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"Like Coming Home": African Americans Tinkering and Playing toward a Computer Code Bootcamp

Some computer code bootcamps offer racially marginalized adults training in computer programming to assist in their social mobility. Many African American adults have little to no prior experience with programming. Literacy life history interviews show that the procedural literacy adult students practiced out of school scaffolded their learning coding literacy.

From Digital Literacy to Coding Literacy and Procedural Literacy

In the past decade, computer programming has been called the new literacy necessary for everyday life. Echoing the historical and persistent myth that reading and writing "results in economic development, democratic practice, cognitive enhancement, and upward social mobility" (Graff and Duffy 32), computer programming may offer a range of individual and societal benefits: computer programming can be a tool for teaching students computational thinking—"a way of reasoning that compiles several high-level skills and practices that are at the heart of computing, but applicable to many areas far beyond computer science" (Flórez et al.), and computer programming itself is an advanced communication tool for lucrative job

opportunities in information technology (Dishman; Rushkoff).[1] Regardless of the desired consequences for these different pedagogical approaches, discussion on democratizing coding literacy can too often center the experiences of K–12 learners and undergraduates, leaving adult learners' experiences with coding literacy unexamined.[2]

While I agree educators and policymakers should closely consider what exactly youth and young adults should learn and why, we should pay attention to adult learners who are already perpetually updating their literacies "in response to rapid social change" (Brandt 75) to remain relevant in the economy. In other words, if employers come to value computer programming as an important or desired skill set, we should closely examine how exactly coding literacy is learned for the workplace. The need to grow repertories of literacies matters especially for low-income racially marginalized adults, as they must navigate systemic racism that prevents their accessing new literacies that may promote their social advancement or their own survival.

If employers come to value computer programming as an important or desired skillset, we should closely examine how exactly coding literacy is learned for the workplace.

In this essay, I address this concern by examining the digital literacy life histories of African American adults who attended Clearwater Academy, a nonprofit computer code bootcamp that trains low-income women and people of color in computer programming and job skills.[3] These participants indicated that they had learned little to no computer programming when they were young. Nevertheless, they sought to learn coding literacy in adulthood for social mobility and to better navigate a labor market that is gradually valuing programming as "the lingua franca of the modern economy" (Lohr, "Where"). A recent report showed that "across a range of industries" computer programming is highly valued if not required among employers. The report goes on to explain that "[h]alf of all programming openings are in Finance, Manufacturing, Health Care, and other sectors outside of the technology industry" ("Beyond Point-and-Click" 7). Given the increasing value of computer programming, I offer a discussion of the preconditions of learning coding literacy later in life and the relationship of print literacy and procedural literacy to coding literacy.[4] Exploring these relationships helps us understand what exactly scaffolds learning coding literacy for adults and, in turn, help better our own pedagogical approaches to teaching coding literacy in writing studies.

Based on participants' digital literacy life history interviews, I argue that digital literacy was the kind of computer-based literacy learned in school and was associated with print literacy. Both literacies were withheld from male participants in ways that were racist while women did not describe difficult school relationships with literacy. Either way their literacy experiences with computers were not procedural. Ultimately, for reasons having to do with schools' white supremacy and limited conceptions of procedural literacy, participants did not encounter procedural literacy in the otherwise literacy-sanctioned space of the school, implying that school-based digital literacy did not scaffold or promote the possibility of learning coding literacy later in adulthood.

The study speaks to scholarship that notes the different affordances of and tensions between racially marginalized people's home-based and after-school literacies and school-based literacies, which tend to favor the language practices of white middle-class students.

This study reconsiders the contexts in which procedural literacy may be practiced. Ian Bogost calls procedural literacy "the ability to reconfigure basic concepts and rules to understand and solve problems, not just on the computer, but in general" (32). Similar to other scholars, Bogost argues that computer programming can be a vehicle for conceptualizing "the process of grammatical learning in general, and it helps create adults who are able to express themselves through technology" ("Procedural" 33). He also contends, however, that "*any activity* that encourages active experimentation with basic building blocks in new combinations" teaches procedural literacy (36, emphasis mine). Bogost writes elsewhere that these building blocks help students grasp at a process—"the methods, techniques, and logics that drive the operation of systems, from mechanical systems like engines to organizational systems like high schools to conceptual systems like religious faith" (*Persuasive* 3). In addition to manipulating pieces of a process, procedural literacy is a way to read procedural rhetoric, or the ways processes combine to make persuasive expression (258). Video games, notes Bogost, are suitable for learning and practicing procedural literacy and procedural rhetoric; they do more with code and are "uniquely, consciously, and principally crafted as expressions" (44–45). But the most useful kinds of video games are those designed to "make arguments about the way systems work in the material world. These games strive to alter or affect player opinion outside of the game" (47). The primary location for

teaching procedural literacy is the classroom (260), leaving an opportunity to update the contexts in which we see procedural literacy at work.

This study examines the school and out-of-school literacies of African American adult coders as seen in their life histories of engagement with digital technology. As a result, this study converses with several existing inquiries. The study speaks to scholarship that notes the different affordances of and tensions between racially marginalized people's home-based and after-school literacies and school-based literacies, which tend to favor the language practices of white middle-class students. Studies on these conflicts advocate for the need to reconcile these two worlds to promote racially marginalized communities' well-being in a racist society (Heath), while acknowledging that after-school literacy activities can offer academic and social capital-building opportunities that racially marginalized students may not encounter in schools (Watkins). Because this article often highlights the experiences of male participants, this study builds on existing research on black men and literacy, especially work on using African American boys' interest in playing video games as incentives "to look inside the black box of video games to see the power of computation in their lives" (DiSalvo et al. 1). This study joins others in valorizing the language and writing practices Black men use that often get denied, ignored, or silenced in schools (Kirkland).

