOSE things are an important part of Code Club?
12i. Why or why not?

7s. ...Yes.
8s. Um, because…
9s. Like I said, you're copying code DOWN,
10s. and then you're reading SITES, and you're playing games?

Again, my own design and utterance of the questions can be seen as contributing to the situated and co-constructed nature of this perspective on literacy. We can first note that like the parent interviews, student interviews began with more general questions, such as why students came to Code Club, what their favorite part of the experience was, and whether or not they felt Code Club was helping them in any way. In the "literacy-specific" part of the student interviews, however, I replaced what I deemed the more term, "literacy," with the phrase "reading and writing," which I thought would be more approachable to students within the age range of 8-14 years old. In addition, rather than providing alternative perspectives on reading and writing up front, I waited for students to respond to my first question pairing, "Do you think that reading and writing are an important part of Code Club? Why or why not?" (Lines 4i-5i). Then, I followed-up with another question series, framing it with an emphatic "WHAT IF" in Lines 7i-8i:

> WHAT IF I told you, um, that, being able to understand and MAKE things, like PICTURES, animations, games, websites and OTHER stuff. What if I told you all of that also COUNTED as reading and writing. Would you say that THOSE things are an important part of Code Club? Why or why not?

My rationale for approaching the interview design in this way was to attempt to reduce the cognitive load of having multiple, seemingly contrasting lines of questioning posed to young participants at once (Kirschner, Sweller, & Clark, 2006). Further, I attempt to

anticipate such issues by reminding the student in this interview that the question has "a couple of parts." (Line 2i).

With regard to what Halliday (2014) has called the "ideational" metafunction, the first question pairing I pose (Lines 4i-5i) is meant to align with a more "traditional" view of literacy presented also in parent and librarian interviews. The second question series (Lines 7i-12i), which includes a hypothetical "WHAT IF" framing, is meant to align with perspectives on multimodal literacy (Jewitt & Kress, 2003) and New Media Literacies (Jenkins et al., 2009). Let us look at how Natasha responds.

While Natasha does indeed address both series of questions, the similarity of her answers may indicate that she is not drawing as clear of a distinction between literacy perspectives as I have. Note the similarities, in both content and form of her responses in Lines 2s-6s and Lines 7s-10s, which I have reproduced side-by-side below, with some emphasis added in bold

2s. I think **it is** part of Code Club because you can,
3s. You have to **read some sites** to learn more.
4s. And then that's the **reading** part,
5s. And then writing, yes, because, um,
6s. You have to like, **copy code down** to the computer.
7s. ...**Yes**.
8s. Um, because…
9s. Like I said, you're **copying code DOWN**,
10s. and then you're **reading SITES**, and you're playing game

As suggested by Lines 2s-6s, Natasha indicates that "reading and writing" literacies already involve things like reading (web)sites (Line 3s) and writing (by "copying") code to the computer (Line 6s). While I frame a follow-up question series around being able to "MAKE" things (Line 8i.) like "PICTURES" and "OTHER stuff" (Line 9i), Natasha seems to simply rephrase her answers to the prior question, while

adding some emphasis of her own, rather than constructing a new response. In addition, she appears to be using the phrase "Like I said," (Line 9s) to signal to me that she has just responded to a similar question. This evidence indicates that, like Colleen, Natasha has also constructed a complementary, rather than contrasting perspective of "traditional" and "new medial iteracies.

As in Collen's case, one can see in Natasha's excerpt a similar kind of situated and co-constructed perspective on literacy. Like other participants, Natasha is likely drawing on her understanding of the situated context of our conversation (e.g. an interview with a "grown up," who is doing "research," has been a "helper" in the Code Club for about a year, and is asking about her ideas). The perspective on literacy evident in her example can also be seen as a co-construction, as she echoes the words "reading" and "writing" that I use in my own framing while drawing on her prior experience and contributing her own ideas on what counts as reading and writing in the Code Club. Importantly, not all students interviewed exhibited the same kind of "language mirroring" patterns that Natasha did. As we will see by through other examples, however, the other interviews with students did demonstrate a situated and mutually co-constructed perspective.

Labelling Literacy: Sign Systems and Knowledge

One way to begin to understand the ways that different Code Club participants build perspectives on literacy through discourse is to examine the instances that interviewees' directly mention the idea of "literacy," the words and phrases they attach to it, and what situated meanings they might be attributing to these terms. These situated meanings may also signal different figured worlds about literacy in the world and in their own lives. As

practically all scholarly perspectives in the field agree that literacy has a connection to sign systems and knowledge, we can use the Situated Meanings Tool and the Figured Worlds Tool to examine the different sign systems and ways of knowing that are being privileged or disprivileged in participant discourse about the concept of literacy.

I will refer to the ways that adult participants' directly mention forms of the word 'literacy' as their "labelling" of this concept. Returning briefly to the ways that I framed 'literacy' across two perspectives, we can group the labelling of adult participants into at least three types.

What I will call the "Type A" category can be understood as analogous to the more "traditional," "logocentric," or "autonomous" views that everyday people might construe as "literacy in a general sense." Examples of this include librarian Pat's labelling of "just literacy such as working with our literature," and parent Steve's labelling of "literacy from, like, the standard traditional sense."

Another category, which I will refer to as "Type B," reflects what scholars have called more "situated" (Gee, 2010), "contingent" (Luke, 2012), or "expanded" (Moje, 2002) views of literacy. I distinguished this type of labelling by instances when participants described a particular kind of literacy, such as "computer literacy" (librarian Aaron), "digital literacy" (librarian Jean), or "cultural literacy" (parent Steve). Beyond grammatical constructions of "modifier + 'literacy'," I also counted in this category utterances that formed longer nominal groups (groups of words that all come together to name something specific), such as librarian Pat's labelling of, "the literacy of them remembering how to spell their password or their login ID," and "the literacy of using the computer."

A third category of labelling literacy, which I will call "Type C," involves utterances of the word "literate," as in parent Denise's labelling of "being literate," and how "you can become literate." Notably, Denise was the only participant of all adults mentioned so far that used Type C labelling. Still, I chose to group these utterances into a separate category, as their presence can inform the ways we understand how Denise and the other participants attribute situated meanings and develop figured worlds through discourse.

I will address students' examples in another section, as I did not frame their questions around the concept of "literacy" but instead around what I called "reading and writing." For the moment, I will focus on adult participants' labelling of literacy.

The examples of labelling categories shared above make more mention of librarians' Type B labelling than parents'. I do not do this by accident. Examining the frequency counts of literacy labelling across all participants, we can indeed see that librarians' Type B labelling of literacy takes up a larger proportion of their combined total across categories (15 of 22, or about 68%). Parents' labelling of literacy, on the other hand, tends toward the Type A category (9 of 13 utterances, or about 70% of their combined total across categories). These frequencies are summarized in Table 4.1 below.

Table 4.1
Librarians' and Parents' Labelling of Literacy (Frequency Counts)

	Librarians				**Parents**				**Totals**
	Pat	**Jean**	**Aaron**	**Subtotal**	**Colleen**	**Steve**	**Denise**	**Subtotal**	
TYPE A	1	0	6	7	1	7	1	9	16
TYPE B	3	2	11	15	0	2	0	2	17
TYPE C	0	0	0	0	0	0	2	2	2

Subtotal	4	2	16	--	1	9	3	--	--
Total	**22**				**13**				**35**

I will pause here to re-issue Gee's (2014a) reminder that discourse analysis, in the way he has construed it, is not primarily about counting things. Rather than viewing these frequencies and proportions as "significant" in and of themselves, I use them as guidance toward cases in the data set that might yield interesting insights through closer scrutiny of the actual details of these participants' responses. My assumption here is that what people actually say is more important to this study than how many times they say certain kinds of things.

One such area that we can more closely examine, as I have mentioned, is suggested by the proportional discrepancy of Type A and Type B labellings between parents and librarians. To more deeply examine what might be going on here, I turn to an analysis of some of the situated meanings that participants may be attributing to these labels, as well as the figured worlds that these labels and meanings might be connected to. To clarify, my concern is not about why parents and librarians as mutually exclusive groups (they of course, are not) might differ in how they label literacy. Instead, I am interested in what different people mean when they engage in Type A and Type B labelling of literacy.

Turning first to the Type A category of labelling, I will apply Gee's Situated Meanings Tool to ask: "What specific meanings do listeners have to attribute to these words and phrases given the context and how the context is construed?" (2014b, p. 159). This tool allows us more closely examine a representative sample of parents' and librarians' Type A labelling of literacy, which I reproduce here:

Parents

Colleen (mother of 2 children registered in Code Club)
Um, so I think that if you didn't have ... literacy, as in reading and writing, then you wouldn't be able to understand coding, 'cause there's abbreviations and everything like that- So, I think it would be both.

Steve (father of 1 child registered in Code Club)
So, I would say, um, literacy from like the standard traditional sense of math and things like that, I'd say it plays an incredibly important role within the coding, but I don't think that it's necessary to have those skills developed prior to going into something like Coding Club.

Denise (mother of 1 child registered in Code Club)
Um, so to answer your question, "What role does literacy play?" Um, it plays a large role, but you can go into computer, um, code not being literate.

Librarians

Pat (female, main Code Club facilitator)
So they need the literacy for the logging in, they need it for coding because when they do start without, beyond the block coding that they're using with Scratch, when they're using the other stuff if you don't spell words right, you're not going to make your program work.

Aaron (male, former Code Club co-facilitator)
Um, my uh, I feel that um, beyond just literacy such as w-working with our literature, with our books, um reading online, we really need to focus more, especially in public libraries on um computer literacy.

Yeah, I think um, literacy is I believe just as, just much part of um, this um, program as if not more at times then lets say a book club that we might have. (Note that librarian Jean does not do any Type A labelling of literacy, so another of Aaron's is provided).

Across these parent and librarian examples, the Type A labelling of literacy appears to co-locate with phrases like "the standard traditional sense," "reading and writing," "spell words right," "working with our literature," and "book club." What I believe this suggests, in terms of situated meaning, is that their label of "literacy" in a Type A sense refers to what Rowsell et al. (2013) have called a "fairly neutral description of an activity," in this case one that might occur in more "mundane" or "traditional" settings

such as a classroom or book club. Part of the context in which this situated meaning is construed may include participants' interpretations of the following:

- This labelling of literacy is happening as part of an interview;
- This interview is taking place as part of a study on a library program;
- The interviewer is a former teacher and literacy researcher of an "educated" sort;
- The interviewer has just asked about 'literacy' specifically;
- The interviewer has framed two perspectives of literacy as part of the question.

The idea that reading and writing, spelling, literature, and books all have in common a relationship to the more traditionally alphabetic or logocentric view of literacy lends further evidence to this interpretation.

But what of parent Steve's labelling of literacy "from like the standard traditional sense of math and things like that"? Outside of labels such as "mathematical literacy" or "numeracy," many people today may not immediately draw an equivalence between math and literacy. However, this utterance does seem to echo an older conversation about the so-called "3 R's:" reading, writing, and arithmetic; some scholars trace this idea to a phrase coined by Sir William Curtis, a member of the British Parliament, around 1795 (Percy & Timbs, 1840). Taking this into account, it does seem to make more sense that Steve would co-locate the ideas of "literacy," "the traditional sense," "math," and "things like that." At other times during the interview, Steve relates literacy to the idea of "storytelling"," and "grade-level requirements," and thus still appears related to the Type A situated meaning of literacy the other adults seem to attribute.

Turning from here to the Type B category of labelling literacy, we can similarly examine a sampling of adults' utterances in this category. I have reproduced these below. As I have mentioned, librarians overall demonstrated a higher frequency of Type B labelling, so I will list examples of their examples first.

Librarians
Pat (female, main Code Club facilitator)
And then beyond the, like symbolism literacy and all the other stuff of the things that they're getting, they are using stuff from all different kinds of things to make their programs.

Aaron (male, former Code Club co-facilitator)
There are more dimensions to working with computer literacy and coding than a lot of literacies that are out there, and what's great is that you can pair them, too.

Jean (female, head Youth Librarian)
Yeah, I think, um, you know, again, I-I mentioned a little earlier, just those next, um, that next generation of skill sets are, uh, information literacy as well as just digital literacy is huge.

Parents
Steve (father of 1 child registered in Code Club)
I don't think that there's any particular, um, grade level requirement literacy wise, but I also think that there is at least some sort of cultural literacy that needs to happen, in order to be successful at it.

So, we're going to go with literacy in the latter scope of the definition there. Um, I would say, I mean, literacy from where they're currently at ... like, I don't know if it's incredibly important, like it depends on the age range really, I would say, too.

(Neither Colleen nor Denise do any Type B labelling of literacy, so both of Steve's examples are provided instead).

Across librarian and parent examples, one subtype of Type B labelling of literacy takes the grammatical form of a "modifier" + the word "literacy" to describe a specific varieties of literacy. Examples of this include "symbolism literacy," "computer literacy," "information literacy," "digital literacy," and "cultural literacy." This expansion into different kinds of literacy seems to lie beyond the more general, traditional, or mundane associations of Type A labelling. Interestingly, librarian Aaron was the only participant to mention "literacies" in the plural, a point which I will return to later.

Another form that Type B labelling of literacy takes are formed of longer nominal groups than just the "modifier+literacy" structure. Examples of this include librarian

Pat's "literacy of them remembering how to spell their password or their login ID" and parent Steve's "literacy in the latter scope of the definition." In Steve's case, the phrase "in the latter scope of the definition" is operating deictically, pointing to my own expanded framing of literacy as "being able to understand and create different kinds of MEDIA, such as images, games, animations, websites, and more" (capital letters indicate intonational emphasis) "Like the "modifier+literacy" subtype, these longer nominal groups also appear to reference distinctive kinds of literacy and appear tied to a perspective that recognizes literacies as multiple, in contrast to the singularity characteristic of type A labelling.

Taken together, adult participants' Type B labelling of literacy seems to align with a situated meaning akin to what scholars of the New Literacy Studies have called a "multiliteracies," perspective, which indeed construes literacies in the plural: as multiple, socially-situated, and contingent on context (Gee, 2004b; Kalantzis & Cope, 2001; Luke, 2012; Serafini & Gee, 2017; The New London Group, 1996) Like librarian Aaron, those who adopt this perspective recognize multiple ways of being and becoming literate in the world, though not all ways are equally valued by institutions, groups, and individuals in power. This has led literacy scholars such as Brian Street (1984), to refer to such perspectives as "ideological" models of literacy, since they are concerned with what "counts" as literacy and the ways in which that recognition, privileging, or disprevileging is ideologically realized about. Like the situated meanings of Type A labellings of literacy, Type B situated meanings are informed by the ways that interview participants (including myself as an interviewer) construe the context, which may include:

- An interview is framed as part of research on the Code Club experience;
- Parents and librarians have been involved in students' experience of the program;

- Parents and librarians have recognized student creativity and clarity in the program;
- Parents and librarians are invested in the success of their students in the program;
- A "school reform" Discourse has grown more vocal in mainstream media over time.

It is important also to note that what I have called Type B labellings do not always occur "in a vacuum" or presented as a contrast to Type A labellings. Rather, as in parent Steve's mention of "grade-level literacy" (Type A) and "cultural literacy" (Type B) as related idea units (see also, Colleen and Natasha's initial interview responses), participants typically frame these ideas as more complementary and interrelated than is sometimes framed in other debates about the nature of literacy (Street, 2006).

Before moving on to examine the figured worlds that these labels and situated meanings might point to, I will address what I have separated as a third kind of literacy labelling, although this Type C labelling is only reflected in two related instances. I will argue, however, that both in terms of grammatical construction and situated meaning, the things that make Type C labelling stand distinct from Type A and Type B labelling are worth commenting on.

As I have mentioned, what I call Type C labellings of literacy involve utterances of the word "literate," rather than "literacy." Parent Denise was the only participant of all adults mentioned that used Type C labelling. I reproduce the transcript of these labellings below. Note that pauses are indicated by a comma (,), non-final intonation contours by a forward-slash (/), final intonation contours with a double-forward slash (//), and interviewer interjections in square brackets ([ ]). Capitalized letters indicate intonational emphasis.

1. Um, so to answer your question /
2. What role does literacy PLAY /

3. Um, it plays a large role /
4. but you can go into computer, um, code, n-not being literate / [Interviewer: Mm-hmm].
5. An-and you can take the course /
6. And you can BECOME literate /
7. I suppose is how I want to answer //

As the transcript shows, the word "literate" is being used in conjunction with a conjugated form of the verb "to be" (Line 4) as well as the verb "BECOME" (Line 7) to create the verbal groups "being literate" and "BECOME literate." Widening our lens of analysis to the unit of the line, we can also see that these verbal groups co-locate with the pronoun "you." What I believe these grammatical constructions suggest, in terms of situated meaning, is not just the framing of "literate" as state-of-being, but a state-of-being-of-a-person. I would argue the importance of this distinction as tied to one of Gee's (2014a, 2014b) building tasks of language, identity-building. Simply put, while Type A and Type B uses of the word "literacy" could be reasoned to assume that the concept has something to do with a person's identity, Denise's Type C labelling is the only reference to the concept that explicitly makes this content. Additionally, the second instance of Denise's Type C labelling also suggests a situated meaning of being and becoming literate beyond a fixed aspect of identity and toward something more dynamic and malleable.