As an update to these inquiries into both print and digital out-of-school literacies and their consequences, this article suggests that participants demonstrate in their digital literacy life histories awareness that our digital infrastructure is a sociotechnical construction of digital processes that mediate every day communication. This real-world tinkering and play with a variety of physical and digital technologies, as seen in participants' out-of-school practices, call for us to conceptualize technology as more than mere communication devices but rather as objects persistently active in our social environment. Procedural literacy may offer a pathway toward coding literacy, and the combination of these two literacies may offer users lifelong ways to control the activities these technical objects practice in their lives. Finally, this study implies that literacy scholars should examine the ways funds of knowledge develop in racially marginalized communities when learning to navigate their digital ecosystems and their sociomaterial conditions, how this knowledge can often involve procedural and multimodal literacy, and how these practices promote the development of other literacies later in life.

In the next section, I highlight how computer code bootcamps have placed themselves at the forefront of rapid training for careers in information technology. Some of these training programs not only desire to strengthen US global competition and innovation but also to develop pathways toward "the realignment and rectification of social inequalities" through coding literacy education (Patel 90). Then I explain the context and data collection of my year-long ethnographic study before describing the digital literacy life histories of participants. I highlight in particular the relationship among procedural literacy, digital literacy, and coding literacy in the midst of everyday racial conflict. Finally, I describe the implications for this study and call for research on procedural literacy practices among marginalized communities.

Computer code bootcamps participate in upskilling digital literacies by offering adults accelerated (fourteen weeks for in-person instruction; fifteen weeks for online instruction) part-time or full-time training in computer programming.

Coding Literacy for the Economy and Racial Justice

Information technology is vital to maintaining our present knowledge economy. As it proliferates and evolves, current working adults must learn and then relearn literacy over a lifespan to accumulate and maintain one's social and class status to remain relevant to the economy (Brandt). Computer code bootcamps participate in upskilling digital literacies by offering adults accelerated (fourteen weeks for in-person instruction; fifteen weeks for online instruction) part-time or full-time training in computer programming. They also train students in soft skills, such as interviewing, conducting elevators pitches, and networking. Upon graduating, students may begin paid internships or full-time employment. These camps are sponsored by a range of national and local companies and nonprofit organizations, such as Code.org. Code bootcamps must always update their curricula to match the needs and recent coding practices of the software developer profession; those bootcamps that fail to adapt or evolve their curricula according to the field's standards will close. Dev Bootcamp, for example, was one of the first for-profit code bootcamps to open in 2012 and had multiple camps throughout the United States before it faltered in maintaining a contemporary curriculum and closed in 2017 (Lohr, "As Coding").

Computer code bootcamps have grown into a profitable industry in the United States. According to Course Report, a website that captures data on the latest trends in this industry, the number of full-time computer code bootcamps grew from 67 to 106 between 2015 and 2018, and the industry has generated $240 million in profit. A total of 20,316 students graduated from computer code bootcamps in 2018, a 20 percent increase from 16,867 graduating students in 2017 (Eggleston, "2018 Coding Bootcamp"). The average tuition cost for in-person computer code bootcamps is $11,906 (online courses, Course Report notes, are less expensive). Some bootcamps are eligible for federal student aid while others offer deferred tuition or income-sharing agreements. The return on investment seems worth the money and time: some graduating students report increasing their salary by $23,724 after completing the training (Eggleston, "2017 Coding Bootcamp"). African Americans make up just one percent of computer code bootcamp graduates and reported an average salary of $61,476 (Truong), up from $43,300, the average household income for African American families as of 2014 (Pew Research Center).

Computer code bootcamps appear to be ideal sites for promoting diversity as they have fewer barriers to entry than higher education.

Computer code bootcamps appear to be ideal sites for promoting diversity as they have fewer barriers to entry than higher education (Stewart). Camps that serve African Americans and other people of color, such as Yes We Code and Black Girls Code, help combat the prevention of racially marginalized people from equitable learning, or what education researchers call the education debt (Ladson-Billings, "From the Achievement"). This debt includes other disparities related to learning such as sending better financial funding to white affluent school districts, withholding the right to civic participation from racially marginalized people, and refusing to pay moral reparations for failing to recognize the contributions of marginalized people. The combination of these structural debts ensures that the best learning opportunities will likely accrue for white students (Ladson-Billings, "Stakes Is High"). The education debt continues its influence in coding literacy education, but some possibilities to rectify the problem exist. For years, few African American students had taken Advanced Placement computer science in public schools due to a range of inequities: racist tracking methods, anti-intellectual peer pressure, and expensive fees for taking these courses ("More Blacks"). However, the College Board introduced AP

Computer Science Principles in 2016, a high school course that teaches the fundamental concepts of computer programming and digital technology's global influence. This new curriculum has garnered more enrollment among African Americans and has better prepared them for the AP Computer Science exam ("AP Computer Science"). This suggests that it is possible to repay the education debt through careful institutional and curricular inclusive practices that welcome racially marginalized students and their experiences with digital technology.