Looking across adult participants' labelling of literacy and the situated meanings they seem to be attributing to these labels, we can then ask in a broad sense what "typical stories," or figured worlds about literacy these situated meanings might be pointing to. Gee's (2014b) Figured Worlds Tool guides us to ask "what typical stories or figured worlds the words and phrases of the communication are assuming and inviting listeners to assume" (p. 117). Considering the evidence and assertions we have examined so far, I

would broadly state participants' figured world about the concept of literacy as something like this:

> **Adults participants' shared figured world about literacy:**
> An idea that involves both "mundane" everyday, activities such as reading, writing, spelling, and remembering, as well as more "complicated" and specific practices as storytelling and computer programming. The former meaning is typically viewed as "traditional," tied to schooling, and bound by things like grade-level requirements. The more complicated meaning is not always recognized or sanctioned by institutions in power. Nevertheless, just because some people do not recognize certain literacies does not make them any less valuable. Further, even things that we ourselves may not understand, but our children seem to, can be considered valuable literacies in their own right. Finally, these different views on literacy are not irreconcilable or in competition with one another. Rather, they are synergistic and interrelated in many ways.

This shared figured world is particularly interesting to me because it seems to stand apart from certain debates in education that position differing perspectives of literacy in opposition to one another (Pearson, 2004; Serafini & Gee, 2017). Based on the evidence I have examined, I would argue that adult participants in the Code Club seem to instead view different perspectives on literacy as complementary and interrelated, contrary to the ways that certain scholars in education and literacy studies have frame them in the past.

But what of our student participants, who have been the main focus of the preceding two chapters of this manuscript? To more deeply examine their own perspectives on literacy, I will shift the lens of our analysis away from labelling literacy (which the students do not do) and instead toward the activities and practices that participants describe in relation to literacy.

Doing Literacy: Activities and Practices

Labelling things is only one of the many ways people can construct perspectives on an idea through discourse. Another lens through which we can approach our analysis may focus on the different activities and practices when I ask them about literacy in the Code

Club. In the context of discourse analysis, we can begin this examination by looking at the action verbs and verbal groups that participants use to describe these activities. We should also remember that in discussing the building task of practices/activities, Gee (2014b) reminds us that what separates an activity from an action (or behavior) is that an activity "carries out a socially recognizable and institutionally or culturally normed endeavor" (p. 103). Simply put, an activity or practice only "counts" in the sense that other people who engage in a similar activity or practice recognize it in a social context. This particular lens is especially useful in the context of student responses, as my own framing off the question using the -ing words "reading" and "writing" may signal that I am asking about activities. So what activities do our student participants mention when I ask them about this?

Below I have reproduced a sample of the different activities that students mentioned when I asked them about the role of reading and writing in the Code Club, across both my initial and "expanded" framings of what counts as reading and writing.

Initial framing (Are reading and writing important in Code Club?)

Ben (male, 10 years old, newcomer to Code Club)
- using electronics and such
- browsing things that aren't really that safe
- read it in a book or something
- write it down on a piece of paper, and then try it.

Gwen (female, 9 years old, newcomer to Code Club)
- make an account on Scratch
- make stuff like writing

Natasha (female, 11 years old, Code Clubber for 1 year)
- read some sites to learn more
- copy code down to the computer

Expanded framing (pertaining to pictures, animations, games, websites, etc.)

Ben (male, 10 years old, newcomer to Code Club during the summer of 2017)
- make an idea in your- in your own way
- think of something that I could...that could actually work
- fix it [something that was supposed to work]
- connect to different shapes

Gwen (female, 9 years old, newcomer to Code Club during the summer of 2017)
- make them [shapes]
- learn all about it

Natasha (female, 11 years old, Code Clubber for 1 year)
- copying code DOWN
- reading SITES
- playing games

As we saw in our earlier discussion of the situated and co-constructed nature of Natasha's response, we can see students blending both "traditional" and "new media" perspectives on literacy. Even in my initial framing of the question about reading and writing, Ben mentions "using electronics," Gwen says you can "make an account on Scratch" and Natasha identifies reading (web)sites and copying code to a computer. When I expand my framing of reading and writing, Ben and Gwen both mention connecting to different shapes, while Natasha restates her initial response with added intonational emphasis. While Ben's response seems to shift a bit from the "receptive" dimension of literacy (browsing, reading), toward the "productive" dimension (make an idea, fix it, connect to shapes), Gwen and Natasha's responses seem to strike more of balance between receptive and productive activities across framings of the interview question.

In the figured worlds about literacy that students' responses seem to indicate, reading and writing appear to be things that you do across a variety of different contexts (books, electronics, the computer) that allow you to understand things (by learning,

connecting, or looking up) as well as create things (shapes, an idea, some code), and may even extend into other activities, such as fixing malfunctioning inventions and playing games. Perhaps even moreso than their adult counterparts, these children do not indicate much of a boundary between reading and writing through "traditional" vs' "new" media. Rather than unbridled enthusiasm, however, certain students, such as Ben, did express their doubts about new, computational media, and explained how perhaps more "traditional" reading and writing might help address these concerns. In the transcript below, I have just asked Ben if reading and writing (initial framing) are important in Code Club. Question marks indicate words that are have a high terminal inflection (like when a question is being asked).

1. They're IMPORTANT because /
2. You KNOW? People love using electronics and such? [I: Mm-hmm]
3. Doing certain things like BROWSING things that aren't really that safe? [I: Okay]
4. It turns your brain into mush /
5. Even though most of it actually helps you. [I: Mm.]
6. But, so I'm just saying that reading and writing are STILL USEFUL because /
7. If there's like something that you can't um, put your finger on /
8. You could read it in a book? or something?
9. And then, it can instantly pop up into your mind /
10. And that's what could happen.

In this passage, after establishing the context that "people love using electronics and such," (Line 2) Ben highlights that certain activities such as "BROWSING things that aren't really safe" can turn one's brain "into mush" (Lines 3-4). Immediately afterward, however, he suggests that "most of it actually helps you" (Line 5). One way to interpret of this sudden shift is to identify the "it" of Line 4 as functioning deictically to point at the phrase "BROWSING things that aren't really safe?" The "it" of Line 5 may also be operating deictically, but instead pointing at Line 2's concept of "using electronics and

such." This may help reconcile Ben's distinction between using electronics in a way that "turns your brain to mush" vs. in a way that "actually helps you." Interesting, rather than pointing to digital tools such as an online search engine, he indicates that "If there's like something that you can't um, put your finger on / You could read it in a book or something" While Ben could have suggested looking such things up online, perhaps, in Ben's view, there is less of a threat of a book turning your brain to mush than electronics, since fewer barriers to posting internet content can result in a danger of "BROWSING things that aren't really that safe."

Applying a similar activity-focused lens to the transcripts of interviews with adults, we can also note a variety of activities that they appear to associate with the concept of literacy:

> **Colleen** (mother of 2 children registered in Code Club)
> reading and writing
> understand coding
> understand the written word of books
>
> **Steve** (father of 1 child registered in Code Club)
> get into to, uh, to coding or anything like that
> making the games and things like that
> being able to read things and whatnot
>
> **Denise** (mother of 1 child registered in Code Club)
> go into computer, um, code
> take the course
> understanding this brand new language
>
> **Pat** (female, main Code Club facilitator)
> remembering how to spell their password or their login ID
> pulling different backgrounds with pictures off of the internet with Google
> finding music to use for their videos
>
> **Aaron** (male, former Code Club co-facilitator)
> word processing
> reading through a book
> work with the coding

Jean (female, lead Youth Librarian)
playing with that an-animation
using (apps) already on their own
looking at that backend

Similar to the responses of students, this sampling of activities mentioned by adults demonstrates a variety of literacy practices, spanning "understanding the written word of books" (parent Colleen), to "word processing" (librarian Aaron); from "making games and things like that" (parent Steve), to "looking at that backend" (librarian Jean), which likely refers to the interface through which programmers enter and manipulate computer code. In addition, these activities are not always discussed by adults as completely separable from another another, as an excerpt from librarian Pat's transcript exemplifies:

STANZA 1
1. So they need the literacy for, the logging in /
2. They need it for coding because /
3. When they do start, without /
4. Beyond the block coding that they're using with Scratch //
5. When they're using the other stuff /
6. If you don't spell words right/
7. You're not going to make your program work //
8. So there's that too /

STANZA 2
9. ...beyond the, like, symbolism literacy and all the other stuff of the things that they're getting //

10. They ARE, USING stuff from ALL different kinds of things to make their programs /

11. They're pulling, different backgrounds with pictures off of the internet with Google //

12. They're finding music to use for their videos /

13. There are games that they're making on Scratch /

14. They're pulling all kinds of different things in, so //

15. They ARE learning the use of the computer, the literacy of using the computer that

um/

16. Maybe not all kids their age are getting a chance to do that //

Pat is the lead facilitator of the Code Club program, and the librarian with whom I have been most closely working throughout the project. In Stanza 1, she relates a few different activities related to the Code Club (logging in, block coding, making a program work), framing literacy (in a Type A sense) as a kind of prerequisite to engaging in more programming-specific activities. In Stanza 2, she goes through a list of some of the many activities that she has observed students engaging with, which encompass "ALL different kinds of things to make their programs" (Line 10). She also relates these activities to more of a Type B labelling of literacy, which we can see in Line 15.

Again, rather than framing these Type A and Type B meanings of literacy as encompassing completely distinct and separable activities, she discusses multiple literacy practices in the ways they complement each other. She also seems highlight that opportunities to engage in these multiple literacy practices are a kind of social good when she mentions in Line 16 that "maybe not all kids their age are getting a chance to do that." For Alicia, as for other adults interviewed, it seems that having the opportunities to engage in activities and having caring adults to guide students through them is an important part of what defines the Code Club experience.

For both students and adults in the Code Club then, literacy appears to involve a wide variety of practices that 1) cut across analog and digital spaces, 2) encompass both receptive and creative processes, and 3) typically work together, rather than separately, to help people accomplish meaningful goals.

Expanding Literacy: Significance and Connections

One final shift in our lens of analysis that we use to explore participants' perspectives on literacy involves a kind of "zooming out" from the collected data set to examine how participants' labelling of literacy, situated meanings, figured worlds, and activity-building through language might align with, contrast against, or otherwise complicate broader Discourses and Conversations about literacy across historical and contemporary contexts. We have already begun to do some of this work already, so I will structure this section around several key connections to broader contexts

Autonomous and ideological models of literacy. In considering the concept of literacy in theory and in practice, Street (1995; 2006; 1984) has discussed the contrasting ideas of autonomous and ideological models of literacy. For Street and the many scholars who have adopted this view, autonomous models of literacy take the standard Western view of literacy as a purely technical, cognitive, and "neutral" set of skills (see, for example, Willingham, 2017), and impose such a conception on all other people and cultures, including those in the West whose language practices have been historically marginalized and minoritized by those in power. This has led to what some have called an "deficit" view of people who do not conform to the dominant language and literacy practices, itself a matter of considerable debate over the last several decades (Collins, 1988; Gorski, 2008; Harrison & Trabasso, 1976).

Street identifies an alternative to such a perspective, which he labels as a more ideological model of literacy. In addition to framing literacy as rooted in particular social practices, an ideological perspective frames multiple literacies as rooted in issues of knowledge, identity and being. As he summarizes:

> Literacy, in this sense, is always contested, both its meanings and its practices, hence particular versions of it are always 'ideological,' they are always rooted in a particular world-view and a desire for that view of literacy to dominate and to marginalise others" (Street, 2006, p. 2; citing Gee, 1990; Besnier & Street, 1994).

While participant responses suggested a figured world about literacy that indeed recognized and valued literacies as situated, multiple, and contingent on context, they also seemed to involve a recognition that certain literacies were more valued than others - particularly when it came to established institutions such as the education system. Thus, while participants recognized an autonomous view of literacy existed in the minds of some, the perspectives voiced by parents, librarians, and students nevertheless appeared to align more with an ideological model of literacy. As librarian Aaron indicated when given an additional chance to comment after I had run out of questions:

> Helping people understand information and learn how to find it / and I think that that's what Code Club represents, is learning how to utilize literacy in different ways and how to recognize literacy in different ways...And, I think that's what Code Club is doing / is helping children find meaning in a literacy that they may not understand / or how to utilize, and now they're actually able to, uh, be a part of that process, which I think is really great //

Aaron's mention of "recognizing literacy in different ways," along with the implicit recognition about multiple possible literacies - signaled by his choice of the indefinite article to describe "a literacy that they may not understand" - helps to illustrate how his thoughts perhaps echo those who adopt similar perspectives to scholars of the New Literacy Studies (NLS). His mention of "literacies" in the plural, which I have discussed earlier, further corroborates this claim.

Traditional and new media literacies. Throughout this chapter, I have referred to the idea of "new media" literacies in contrast to "traditional" literacies. If we take the concept of "traditional" literacies to be somewhat related to an "autonomous" model of

literacy, and focusing primarily on reading and writing in print, then we can distinguish "new" (computational) media literacies as extending the concept of social literacy practices into other kinds of media. Of course, in today's terms, it is may feel antiquated to think of computational media - media that primarily derive from digital computing technologies as "new." Still, scholars of what has come to be called the New Media Literacy Studies (NMLS) have been vocal in their argument that "schools and afterschool programs must devote more attention to fostering what we call the new media literacies: a set of cultural competencies and social skills that young people need in the new media landscape" (Jenkins et al., 2009, p. 4). While various scholars from different fields have (perhaps rightfully) branded computational media as "new media" (Jenkins et al., 2009), "new digital media" (Gee, 2009), and "digital environments" (Murray, 1997; 2016), the procedurally-generated nature of this media has historically been less celebrated on than its participatory dimension.

As discussed in the previous chapter of this manuscript, these new media literacies have been said to "build on the foundation of traditional literacy, research skills, technical skills, and critical analysis skills" while "helping students acquire the skills they need to become full participants in our society" (Jenkins et al., 2009, p. 4). New media literacies named in a foundational document called "Confronting the Challenges of Participatory Culture," and which have been referenced by Code Club participants include:

- Play — the capacity to experiment with one's surroundings as a form of problem-solving
- Appropriation — the ability to meaningfully sample and remix media content;
- Distributed Cognition — the ability to interact meaningfully with tools that expand mental capacities;
- Transmedia Navigation — the ability to follow the flow of stories and information across multiple modalities; and

- Networking — the ability to search for, synthesize, and disseminate information (Jenkins et al., 2009).

Revisiting librarian Pat's reflection on literacy practice in the Code Club, we can see parallels between some of the new media literacies listed above and her own discourse on how students engage in the club:

> They ARE, USING stuff from ALL different kinds of things to make their programs / They're pulling, different backgrounds with pictures off of the internet with Google // They're finding music to use for their videos / There are games that they're making on Scratch / They're pulling all kinds of different things in, so // They ARE learning the use of the computer, the literacy of using the computer that um / Maybe not all kids their age are getting a chance to do that //

In this passage, we see that Pat seems to be identifying a variety of new media literacies the students engage with as a part of their Code Club experience. We can also see how play, appropriation, distributed cognition, transmedia navigation, and networking all seem to play a role in the activities she has framed. And like other librarians, parents, and students (and in line with the Discourse of the NMLS), Pat does not appear to frame new media literacies as disconnected from traditional literacies, but instead complementary and intertwined.

Logocentric and multimodal perspectives on literacy. A final way that I will discuss participant discourse being connected to broader Discourses and Conversations in the world in connection to the concept of multimodal literacy (Jewitt & Kress, 2003). Historically, the autonomous model of literacy that has dominated formal education in the West has emphasized language-based (logocentric) perspectives of literacy, whether in print-based or digital texts (Serafini, 2013). This has led other scholars to critically examine its applicability to the more multimodal texts that have come to dominate our contemporary literacy landscape (Serafini & Gee, 2017).