Similarly, computer code bootcamps as an institution can directly or indirectly serve social justice. They can distribute literacy as currency repaid to the descendants of oppressed people. Bringing racially marginalized people into the tech pipeline,[5] some argue, would alleviate socioeconomic stratification, close the digital participation gap between people of color and whites, and diversify an otherwise white male–dominated information technology field. The rhetoric of these bootcamps suggests that the path to racial justice is paved with programming and money. But what are the personal literacy legacies that scaffold such success for African American participants? And what does this teach us about coding literacy among African American adults?

Context

This article addresses these questions using the digital literacy life histories of seven participants who attended Clearwater Academy during spring 2017. Located in the Midwest, Clearwater Academy is one of many services provided through a nonprofit organization whose mission is to combat racism and poverty in the local community. To this end, Clearwater trains low-income people of color and women in front-end web development (HTML, CSS, and JavaScript) and soft skills. Over the duration of three and a half months, students must attend class on time four days a week, eight hours a day. Students learn how to design and code websites in class and outside of class on their own, in pair programming, and in teams. In addition, students tour local tech companies and speak to information technology professionals. To solidify their success on the job market, students also learn to write cover letters and résumés, present elevator pitches, and practice mock job interviews; guest speakers visit to discuss a variety of job-, finance-, and tech-related topics.

Clearwater's students do not pay tuition or a fee and are lent MacBook Air laptops from Clearwater that they can keep upon graduation. After completing their education, students may find work as freelance web designers or complete a paid three- to six-month internship. Ideally, if Clearwater graduates do well on their internships, their employers may ask them to return as full-time hires. Although getting work in tech is the ultimate goal for Clearwater Academy, any kind of full-time work counts as a success. The instructors and program coordinators provide mentorship to ensure students choose the track that best fits their technical skills. In 2017, when this study took place, Clearwater instructors postulated that, based on their own research, they were the only accredited computer code bootcamp in the country. Thus, students can use their certificate from Clearwater for college credit at a local community college.

When this study began, Clearwater had graduated four cohorts since it opened two years prior; however, Clearwater faced two challenges. First, students arrived contending with structural barriers in their lives that forced many to leave the bootcamp: homelessness, substance abuse, health care, family responsibilities, and financial hardship. In addition to losing students to attrition, Clearwater sent some of the few students who did graduate to intern for local companies' information technology departments. Although these students had been trained in computer programming, they were still unable to adapt to the workplace culture's emphasis on practicing whiteness.

As a response to the barriers that led to dropping out of the program, Clearwater directed its few resources toward protecting and assisting students with these challenges as much as possible. Clearwater gives students gas cards and bus passes each week, and it finds services that may help students with childcare and housing. Occasionally, Clearwater will help pay one month's rent. To better prepare students for the culture of whiteness in the tech industry, Clearwater developed a new curriculum that emphasized teaching soft skills and expects students to behave as workers in the classroom. Since fall 2016, Clearwater Academy has regained its reputation in the local tech industry. It no longer has to recruit or find students for class—students come to Clearwater or are referred by its graduates, and employers send job announcements to instructors for which students may apply.

Methods

The spring 2017 class, the focus of this article, was the fifth cohort of admitted students. Clearwater recruited nine African American adults, seven of whom volunteered to share their experiences with me before, during, and after the bootcamp. Ranging in age from twenty-one to fifty-six, six participants self-identified as African American, and one participant self-identified as "African and American." Five had grown up in the Midwest, and one was born in Sudan but spent much of her life in the Midwest; another participant moved frequently around the southern region of the United States before settling down in the Southwest. Of these seven, only three participants—DeAndre, Nadaline, and Isaiah—recalled working directly with programming at home or at school on their own. These brief encounters seemed formative for their attending Clearwater. Nadaline, the participant from Sudan and who identified as "African and American," was in the fifth grade when she started chatting with other users on America Online's instant messenger program AIM. She learned that some users had created their own websites. "They were just giving out links to their website," Nadaline recalled, "and I looked at their website and I asked, 'How did you do this?' And somebody helped me out." Nadaline played around with HTML for a while but soon took on other interests in grade school: writing for the school newspaper, practicing the cello, and making art. When I first asked Nadaline to participate in my study, she told me that coming to Clearwater Academy was like "coming home."

In addition to discovering when and where coding entered someone's life, the anecdote above shows the insights we can gather about literate practice when collecting participants' life histories with digital literacy. The literacy life histories of individuals help us understand the social history of literacy or understand a specific social use or pursuit of literacy over time (Brandt). Using this method of data collection, scholars have been able to reveal how undocumented immigrants' movement across borders into the United States changes their literacy practices (Vieira), how people change their sociomaterial literate lives post-aphasia (Miller), how literacy empowers African Americans living in the rural Southeast (Lachuk), and how the writings of historical queer writers influence the literate lives of present-day queer African Americans (Pritchard).

In this study I drew on digital literacy life history interviews to discover if participants had encountered coding earlier in life and to determine how

that exposure played a role in their decision to attend Clearwater Academy. If participants had not learned programming before, interviews could show what else in their literacy life history scaffolded their learning coding literacy in adulthood. What I present below highlights a complex relationship between digital literacy and procedural literacy and how they are mediated by racist ideologies in school and sociomaterial conditions at home. These relationships played significant roles in shaping the quality of participants' digital literate lives as preconditions toward learning coding literacy.