As I have mentioned in previous chapters, multimodal perspectives on literacy emphasize that, beyond written language, people draw from a wide variety of modal resources - composition, typeface, color visual images, and more - to create and exchange meaning through designed artifacts (Jewitt & Kress, 2003). In Serafini's (2012) Expanded Four Resources model of visual and multimodal literacies, for example, the concept of a text is re-defined to "address the multimodal aspects of communication and to include research and theories from visual culture (Barnard, 2001), semiotics (Scholes, 1982; Smith-Shank, 2004), critical media studies (Semali, 2003), grammars of visual design (Kress & van Leeuwen, 1996) and multi-modal analysis (Baldry & Thibault, 2006; Bateman, 2008; Jewitt, 2009)." In doing so, Serafini also expands the notion of reader to reader-viewer to better account for the perceptual, structural, and ideological aspects of visual and multimodal texts (Serafini, 2010). Thus, for Serafini, families of literacy practices can be expanded to include the following:

- **Reader as Navigator.** Beyond decoding, concepts of print, directionality, and sequencing, visual and multimodal texts often require readers to navigate the grammar of visual design (Kress & Van Leeuwen, 1996). Today's visual and multimodal texts, whether print or digital, can also involve non-linear structures, visual images compositional features that draw on different kinds of literacy resources and practices than purely language-based texts.
- **Reader as Interpreter.** The term "interpretation," while often used interchangeably with "comprehending," "understanding," "constructing meaning" and "making sense," aligns more closely with the philosophical position that no single "truth" exists in a text, but instead a range of possible interpretations (Rorty, 1979; Serafini, 2012a). Visual images, like written texts, do not exist in a vacuum, and so reader-viewers must learn to develop interpretive repertoires that address the features of multimodal texts within broader social contexts.
- **Reader as Designer.** As Serafini asserts, "readers of multimodal texts not only construct meaning from what is depicted or represented, but also design the way the text is read, its reading path, what is attended to and, in the process, construct a unique experience during their transaction with a text." (Serafini, 2012a, p. 158, emphasis mine). In addition, reader-viewers also construct, or design frames around experiences with multimodal texts to consider them in the contexts in which they are realized.

- **Reader as Interrogator.** To interrogate visual and multimodal texts requires readers to consider the sociocultural contexts in which these texts are produced, as well as those in which they are received. Visual images are one means through which ideologies are produced and projected; thus learning to interrogate these texts for their embedded ideologies is an important consideration in today's educational environment (Rose, 2012; Serafini, 2012b; Sturken & Cartwright, 2001).

Considering the varieties of activities that participants have tied to the concept of literacy through their language, we can see how they might fit into Serafini's model in different ways. From Natasha's work as a navigator and interpreter playing games, to Gwen's work as a designer making shapes and programs, to Ben's work as an interrogator considering the dangers of browsing junk content online. Beyond the modal resources of letters and words, we also see mentions of symbols and sounds (librarian Pat), animations (librarian Jean), and shapes (students Ben and Gwen) in relation to the concept of literacy. Again, while students, parents, and librarians alike all seemed to recognize the primacy of logocentric views in established and standardized institutions, they nevertheless constructed perspectives in literacy that appeared to more closely align to multimodal perspectives on what it means to be and become literate today.

Perspectives on Literacy Across Participants and Participant-Groups

Before making some concluding remarks on this study, I will briefly summarize the key assertions I have made in light of the evidence I have examined and the different discourse analysis tools I have brought to bear on this evidence. As a reminder, the guiding question for this study was:

> How do interview participants use language to construct their perspectives on literacy as part of the Code Club experience?

I defined the idea of "perspectives" as combinations of the different "building tasks" of language that Gee (2014a, 2014b) has identified, including sign systems and knowledge-

building, significance-building, and connection-building that comprise a set of views about an idea, in this case the broad concept of literacy as it relates to the Code Club experience.

Firstly, I argued that participants' perspectives on literacy are actually mutually co-constructed and socially situated in the context of the interviews I conducted with Code Club participants. I provided an analysis of excerpts from a parent interview and a child interview and demonstrated that this co-construction could be seen through participants' lexical and grammatical mirroring of my own questioning pattern, and the socially-situated nature of the responses demonstrated through integration of participants' integration of contextual details into the interview.

Secondly, I examined the ways that adult participants in the Code Club engaged in the "labelling" of literacy throughout our interview process. I mapped the frequency of participants' utterances of the words "literacy," and "literate." I then engaged in more detailed analyses of excerpts from three parent and three librarian interviews to highlight the situated meanings they attributed to these labellings and the figured worlds they might signal. Based on the evidence I examined, I argued that adult participants in the Code Club seem to view different perspectives on literacy as complementary and interrelated, contrary to the ways that certain scholars in education and literacy studies have framed them in the past.

Thirdly, I shifted my focus from labelling practices to the activities and practices that students associated with literacy, or as I framed it in student interviews, "reading and writing." I reproduced samples of the different activities students had identified as part of their Code Club experience, then closely examined an excerpt from student Ben to more

deeply analyze the ways in which he was framing different kinds of literacy activities in relation to one another. I turned this activity-focused examination to parent and librarian interviews as well, and found a similar variety of activities identified and framing of activities as complementary. For students and adult participants in the interviews, I concluded that literacy was framed around a wide variety of practices that 1) cut across analog and digital spaces, 2) encompass both receptive and creative processes, and 3) typically work together, rather than separately, to help people accomplish meaningful goals.

Finally, I expanded my frame of analysis to consider the ways that participant discourse during the interviews might be seen as connected with broader Discourses and Conversations about the nature of literacy in our modern world. On reviewing some of the data analyzed in this chapter and revisiting the scholarship on historical and contemporary Discourses about literacy, I drew parallels to three broad Conversations regarding 1) autonomous and ideological models of literacy, 2) traditional and new media literacies, and 3) logocentric and multimodal perspectives on literacy. Again, while students, parents, and librarians alike all seemed to recognize the primacy of autonomous and logocentric views in traditional institutions, they nevertheless constructed perspectives in literacy that appeared to more closely align with NLS, NMLS, and social-semiotic perspectives on what it means to be and become literate today.

Implications, Limitations, and Future Research

Addressing limitations of the previous chapter, I argued that a stronger shift of focus toward participant perspectives may shed additional understanding on the claims I made about participant literacy experiences in the Code Club. In this chapter, I presented an

analysis of the discourse used by participants to characterize their experience of literacy as part of the Code Club to help address this issue.

The first finding I have outlined above regarding the situated and mutually co-constructed nature of participant perspectives aligns with prior work examining discourse in educational settings (Rogers, 2011), while also re-assembling Gee's fundamental building tasks of language around the construct of "perspectives."

The second finding was particularly interesting to me, however, mainly because of the autonomous and logocentric models of literacy that to this day seem to dominate educational institutions and the mainstream media. At the moment of this writing, the globally crowdsourced Wikipedia entry for "reading" overviews the concept as a "complex cognitive process" involving the decoding of symbols. Meanwhile, text on the International Literacy Association's homepage argues uncritically that "The ability to READ, WRITE, and COMMUNICATE connects people and empowers them to achieve things they never thought possible." Despite narrow or uncritical definitions of literacy that dominate Western society, I was intrigued that adult participants in the Code Club seemed not only to recognize multiple perspectives on literacy, but also to frame these different perspectives as complementary and interrelated, contrary to the ways that certain scholars in education and literacy studies have framed them in the past.

The third finding of the study is notable when framed in context of historical conversations about parent involvement (or lack thereof) in education, which can often be couched in deficit perspectives - especially for those coming from marginalized backgrounds (Jacobs, 2014). This finding suggests that provided with responsive context, parents, students, and librarians outside the "formal schooling" context can and do think

deeply, critically, and constructively about the possibilities that expanded perspectives on literacy can afford. The fourth finding of the study supports the claim that scholarly perspectives on ideological models, new media literacies, and multimodal literacies can benefit from detailed examinations of participants' discursive experiences.

With regard to questions of validity, several limitations of the present analysis invite further exploration of these issues through additional scholarly efforts. First, though the project engaged in an in-depth discourse analysis based on key theoretical tools, I did not intend to conduct a "complete" or "ideal" discourse analysis. This suggests that applying other analytic tools to the data set may indeed reveal more nuanced findings or even alternative explanations of the evidence I have presented.

Secondly while I have worked to rigorously construe participant perspectives as expressed through discourse, additional trustworthiness would be lent to the analysis through member-checking with participants who might be "insiders" to similar situations. Further validity would be added based on the analyses of other researchers in and outside the field of discourse analysis on this dataset as well.

Thirdly, while I attempted to balance more global and in-depth analyses of the dataset I generated through interviews, this analysis could be strengthened further with the inclusion of a larger and more representative sample of participants in the research context.

Finally, while I have grounded my analysis and conclusions in the linguistic details of what participants actually said during interviews, I purposefully elected to exclude certain details, such as the intonational pitch changes across lines and lengths of

pauses. For this reason, I remain open to additional analyses that may reveal that these details would indeed change the analysis in a significant way.

As Gee (2014a) points out, however, discourse analysis, linguistics, and indeed all of science is a social and accumulative endeavor; however, as he summarizes,

> no piece of work can, or should ask all possible questions, seek all possible sources of agreement, cover all data conceivably related to the data under analysis, or seek to deal with every possible relevant linguistic detail. (p. 124).

Keeping this perspective in mind, I have worked to narrow down the findings of this analysis to the four key assertions I have summarized above. It is my hope that future researchers interested in this work will juxtapose it with earlier and later work in the field and build on, extend, or refine the assertions I have made here about how people frame literacy in the context of an everyday experience learning through and about new technologies.

Ultimately, this work contributes to the broader literature base underpinning literacy education by providing additional evidence into how digital-age literacies, as enacted on, behind, and beyond the screen, are framed by those engaging with them. These understandings can then inform the ways that teachers, parents, librarians, and other caring adults teach, learn, and talk about evolving literacy practices in our digital age.

CHAPTER 5:

EXPANDING ANALYTICAL PERSPECTIVES ON LITERACY IN A DIGITAL AGE

The purpose of this chapter is to look across the three studies that constitute this project to develop a vision for how this work might be further developed, applied, and extended beyond the context of this research. I begin by reviewing key findings within and across the three studies presented in the previous chapters. I then discuss the concepts of validity and trustworthiness as they relate to the strengths and limitations of the work I have presented. Finally, I broaden the discussion of this project to consider the implications and future directions of this work, particularly for literacy research, policy, and practice.

Digital-Age Literacies Across Multiple Dimensions

As I stated in the introductory chapter of this manuscript, the overall goal of this project was to explore the literacy experiences of students within one context that has come to be associated with movements around digital-age literacies: a library-based computer programming club for children. Distributed across three studies, the project sought to develop an empirical account of an out-of-school library-based program called a "Code Club," designed to engage youth aged 8-14 to engage with computer programming concepts through a variety of activities. Through a series of interconnected, interpretive studies of artefactual, observational, and interview data collected over the course of one year of implementation of one such program in a local public library, I highlighted the various literacy demands, social practices, and linguistic resources that participants engaged with throughout the process, connecting my findings to digital-age literacy research and pedagogy. Ultimately, I argued that such an analysis of rich qualitative data collected over time would expand our understanding of possibilities and

challenges of understanding and supporting young people's literacy development in a digital age.

At the outset of this work, I grounded this project from an interpretivist stance - in particular, one which asserts that "interpretation is central to all kinds of educational research and enters into it at every stage of the process," from the formulation of research questions to the presentation of findings drawn from empirical analysis (Smeyers, Bridges, Burbules, & Griffiths, 2015, p. 3). The analysis proposed for this project can be even more specifically located within a "family" of approaches that defines interpretation as a product of research - as an argument, grounded in evidence, which demonstrates to an audience the significance of something that may not be readily apparent.

Each of the studies I presented were guided by such 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, Barnett, & Squire, 2002; Denzin & Lincoln, 2008; Erickson, 1986; Guba, Lincoln, & Others, 1994; Lincoln & Guba, 1985). While conventional approaches to empirical research may attempt to control for factors or variables that might affect the outcomes of a study, naturalistic approaches instead aim to capture the complexity of social contexts that may be "explainable only in terms of multiple interacting factors, events, and processes that give shape to it and are part of it." (Lincoln & Guba, 1986, p. 17).

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). Finally, these perspectives reject the notion that a researcher, or inquirer, can necessarily maintain a completely objective distance from participants or the phenomena of study, and instead should learn to embrace the importance of the interactive nature of participant-observer relationships, as it may be because of these relationships that both participants and researchers can meaningfully engage in learning together through the inquiry process (Lincoln & Guba, 1986). Sometimes referred to as "ethnographic" in nature, these relationships are often considered a central part of studies in the tradition of naturalistic and interpretive inquiry, including ethnographic approaches to educational research (Cavanagh, 2016). In the sections that follow, I briefly review key findings within and across the three studies I have presented.

In Chapter 2 of this manuscript, I described a study designed to expand educators' understanding of the complexity of one subset of digital-age texts. The purpose of the study was to analyze the literacy demands evident in the the designed user interfaces of several online learning platforms, which I identified as multimodal, hypermedia artifacts (Djonov, Knox, & Zhao, 2015; Lemke, 1998; Zhao & Others, 2012). Specifically, the study sought to address the following overarching question: What literacy demands are evident in web applications as multimodal artifacts designed to engage novices in computer science education? To address this question, I developed an interpretive framework of analysis by combining Pauwels' (2012) "Multimodal Framework for Analyzing Websites as Cultural Expressions," with my own conceptual framework of digital media across content, procedural, and contextual dimensions (Author, 2017). I then applied this multidimensional analysis to two web-based application interfaces

commonly used by students on Khan Academy and Code.org. The findings of the project revealed a wide variety of complex literacy demands across digital hypermedia artifacts, such as web-based applications. These findings might be used as one starting point for educators interested in helping students develop literacy practices better aligned with the changing literacy demands of a digital age.

In Chapter 3, I presented an analysis of data collected over the course of a ten-week summer session of the Code Club (June 2017 - August 2017). A total of 47 students aged 8-14 participated in the Code Club, which met for two separate sessions on Thursday afternoons, along with a library facilitator. I also served to co-facilitate these sessions throughout the research process. Specifically, this study sought to address the following question: In what ways do students draw on literacy resources and practices as part of their experience in a computer programming club? To address this question, I collected observational, artefactual, and audio-recorded data related to the activities, conversations, and practices students engaged in during Code Club time. I then applied systematic cycles of qualitative coding (Saldana, 2015) to identify patterns in the ways students drew on literacy practices to meet the various literacy demands they encountered as they navigated, interpreted, interrogated, and designed their learning experiences across virtual and face-to-face contexts (Serafini, 2012). Through this analysis, I argued that the ways that students drew on literacy resources and practices could be best expressed through the concept of entanglements: between virtual and material literacy practices, between "traditional" and "new media" literacy practices, and between receptive and productive literacy practices. Ultimately, I asserted that than attempting to separate these dimensions from one another, learning to reconcile these conceptual

entanglements may contribute to broader understandings about youth literacy practices in a digital age.

In Chapter 4, I presented a study drawing on a theory and method of discourse analysis developed by Gee (1999; 2004, 2014a, 2017) to analyze qualitative interviews with parents, students, library facilitators, and designers of the Code Club Program. I conducted a total of 9 qualitative interviews with people connected to the the Code Club in various ways (3 parents, 3 students, and 3 librarian facilitators). In the interviews, I asked about their perceptions of and experience with the Code Club and role that literacy might play as part of it. I then applied the analytic "toolkit" of Gee's discourse analysis to respond the following overarching question: How do interview participants use language to construct their perspectives on literacy as part of the Code Club experience? Discussing findings across interviews, I argued that participant discourse evidenced 1) mutually co-constructed and situated perspectives on literacy; 2) complementary framings of "traditional" and "new" literacies; 3) deep and critical reflection about the ideological positioning of literacy in and outside of school, and 4) perspectives that aligned with broader Discourses typically associated with the New Literacy Studies, New Media Literacies Studies, and social-semiotic framings of literacy.

Findings Across Studies

Overall, the findings of the project revealed a wide variety of complex literacy demands, practices, and discourses that evidence the dynamic and multidimensional nature of literacies in a digital age. Further, while a wide variety of literacy practices can be observed while students engage with digital content on screens, other practices may be obscured unless we pay specific attention to the ways that students are engaging with the

"behind-the-screen" (procedural) dimension of digital media, including the technological tools that render this content visible on our digital devices (Aguilera, 2017). Additional insight into students' literacy practices can also be gained from an examination of students' engagement with the "beyond-the-screen" (contextual) dimensions of their digital-age literacy experiences, including the social situations that simultaneously give rise to and are shaped by sites of production, dissemination, and everyday use (Rose, 2012). Finally, the project helped to reveal how participants' perspectives about their literacy experiences are both situated and co-constructed, simultaneously reflecting wider societal conversations while at the same time grounded in the details of individual experience (Avila &Pandya, 2013; Gee, 1999). Taken together, these findings illustrate the multidimensional nature of digital literacy experiences as they are rendered "on the screen" at the content level, "behind the screen" at the procedural level, and "beyond the screen" at the contextual level.

Evaluating Scholarly Rigor: Three Perspectives

Before considering the implications of these findings, I will discuss several perspectives on scholarly rigor (sometimes discussed more specifically as "validity") as they pertain to the strengths and limitations of this multi-study project. While there is overlap in each of these viewpoints, juxtaposing these multiple perspectives not only helps to more clearly define the scope of the claims I have made, but also suggests the importance of a more nuanced discussion of how to move this work forward.

Rigor in the Naturalistic Paradigm: Trustworthiness, and Authenticity

Among the most seminal perspectives on the notion of scholarly rigor in naturalistic and interpretive research is the work of Yvonne Lincoln and Egon Guba (Guba & Lincoln,

1989; Guba et al., 1985, 1986, 1994). Writing from what they called a "naturalistic paradigm," they argued that conventional criteria for scientific rigor, which typically emphasize validity, reliability, and objectivity, are often more honored "in the breach" than in the observance. In other words, in studying the "buzzing, blooming confusion" of the social world requires not only an approach to rigor that is more realistically attainable, but also one that more appropriately addresses the philosophical and methodological differences between conventional (sometimes labeled "positivist") and naturalistic paradigms (Barab & Squire, 2004; Lincoln & Guba, 1986; Schwandt, Lincoln, & Guba, 2007).