When Digital Literacy Means Print Literacy

I present two kinds of empirical evidence that suggest why school-based digital literacy does not easily scaffold learning coding literacy. First, participants learned to use computers to research and write essays in school but rarely encountered coding literacy or procedural literacy in classrooms. Second, participants felt disenfranchised from the digital literacy and print literacy they learned in school because of racist perspectives on the toolbox of literate abilities they brought to the classroom. Their stories demonstrate that a strict focus on how to write digitally constrained them from exploring what computers can do and that a racist or unwelcoming learning environment contributes to their devaluing educational institutions as safe spaces for their well-being. This evidence, drawn from participants' experiences, indicates the ideologies around literacy and technology their schools promoted, ideologies that were especially limiting to African American students given race- and class-based inequity among public schools. This section implies for my larger argument that educational institutions may promote an approach to learning digital technology that reduces technologies to mere communication devices that work similarly over time rather than as objects that evolve and emerge constantly and thus need to be learned and relearned over a lifetime.

I focus on participants' schooling because schools are instrumental in making digital literacy widespread. Scholars in computer science believed that programming would offer children new ways of learning, thinking, and problem solving and that public schools would be poised for this education (Papert; Kay and Goldberg). The graphical user interface, however, made using computers easier. Instead of working directly with complex code, the user could use various software programs to point, click, and type to complete daily tasks. Few people learned how to write programs for com-

puters, but the return of mass coding literacy today gives schools another chance to influence how people use or don't use programming in their lives.

The digital literacy life histories of African American participants from Clearwater show that very few encountered programming in public schools, and they hardly used computers for exploring the power of computing. As an adult, Kevin, a twenty-eight-year-old educated in culinary school, valued using his phone to write "a ton of notes. From poetry to just my thoughts. Things that I don't feel comfortable saying, I just write it down." Despite all of this writing he did during the study, Kevin said during our interview, "I've never been a writer. Like a writer. English was my worst subject." Kevin summarized his entire experiences with digital literacy at school during the 1990s in the following way:

The digital literacy life histories of African American participants from Clearwater show that very few encountered programming in public schools, and they hardly used computers for exploring the power of computing.

> Okay, at school, they really didn't reach us how to use computers. It was more like educational games. Writing games. Spelling games. And then on occasion you had those *Oregon Trail* days! . . . In middle school, high school, we had computer classes but it was . . . word processor . . . How to use PowerPoint. How to use Excel.

Kevin learned how to be a proficient writer using computers over time. Educational games helped him learn spelling in elementary school, and then he learned rapid touch-typing to draft essays and reports in middle school. Kevin didn't think the writing he did in elementary and middle school was important or real, as teachers assigned short pieces that covered topics like "What did you do over the summer?"

"Real" writing for Kevin began in high school when teachers taught him how to do research using library databases and integrating scholarly sources into his papers. But even these assignments frustrated him: Kevin was required to write "3 pages, 6-page, 8-page papers" on mundane topics or topics irrelevant to himself: "Like American history stuff. You get someone like Benjamin Franklin. 'Write a three-page paper on Ben Franklin.' And you're just like, 'Why? Why would I want to do this? This is crazy.' In high school, I felt like that a lot. 'Why would I want to do this? This is crazy.'" The link between digital literacy with digitalized print literacy deepened

as Kevin described difficulty attributing credit to sources gathered from the library. When learning research writing, Kevin said he seemed to have missed the lessons on plagiarism. In his first year of high school, Kevin would "turn in papers copy and pasted from websites and stuff. No reference . . . They'd[teachers] give me credit for them. Boom, boom! Credit!" But it wasn't until later in the second half of class that Kevin learned from his teacher about citing sources and giving credit, as if she had been teaching them citation since the beginning. When Kevin learned he was supposed to attribute ideas in his paper to their authors, he was more dismayed and left wishing he had known about plagiarism earlier. Nevertheless, we see here an example of exploring multiple, mainly text-based resources that, thanks to the copy and paste feature of the computer, are easily lifted and placed onto another text-based research paper. Regardless of the context, Kevin reported using computers heavily for writing print.

Kevin did recall learning more "advanced" features with PowerPoint, Excel, and Outlook in computer classes. Under financial constraints, his family moved from the South to the Southwest, and during those travels Kevin never encountered programming language in any of his schools. As was true for other participants' life histories with digital literacy, much of Kevin's work with computers involved typing alphabetic text on a computer screen and never looking behind the interface to see what was in the black box that made it all work.

In the 2000s not much had changed in the schools twenty-one-year-old DeAndre attended in the Midwest. DeAndre split his formative years between a major metropolitan city and a midsized city. His family never owned a computer, so his first encounter with a computer was in school. He recalled using an iMac in the second or third grade but, again, mostly for learning how to type. DeAndre recalled inconsistencies between his second- and third-grade curricula in the midsized city and his sixth-grade curriculum in the metropolitan city. "After 5th grade was when I left from the white school system and went to the [metropolitan] school system," DeAndre explained. "And I was learning in 6th grade what I had learned in the 2nd grade." As a third grader in the white school system, DeAndre learned how to use a MacBook and the basics of writing with a computer. Like Kevin, he learned how to use Word, PowerPoint, and Excel. He even learned how to structure essays from writing assignments, such as one that asked him to imagine how he would run a school if he were its principal.

DeAndre learned how to type using an educational software called Type Time Machine, which helped accelerate his typing skills in elementary school: "We had our own [keyboards] . . . And they started teaching us all that shit. And when it went to this and then it went to that, and then eventually I was just fast with it. Just moving around without looking down."

The metropolitan city school had a majority Puerto Rican student population. Moving to this school, DeAndre felt he had gone back several steps in his learning. This school didn't receive computers until he was in the seventh grade. Even then, the computers were outdated. "It was one of those old ass fucking police monitor things that sit up in the car," DeAndre recalled. "And I'm like 'What the fuck is this? This'll break. You guys don't have Apple?'" His teachers explained that they didn't have the money for new computers. "I'm like 'Uhhh, okay. All right.' I didn't know." As an adult looking back on his formative years, DeAndre wondered why the eighth-grade curricula was on a second-grade level, why he needed to relearn what he knew six years before.

DeAndre and Kevin had firsthand experience with how educational resources are unevenly distributed across school districts and entire states, based on the class and race of school funders. Even though DeAndre and Kevin moved from school to school, they always seemed to arrive at the same destination: schools teaching how to transfer writing on paper to writing on the screen using the most common and basic software—the Microsoft Office Suite. Their schools taught them enough to navigate the basic demands for using digital technology that would make them suitable workers and citizens, but these practices and contexts did not help participants conceptualize *other possible capabilities* of digital technology. Instead, for participants in this study, digital literacy education saw computers as devices for textual production and consumption. This way of thinking about technology may fail to promote a digital ecosystem made up of a series of networked functionalities that require a diverse set of literacies possessed by different kinds of people that shape how others access various goods, resources, and services in their lives. Racially marginalized students' limited knowledge of such complex connections confine access to what they themselves as users can do: they may be considered for low-level, menial positions and given less opportunity to join the highly competent, creative, and critical class of literate subjects that determine the logic of these technological processes.

Ideologies on Literacy and Race Limit Learning

In this section, I describe participants' mixed experiences in school that show how ideologies on literacy and technology actively limited or withheld learning from participants. Teacher instruction and perception and hostile school cultures were significant players in shaping how participants engaged with school-based digital literacy. If the section above identifies narrow conceptions of digital literacy practice, the following paragraphs uncover ideologies on whose literate practices matter and who is worthy of accessing new literacies. First, I offer examples on how sociocultural forces such as race, class, and the limitations of meritocracy helped withhold crucial digital literacy experiences from participants.

Teacher instruction and perception and hostile school cultures were significant players in shaping how participants engaged with school-based digital literacy.

DeAndre's jump from an advanced curriculum to a slower curriculum marked him as an exceptional academic student. He later leveraged his academic success for profit: from sixth grade to eighth grade, teachers gave students 150 vocabulary words and exercises. DeAndre would complete these problems in the workbook and then sell the answers to his classmates. For three years. Every year. DeAndre was so ahead in his other classes that school teachers and administrators wanted to promote him to a higher grade level. DeAndre and his mother refused the option; he reasoned that although he knew "the whole damn grade," he could benefit from learning material he may have missed or didn't learn.

Despite his learning digital literacy early on at one school and doing well in school overall, his academic success negatively impacted DeAndre's peer relationships. When they learned of how well he was doing in class, DeAndre's classmates asked him for tutoring, but this request was a ploy to beat him up out of jealousy and frustration. Getting bullied for advanced digital literacy, and for doing academically well in general, had considerable influence on DeAndre's motivation to continue doing well in school. Caring too much, DeAndre explained, only got him "whooped." To protect himself, he stopped caring about others and started looking out for himself. DeAndre quit high school when he was seventeen and took up carpentry instead. Full-time work satisfied what DeAndre called his hunger for money.

In his life history interview, Alex, a thirty-six-year-old who had served in the navy and worked in various jobs in radio and finance before coming to Clearwater, admitted he didn't remember much from computer classes in school. He associated computer labs with hearing the O.J. Simpson case's final verdict and the excitement he and the few black students in the school felt. What came to the surface of his memory was teachers' negative perceptions of him because he was African American, and this racism became more visible when Alex refused to engage with what he considered an easy curriculum.

Alex told vivid positive accounts of literacy sponsors in his childhood. In second grade, Alex had his first and only African American teacher who "put books in my hand and put stories in my mouth. And she sat me down in front of her class as a second grader and allowed me to read to her first graders." To him, his second-grade teacher was "exceptional . . . She's magical." This experience in school overlapped with his home literacy. His mother loved books just as much as his father did. She encouraged Alex to read and build his repertoire of words by giving him a new vocabulary word each day before going to school. He remembered being a ferocious reader himself, even jumping into *Othello* by the sixth grade. The language to him was "weird," so Alex read slower to comprehend the play. By the time he started middle school English classes, Alex was a well-read student. However, his time in middle school was the opposite of his learning literacy at home. For Alex, he could do well in sixth-grade English. As he explained, he "could debate these points" and "express these theories," but he didn't want to because he didn't "appreciate" the "slow" curriculum. Because the work was so easy to him, Alex "clowned" around and "tested badly." His behavior backfired, as his teacher mistook his lack of engagement with school for being "remedial." He recalled teachers telling him, "'You slow! So we're gonna put him in remedial reading.'" Although they claimed he was remedial, Alex believed he was placed in this class because he was African American and "gregarious." Nevertheless, Alex was so embarrassed that he plowed through the work in the remedial class and "by the last semester they had moved me to advanced [reading]."