Toward this end, Lincoln and Guba offer what they deem to be "parallel" criteria for rigor in the conventional paradigm, which they call criteria of trustworthiness. These include, in their terms, credibility (What is the truth value of this work?), transferability (How applicable is this to other contexts?), dependability (How consistent are these findings?), and confirmability (Can these findings be confirmed by other interested parties?). In addition, the authors also suggest a set of criteria more "intrinsic" to naturalistic paradigms, which they call criteria of authenticity. These include addressing issues of fairness (How does the work balance the representation of multiple values?), ontological authentication (How has the work contributed to a more sophisticated consciousness of the issues at hand?), educative authentication (How has the work contributed to an appreciation of the perspectives of others?), catalytic authentication (To what degree has the work stimulated or inspired action?), and tactical authenticity (To what degree is the work empowering or impoverishing, and for whom?).The authors do caution that at the time of their publication, "all five of these authenticity criteria clearly

require more detailed explication," and that "strategies or techniques for meeting and ensuring them largely remain to be devised" (Lincoln & Guba, 1986, p. 25). Nevertheless, this discussions of trustworthiness and authenticity highlights important considerations for evaluating interpretive research such as that presented in this manuscript.

Evidentiary Adequacy and Interpretive Validity in Educational Research

The seminal work of Fred Erickson (1986) approached the challenge of rigor, particularly in interpretive research conducted in educational settings, from a somewhat different angle. While he does not explicitly name the concept of "rigor" in his discussion of qualitative methods in research on teaching, he does address two broad categories of evidentiary adequacy and interpretive validity, in evaluating research conducted from an interpretive stance. While he discusses the former term in the negative as "evidentiary inadequacy," I will re-phrase his criteria here in the positive in defining his vision of evidentiary adequacy as having: 1) adequate amounts of evidence, 2) adequate variety in kinds of evidence, 3) adequate interpretive status of evidence, 4) adequate disconfirming evidence, and 5) adequate discrepant case analysis. For Erickson, it is the combination of evidentiary adequacy and an interpretive perspective that accounts for and connects the evidence through a "statement of a theory of organization and meaning of the events described" that constitute validity from an interpretive perspective (1986, p. 185). One strength of Erickson's perspective is his emphasis on linking interpretive assertions to empirical details, a perspective echoed across both "general" interpretive approaches and more "specialized" methodologies such as discourse analysis, as discussed in the prior chapter of this manuscript.

A "Specialized" Example of Validity: Discourse Analysis

One particular case that may warrant its own examination of rigor is my work in the prior chapter on discourse analysis. I call this case "specialized" because in framing a theory and method of discourse analysis, Gee (1999, 2014b) also outlines four particular criteria for to address the question of what constitutes validity in discourse analysis. These four elements are convergence (How compatible and convincing are a researcher's responses to particular elements of a discourse analysis?); agreement (How do a discourse analyst's assertions align with the perspectives of "native speakers" of a focal Discourse and those of other discourse analysts and researchers?); coverage (How well can an analysis be applied to related sorts of data?); and linguistic details (How tightly tied is a given analysis to the details of the linguistic structure being examined?). In Gee's criteria, we can see parallels to Lincoln and Guba's (1986) criteria of trustworthiness and authenticity, as well as Erickson's (1986) emphasis on evidentiary adequacy. Importantly, however, Gee points out that validity in this is neither a reflection of "objective" reality (as all humans necessarily interpret the world around us), nor a "once-and-for-all" matter. In these issues his, perspectives might be extended to all interpretive research, in that all such analyses are "open to further discussion and dispute, and their status can go up or down with time as work goes on in the field." (Gee, 1999, p. 122).

It is not my purpose here to argue that the studies presented in this manuscript address every element of rigor outlined by the scholars above. In line with Gee's assertion that validity cannot be established in a "once and for all" sense, I instead bring these perspectives up to provide some guidelines against which interested scholars might evaluate my work, especially as it relates to related work in the areas of literacy research.

I will, however, briefly address some of the broad limitations across the studies presented, primarily in the service of discussing future directions for this research.

Limitations Across Studies

In Chapter 2, I presented an in-depth, multi-dimensional analysis of the multimodal literacy demands evident in the interactive digital media commonly used by students in the Code Club. However, as only two sites were presented for illustration of these points, further research efforts may consider expanding the analysis to other digital hypermedia artifacts to examine whether the conceptual framework sufficiently theorizes related artifacts. Additionally, the project utilized an analytical toolkit proposed by the primary researcher and drawing from existing research across a variety of disciplines, but represents only one possibility in a range of interpretive approaches. Future research utilizing an alternate set of interpretive tools may yield further insights into these and other digital hypermedia artifacts. Finally, and perhaps most crucially, this analysis focused almost exclusively on what Rose (2012) identified as the site of the text itself, without extensive analysis of the sites of production, dissemination, and audiencing that would warrant a more thorough examination of the digital hypermedia artifacts in a broader social context.

To address those shortcomings, I presented in Chapter 3 an interpretive analysis of observational data collected over the course of a ten-week summer session of a local library Code Club for young adolescents. Drawing on this data, I argued that the concept of entanglements that often characterize digital-age literacy practices - between virtual and material literacies, between "traditional" and "new media" literacies" and between "receptive" and "productive" literacies - can be a useful characterization of the theoretical

and practical challenges of separating these dimensions. Of course, this study was not without its own limitations.

First, though the study represented a multi-dimensional analysis of digital-age literacy practices in a context of use, an expanded period of observational and systematic data collection may yield additional insights into the development of literacy practices over time. Secondly, while the study applied a systematic approach to qualitative coding of observational data, it still represents only one possibility in a wide range of interpretive approaches. Additional research utilizing an alternate set of coding approaches, or other interpretive tools may yield alternative insights, or further nuance to the claims made in this study. Finally, this analysis focused almost primarily on researcher-generated data corpus. While field note (re)construction was informed by audio-recordings, photos taken on site, observational jottings, and student-produced artifacts, a stronger shift of focus toward participant perspectives on the experience may lend additional trustworthiness to the claims made in this study.

The analysis presented in Chapter 4 of this manuscript was my own attempt to shift the research toward participant perspectives by presenting an analysis of the discourse used by participants to characterize their experience as part of the Code Club. I argued in this chapter how participants' perspectives about their literacy experiences are both situated and co-constructed, simultaneously reflecting wider societal conversations while at the same time grounded in the details of individual experience (Avila et al., 2013; Gee, 1999). In this study, though I engaged in an in-depth discourse analysis based on key theoretical tools, I did not intend to conduct a "complete" or "ideal" discourse analysis. This suggests that applying other analytic tools to the data set may indeed reveal

more nuanced findings or even alternative explanations of the evidence I have presented. Additional trustworthiness would be lent to the analysis through member-checking with participants who might be "insiders" to similar situations. Further validity could be established based on the analyses of other researchers in and outside the field of discourse analysis on this dataset as well. The analysis could be strengthened further with the inclusion of a larger and more representative sample of participants in the research context. Finally, while I have grounded my discourse analysis and conclusions in the linguistic details of what participants actually said during interviews, I purposefully elected to exclude certain details, such as the intonational pitch changes across lines and lengths of pauses. For this reason, I remain open to additional analyses that may reveal that these details would indeed change the analysis in a significant way.

Despite these limitations, I assert that the findings I have presented suggest several implications for re-thinking approaches literacy in a digital age, which I will outline in terms of literacy research, theory, and pedagogical practice.

Implications

With regard to literacy research, this project demonstrates the value of a multi-method, interdisciplinary approach to empirical research aimed at developing insights about young people's literacy experiences in a digital age. In this case, I have brought together methodologies from areas of multimodal analysis, interpretive participant-observation, and discourse analysis to demonstrate how the literacy experiences of students in a technology-enhanced environment can be understood from the perspectives of design, practice, and discourse. By developing empirically-based assertions from these multiple perspectives, I argue that this project accounts for issues that may have been missed or

obscured by taking a more singular approach. While scholars have previously recognized these approaches as theoretically complementary, my own work has contributed additional empirical evidence of this compatibility, as well as the foundations of a novel theoretical framework for examining literacies in a digital age.