Like Kevin, Alex had spent his formative years moving from school to school. To his eighth-grade teacher, this constant moving suggested Alex had been expelled from these schools for misbehavior. But what the teacher didn't know was that Alex moved because money was tight in his family.

Nevertheless, his teacher told him that he would be a problem in her class. Racism mounted further later that year. Alex and his African American friends were walking from the school buses when a white student came from behind and said, "Move out the way, niggers." When Alex and his friends reported the student, the school administration sympathized with the white student's claim that they were "scared because you're black.'" From that point, Alex stopped caring about school; the remainder of his education, school was "about smoking weed and it was about having fun. And skipping class." A few years would pass before Alex came to what he considered his next significant educational opportunity after leaving the navy: a community college in Iowa where he studied broadcast radio, but financial difficulties would later force him to drop out.

Both DeAndre and Alex encountered affirmation of their literacies at the outset of their childhoods. However, later in their schooling they encountered students and teachers who undervalued their knowledge. The system of racial and class stereotypes marked Alex unworthy of empathy and care. Constant migration from one school to the next due to financial difficulties and his Blackness attracted cultural beliefs that influenced his undervaluing the worth of learning school-based literacy and digital literacy. For DeAndre, academic meritocracy was limited. His academic achievement, thanks in part to a relatively advanced curriculum in one school, marked him as a talented scholar and a source of derision. Doing well in school did not reward him with the accolades he expected. Earning nothing from his work in school, DeAndre quit high school and worked in construction. Ultimately, what I find is that participants like DeAndre had difficulty accessing digital literacy because of its association with racist school practices.

School-based digital literacy has slippery characteristics that make it difficult to desire learning coding literacy. In fact, it's difficult to separate print literacy from digital literacy as a technology but also in that the problems of writing on paper tended to transform into new problems on computers. In whatever form literacy took, it was too baffling, opaque, or demanding to promote trying out coding literacy. In addition, institutional support of racism and classism and the limitations of meritocracy make education and digital literacy unattractive or a trap. These barriers did not prevent Kevin, Alex, or DeAndre from becoming literate subjects, as we can glean from their own admitted engagement with reading and writing out-

side of school, but it does mean their literacies within schools were limited or withheld. Pathways toward coding literacy, then, may be stifled without additional avenues for exploration, play, or experimentation.

For this reason, I show in the next section that participants recounted their learning about computers in their homes and communities as procedural literacy. In other words, in these supposedly resource-poor environments, participants actively sought out what computers were capable of or how they worked. Their life histories suggest that desiring to know how computers worked or what they could do may scaffold the desire to learn coding literacy in adulthood when that option becomes available to participants.

Tinkering as Literacy

In this section, I explain that participants recalled fond memories of exploring, discovering, and experimenting with technology in their homes, communities, and the workplace. Across each of these contexts, different kinds of people appear that encouraged this self-motivated interest in tinkering and play as brokers of procedural literacy: family, friends, strangers on the Internet, and employers. We will see that even in so-called resource-poor environments, different funds of coding knowledge can blossom from the technologies available to participants.

I explain that participants recalled fond memories of exploring, discovering, and experimenting with technology in their homes, communities, and the workplace.

Rosie was born in the 1950s and recalled regular updates in her print literacy throughout her formative years. She moved from writing her name on blue-lined trace paper at home to learning how to use a typewriter in high school. Rosie had always wanted to go into information technology, but after graduating from high school, she was called to work to support her family. This decision, however, was only the beginning of her learning to play with technology, as Rosie's work experience exposed her to learning how computers worked. Rosie got a job with the state legislature as a clerical worker in the late 1980s doing "word processing." She worked in a large room with rows and rows of desks where she and other women typed and revised letters, memos, and statutes based on instructions from their superiors that were either given in person, on paper, or through audio recordings.

Rosie's word processing is similar to the word processing that younger participants learned during the 1990s and 2000s; the difference is that typing required that Rosie put in commands for the computer, such as pressing shift and another key to instruct the computer to start a new paragraph. Still, she suggests that training involved more than simply learning word processing. The state government trained Rosie in how to use a computer and to understand "why it was doing what it was doing," what was happening when the computer was commanded to print or calculate. Rosie was not learning how the computer code worked, but she seemed to be learning more than the rudimentary functions of computers. Learning why a computer works the way it works is an explicit nod to procedural literacy; that is, Rosie learned the building blocks of computers to conceptualize their design and function in her mind.

Other workers reacted to the new computers with confusion or ambivalence. "Some people were like, 'How do . . . that's just too much to be working with. You sit there and type?'" Rosie explained. While her coworkers felt uncomfortable using computers, Rosie had relished working with them. In her interview, she explained, "I knew when I started that job I just felt comfortable. I wasn't intimidated. I learned so much from the content. That's another thing that intrigued me, too, you know. The fascination of the computer itself; what it was doing. How it was manipulating what I was doing to some paper. Things like that." The state legislature sponsored additional training with computers so that Rosie and the other clerical workers remained updated on their technical skills to meet the state's needs. She had the opportunity "to be on a team where we created software packages that we wanted to be in-house to do what the software [did] to make our jobs better." But these trainings only inspired her to learn more about how computers worked. When Rosie had time between work and taking care of her family, she would attend night classes at the local community college and, years later, take online courses.

This exploration of computers was a thirty-year journey for Rosie. Just before attending Clearwater Academy, she had nearly finished a certificate in information technology from a community college in town. But Rosie couldn't do a required internship to complete the program because she had been diagnosed with lupus and took early retirement. Clearwater Academy was at once a continuation of her learning about computers as well as a

pathway to finally getting her certificate. Rosie hoped that after graduating from Clearwater she could go on to complete an internship that the college would count as fulfilling the certificate requirements. Rosie's procedural literacy practice may indicate her being a lifelong student. This is certainly true, but it was not economic demand or being able to use computers for everyday tasks that drew her to constantly learn about digital technology's capabilities. When I asked Rosie if she thought it was important that her children know computers for their everyday lives, for example, she shrugged and replied, "I didn't think of it like that. I always thought it was fun."

The idea of enjoying how things worked was an ongoing theme for other participants, such as Kevin. Kevin also explored analog and digital technology at home and in his neighborhood. But he lived around "a lot of negativity" growing up. He remembered his family losing their house and then moving from apartment to apartment around the South before finally settling down in Arizona. He spent most of his life in Arizona and Mississippi, although he was more likely to claim Arizona as home. In Mississippi, Kevin explained, he and his siblings "just lived. We had our fun times and stuff. We survived." They put "much brain power on anything that could happen positive." Print literacy and digital literacy became ways to escape poverty and racism while growing up in Mississippi, and they helped Kevin bond with his siblings, like competing with his older brother in fighting video games, joining his family for board games, or reading *The Hobbit* with his older sister.

His healthy family relationships played a prominent role in his figuring out how things worked. Once they recognized he had an interest in something, they began providing resources that Kevin could explore on his own. His literacy history before getting a computer, for example, is peppered with tinkering, exploring, and figuring out how different types of technologies and symbols worked. Kevin's earliest memory of reading and writing was actually watching his older sister complete multiplication homework when he was in the fourth grade. Taking a peek at her homework, Kevin became fascinated by how numbers grew exponentially:

> I mean being able to transform something into something greater. That was always my thing. I've always been one of those kids who takes apart their roommate's TV remote to see how it works. Took it apart just to see if I could put it back together. Just the magic. To me it was just magic because I didn't know how any of this stuff worked. My sister was on multiplication stuff. I was

> like, 'What? This doesn't make any sense!' I guess it was like turning nothing into something . . . I had a high interest in it. I was always intrigued by that.

When his older sister realized Kevin was fascinated by the magic of numbers, she let him read her math textbook and showed him what else numbers could do.

Pencils and papers did not often circulate in Kevin's household, but he recalled science boards being significant to his procedural literacy practice. These games allowed Kevin to run different kinds of experiments, but they were, for his mother, less about playing as they were about preventing Kevin from taking his sense of exploration too far in the household. His mother bought these science boards often so Kevin could "tinker" with them. "If she didn't," Kevin said, "I would eventually start taking apart the remote and stuff like that . . . I was interested in how things worked." But there was a limit to what else Kevin could take apart. For several Christmases Kevin asked his mother to buy a computer. When she could finally afford to purchase a desktop and computer processing unit (CPU), Kevin was curious how they worked. So he took the back cover off the CPU and looked down inside it. "And my mom walked in. And she was angry. I remember getting spanked . . . I never got spanked for taking apart the remote, except when I couldn't put it back together. I just knew it was serious."

His tinkering would continue in Arizona in his last year in middle school. "That was around the time we started messing with hardware," Kevin said. "Like computer hardware . . . That's when I got into computer tinkering." He met a friend who would visit a waste facility and find computer parts to assemble and install in his own computer. For Kevin and his friend, playing with hardware was less about discovering a career in tech than pursuing a hobby. Something fun to do. Messing around with hardware extended into his playing video games. As mentioned earlier, Kevin played video games with his brothers and, by all accounts, was still a gamer in adulthood. During our interview, Kevin expressed his excitement for the Xbox One's new controllers that players could take apart and customize. For an adult who grew up taking apart computers in his home, the controllers were a dream come true and confirmation of the procedural literacy others like Kevin enjoy. "I was a tinkerer. I still am," he said, reflecting on the broader implications for his interest in the customizable controller. "I've always been. I like to mess around."

Rosie and Kevin relied on communities, families, friends, and their own self-motivation to practice tinkering, exploring, and playing with digital and analog technologies. Rosie's workplace trained her on how computers worked, which was a significant amount of fuel added to her lifelong interest in figuring out technology's abilities; the workplace, a key location for adopting new technologies for productivity, became an unexpected literacy sponsor for Rosie. Meanwhile, Kevin approached technologies with his own curiosity that family and friends later noticed and proceeded to cultivate as brokers of procedural literacy. Rosie and Kevin are examples of drawing on overlooked funds of coding knowledge that can exist within African American lives. When we consider the ideological differences between school-based digital literacy, as well as print literacy, and participants' own procedural and digital literacy practices independently, stark implications for teaching coding literacy and procedural literacy rise to the surface, which I tease apart in the conclusion.

Digital literacy education for these adult learners of coding focused on typing documents on the computer in their formative years, not exploring computers' potential problem-solving power.