The theoretical framework developed and applied in this study brings together prior efforts to conceptualize digital-age literacies have drawn from a variety of disciplinary perspectives and research traditions in a unified framework (Lankshear & Knoebel, 2008). While some have focused on skills for accessing, interpreting, and critiquing digital content, others have emphasized the role of literacy as social practice across contexts of digital connection and communication (Bawden, 2008; Mills, 2010). Still others have framed aspects of digital media production, computer programming, and software design, through the lens of literacy (Bogost, 2005; Mateas, 2005; Vee, 2013). By bringing together these perspectives to complement and complicate one another, this project contributes to expanding the "interpretive repertoires" of researchers, educators, and students living and learning in a digital age (Serafini, 2015). As Albers (2008) asserts, scholarship that may not always be directly associated with literacy can provide further insight into how literacy learners make sense of their worlds, and we can better support them in this.

Building on these foundations, this project developed a theoretical conceptualization and methodological toolkit for examining digital-age literacies across three overlapping and interconnected lenses of analysis (Aguilera, 2017). Focusing on the content dimension, I highlighted participants experiences with the multimodal content rendered on the screens that have become a ubiquitous part of our daily lives (Holmes,

2012). Within the procedural dimension, I addressed literacy learners' engagement with 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 users (Murray, 1997; 2016). Finally, I highlighted the literacy experiences of students "beyond the screen" with the contexts of production, dissemination, and use of digital media technologies - not just as a means for accessing information, but as ways of exchanging meaning (Avila et al., 2013). Such a multidimensional framing of these literacies is important for expanding our analytical perspectives on what "counts" as literacy in a digital age (Stewart, 2017).

Finally, with regard to pedagogical practice, this project has highlighted the multitude of possibilities for supporting students' literacy development beyond the context of conventional classrooms and literacy lessons. By highlighting the varied literacy demands of digital interactive media, this work underscores the importance of providing differentiated support for students engaging with even "school-sanctioned" digital media to ensure meaningful and critical engagement with multiple dimensions of this media, rather than accepting the one-size-fits-all narrative sometimes espoused by the developers and sponsors of educational technologies. By highlighting the multitude of ways that participants engaged with dimensions of literacy on, behind, and beyond the screen, this project demonstrated that a variety of "entry points" exist for engaging students in the interpretive, creative, and participatory practices enacted around the digital media texts that students engage with as part of their everyday experience. Lastly, by highlighting the ways that participants framed "traditional" and "new literacies" practices as more complementary than contrasting, this project provides additional

evidence for the importance of developing curricular, assessment, and pedagogical approaches that respect, engage, and develop multiple ways of being and becoming literate in the world today.

Future Research

Taken together, the studies presented in this manuscript have primarily focused on the concept of literacy learning in digital-age environments. This is, however, not to suggest that there was no teaching being enacted in this context, despite the absence of conventional schooling practices in the patterns commonly associated with traditional institutions. If one accepts that learning, in any meaningful sense, does not occur without the presence of teaching of one kind or another, then one potential direction for future research could examine the multiple dimensions of literacy teaching in digital-age environments. While such research may utilize similar methodological approaches as those described in this study, it may also necessitate the development of novel analytical lenses for understanding teaching as it occurs across virtual and face-to-face contexts (Holmes, 2017).

In contrast to prior educational research, which, emphasized how people should teach, or what teaching looks like in the context of traditional school settings, this particular line of inquiry might emphasize how different kinds of people actually do teach in the world beyond school. Such research might respond to questions about how people enact multiple literacy teaching practices across a variety of digital-age contexts, examine the relationship between these teaching practices and learner experiences, or iteratively develop variations of these practices to address the evolving literacies of a rapidly-changing society. Ultimately, such work might even help to transform our conception of

what it means to teach literacy, as well as the ways that all people can act as teachers and learners to support one another in developing literacies across multiple situations and contexts.

Closing Thoughts

While not without their limitations, the findings presented in this work illustrate the multidimensional nature of digital literacy experiences as they are rendered "on the screen" at the content level, "behind the screen" at the procedural level, and "beyond the screen" at the contextual level. The project contributes to the literature on literacy education by taking an multi-method, interdisciplinary approach to expand analytical perspectives on digital media and literacy in a digital age, while also providing an empirical account of this approach in a community-embedded context of implementation. Further research can help to refine the claims made and to expand the empirical basis of the perspectives presented, the findings of the project can help inform decisions of teachers, literacy professionals and administrators seeking to support literacy learning in a digital age.

It is my hope that future researchers interested in this work will juxtapose it with earlier and later work in the field and build on, extend, or refine the assertions I have made here about how experience literacy in a digital age. Even more than this, I hope that the insights gained from this and future work will inform the ways that teachers, parents, librarians, and other caring adults teach, learn, and talk about literacy and its role in increasing the participation of young people in our rapidly-changing, digitally-connected world.

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APPENDIX A:

SURVEY SUMMARY DATA

Survey #	Age	Gender	School Type	First Code Club Session	Videogame time/day	Computer game time/day	Smartphone game time/day	Website time/day
1*	9	Boy	Home	Spring 2017	None at all	- 1-2 hours a day	- Less than an hour a day	Less than an hour a day
2	10	Boy	District	Summer 2016	1-2 hours a day	- 3-5 hours a day	None at all	Less than an hour a day
3	10	Boy	District	New student	more than 5 hours a day	- more than 5 hours a day	- Less than an hour a day	1-2 hours a day
4*	11	Boy	District	Summer 2017 (new student)	3-5 hours a day	- 1-2 hours a day	- Less than an hour a day	1-2 hours a day
5*	13	Boy	District	Summer 2017 (new student)	1-2 hours a day	- Less than an hour a day	None at all	Less than an hour a day
6*	9	Girl	District	Summer 2017 (new student)	1-2 hours a day	- Less than an hour a day	- Less than an hour a day	None at all
7	8	Girl	District	Summer 2017 (new student)	None at all	- Less than an hour a day	- 1-2 hours a day	1-2 hours a day
8	8	Boy	Charter	Summer 2016	None at all	None at all	None at all	more than 5 hours a day
9*	11	Girl	Private	Summer 2016	None at all	- 1-2 hours a day	- 1-2 hours a day	1-2 hours a day
10	10	Boy	Home	Spring 2017	1-2 hours a day	- Less than an hour a day	None at all	1-2 hours a day
11	12	Boy	Home	Spring 2017	1-2 hours a day	- Less than an hour a day	None at all	Less than an hour a day
12	14	Boy	Private	Spring 2017	1-2 hours a day	- Less than an hour a day	None at all	Less than an hour a day
13	11	Girl	Charter	Fall 2016	None at all	None at all	- Less than an hour a day	1-2 hours a day
14*	10	Girl	Charter	Fall 2016	None at all	None at all	- Less than an hour a day	Less than an hour a day
15	11	Boy	District	Summer 2017 (new student)	more than 5 hours a day	- Less than an hour a day	- more than 5 hours a day	Less than an hour a day
16	11	Boy	District	Summer 2017 (new student)	None at all	None at all	None at all	None at all
17	9	Girl	District	Summer 2017 (new student)	Less than an hour a day	None at all	- 1-2 hours a day	1-2 hours a day
18	11	Girl	International	Fall 2016	None at all	None at all	- Less than an hour a day	Less than an hour a day
19	9	Girl	District	Summer 2017 (new student)	1-2 hours a day	- Less than an hour a day	None at all	Less than an hour a day
20	15	Boy	District	Summer 2017 (new student)	None at all	- 1-2 hours a day	- Less than an hour a day	1-2 hours a day
21	10	Boy	District	Summer 2017 (new student)	1-2 hours a day	- Less than an hour a day	- 1-2 hours a day	1-2 hours a day
22	9	Girl	District	Summer 2017 (new student)	1-2 hours a day	- Less than an hour a day	- 1-2 hours a day	1-2 hours a day
23	13	Boy	District	Summer 2017 (new student)	3-5 hours a day	- 1-2 hours a day	- 1-2 hours a day	1-2 hours a day
24	8	Boy	District	Summer 2017 (new student)	more than 5 hours a day	None at all	- 1-2 hours a day	None at all
25	8	Boy	District	Summer 2017 (new student)	more than 5 hours a day	- more than 5 hours a day	- Less than an hour a day	3-5 hours a day
26	9	Girl	District	Summer 2017 (new student)	1-2 hours a day	- Less than an hour a day	- Less than an hour a day	Less than an hour a day
27	9	Boy	Private	Summer 2017 (new student)	Less than an hour a day	- Less than an hour a day	- 1-2 hours a day	Less than an hour a day
28	9	Boy	Charter	Fall 2016	1-2 hours a day	- 1-2 hours a day	None at all	None at all

*Connotes focal participants