Conclusion and Implications

In their interviews with me, participants indicated they did not encounter coding literacy early in childhood, or if they did, they did not have extensive exposure. Digital literacy education for these adult learners of coding focused on typing documents on the computer in their formative years, not exploring computers' potential problem-solving power. This school-based digital literacy was less likely to scaffold coding literacy learning for participants later in adulthood as they brushed up against racism and ideologies of literacy that limited their access to more advanced interaction with digital technology. Contrast this experience with their homes and communities, which, although relatively resource-poor, nevertheless encouraged their practicing procedural literacy. Participants reported playing with both analog and digital technologies, sometimes encouraged by institutional literacy sponsors, such as the workplace, or by brokers of literacy such as family members and friends. In their stories, participants expressed more excitement and interest doing this self-sponsored play. Digital inequality, created by institutional stratification, seemed to have created alternative ways of promoting procedural literacy. Building on Bogost's argument that

procedural literacy isn't confined to computer programming, digital literacy life histories show that the act of play and discovery, not necessarily interacting with computers themselves, may scaffold a pursuit of coding literacy.

These findings suggest that writing studies scholarship challenges racist perspectives that African Americans suffer from technophobia; in this formulation, black cultural identity embraces a "gritty reality; not virtual reality" and operates as "living links to the lost world of unmediated spontaneity, deeply felt physicality, and social connectedness" (Dery 34). African Americans actively resist civilized tools of convenience, economics, and communication. Digital inequality solutions rely on this "pathological rhetoric" to drive African Americans out of their primitive state and into the fold of white techno-literate society. This research builds on existing scholarship that shows African Americans in fact "suffer" from "techno-lust." Other scholars and practitioners of digital media have shown the tight relationship between Blackness and technology: African American communities have always found ways to access new technologies and pull these digital resources together for collective artistic, cultural, and political engagement and racial uplift (Banks; Everett). The ways African Americans use digital literacy may include Afrofuturists' efforts to "[challenge] both the implicit whiteness of nerds and the explicit technological absence of both realist and romantic black essentialisms" (Eglash 60). These collective efforts recall Ashleigh Greene Wade's argument that using technology to make Blackness viral is a kind of worldmaking. Viral blackness, she writes, is a "deterritorializing mode of subversion to white supremacist systems that seek to restrict the movement of Black bodies, silence Black voices, and quell Black thought" (Wade 36). African American digital literacy practice can be a response to systemic racism or poverty, as suggested in participants' interviews. Any effort to democratize coding literacy may include instructional practices and curricula that unpack how coding literacy contributes to sociocultural worldbuilding. This expands the goals of teaching coding literacy to include social mobility, inclusion, and computational thinking as well as how coding literacy may help redistribute power among racial and ethnic communities.

This study identifies procedural literacy as not only a learning goal for formal education, as Bogost suggests, but also a practice that can be taken up in other contexts. Participant interviews suggest there are rich funds of knowledge. For this reason, literacy scholars may examine the

circumstances under which racially marginalized people tinker or explore. Additional qualitative research on how marginalized communities use sets of processes for learning and then enacting persuasive expressions across different physical and digital environments may offer fertile ground for further theorizing links between racism, writing, and digital technology. However, investigating the ways racially marginalized people create learning and literacy practices in their communities amid racial inequality is not meant to suggest that racism is a *social good*; it does ask scholars to refocus on what kinds of environments foster literacy learning for survival or sustainability and the long-term consequences of these learned practices for accessing the knowledge economy.

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Notes

1. For rhetoric and composition, computer programming is a type of writing (Vee). Rather than teach computer programming itself for careers in software development, writing instructors would expand students' rhetorical awareness of coding's many affordances (Sample and Vee; Brooks and Lindgren).

2. In *Learner-Centered Design of Computing Education* Mark Guzdial suggests that the best way to democratize coding is through K–12 education. Computer science undergraduates, he notes, should be encouraged to seek careers in public school teaching rather than industry. These graduates would then help address the lack of formally trained computer science teachers, one key barrier to cementing widespread coding literacy education.

3. An intersectional analysis of race and gender would provide more insight on participants' digital literacy life histories. However, in this article I catalog the unique barriers to racial or ethnic identity and the role those barriers play in coding literacy learning. See Rachel E. Luft's "Intersectionality and the Risk of Flattening Difference: Gender and Race Logics, and the Strategic Use of Anti-Racist Singularity" for more on the benefits of using single-issue tactics in social justice training.

4. Coding literacy is the ability to read and write in computer programming languages. Procedural literacy is "the ability to reconfigure basic concepts and rules to understand and solve problems, not just on the computer, but in general" (Bogost, "Procedural" 32). Print literacy refers to the practice of reading and writing alphabetic text on paper. Finally, digital literacy, based on participants' interviews, is the ability to use computers to type alphabetic genres, primarily essays and research papers. Following New Literacy Studies tradition, I believe each kind of literacy is a sociocultural practice inflected with ideological beliefs about what they should do and who may benefit from these tools.

5. In *Digital Dead End: Fighting for Social Justice in the Information Age*, Virginia Eubanks observes that the "tech pipeline" often means "highly paid technological positions such as tenured faculty positions at research universities or managerial positions in high-tech industries" (27). She reminds readers that the tech pipeline also includes low-wage positions that support tech industries.

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