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Libraries as Facilitators of Coding for All";

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Introduction

Learning to code has been an increasingly frequent topic of conversation both in academic circles and popular media. Learning to code recently received renewed attention with the announcement of the White House's Computer Science for All initiative (Smith 2016). This initiative intends "to empower all American students from kindergarten through high school to learn computer science and be equipped with the computational thinking skills they need to be creators in the digital economy, not just consumers, and to be active citizens in our technology-driven world" (Smith 2016). For youth from certain demographic and socioeconomic backgrounds exposure to computer science is already a reality. However, many youth are still left out because of lack of access to school or after-school computer science-focused programs. Libraries are in a position to tackle this gap and create meaningful opportunities for youth to be exposed to and excel at computer science.

This article explores Scratch workshops that expose youth to coding and computational thinking in libraries. (Scratch is an online visual coding language developed at the Massachusetts Institute of Technology and intended for use by young learners.) Although computer science encompasses more than coding, it is an important part of computer science. The data presented here examines nine implementations of Scratch coding workshops at eight public library branches in urban under-resourced areas. The librarians who facilitated the workshops were all novice coders when they began holding the workshops. Most youth who participated in the workshops would be considered underrepresented in computer science. This article starts with a discussion of why it is important to create more diversity in computer science. It highlights perspectives of librarians and youth facilitators, describing their process for delivering coding workshops though novice coders themselves, and the perceived impact by facilitators of the workshops and exposure to computational thinking and coding on the participants.

Disparities with Technology-Related Topics for Non-Dominant Populations

Gaps persist in employment diversity for many computing and science jobs. Only 3 percent of African American women and 1 percent of Latinas hold computing jobs (Ashcraft, McLain, and Eger 2016). This lack of representation in the workforce could be set up by early interactions, such as those that take place in school and in informal learning. Current research highlights that, despite attempts to address this employment inequality through formal education, the situation still exists.

A consensus is growing that youth start in early adolescence to think concretely about their futures and these early thoughts impact how young people prepare for their chosen careers (Auger, Blackhurst, and Wahl 2005; Bandura et al. 2001; Riegle-Crumb, Moore, and Ramos-Wada 2011). Existing research already describes the importance of exposure to disciplines that could potentially lead to future opportunities and career pathways (National Research Council 2011; Modi, Schoenburg, and Salmond 2012). Women and girls from low-income families face more obstacles in terms of access and exposure to out-of-school STEM activities and career options, which, in turn, reduces their career aspirations and expectations (Domenico and Jones 2006; Toglia 2013; Watson, Quatman, and Edler 2002). Although there is no simple solution to eliminating employment obstacles, digital media have the potential to create opportunity for upward mobility, particularly for disadvantaged youth (DiMaggio 1982). Creating pathways to opportunities in computer science needs to be supported, and libraries are excellent places to do this.

Libraries Trying to Bridge the Gap

With 9,082 administrative public library units and 98,460 school libraries (ALA 2015), libraries offer great potential for bridging the computer science gap. The question is: How do libraries bridge this gap? John Y. Baek has offered six science-specific capabilities supported by informal learning environments like libraries (2013, 5), capabilities that I have modified for computer science and computational thinking:

1. Experience excitement, interest, and motivation to learn about phenomena in the digital world.
2. Use computational thinking to generate, understand, remember, and use concepts, explanations, arguments, models, and facts related to computer science.
3. Manipulate, test, explore, predict, question, observe, and make sense of the digital world through computational thinking.
4. Reflect on computational thinking as a way of knowing; on processes, concepts, and institutions of science; and on students' own process of learning about computer science.
5. Participate in computer science activities and learning practices with others, using scientific language and tools.

6. Think about themselves as computer science learners and develop an identity as someone who knows about, uses, and sometimes contributes to computer science.

When modified like this, Baek's science-specific capabilities reflect many of the aspects of computational thinking laid out in definitions, such as Brennan and Resnick's, which focuses on computational thinking as a creative process that includes understanding concepts, processes, and perspectives of a designer (2012).

Libraries support informal learning by functioning as connected learning environments (Ito et al. 2013), connecting the learning youth do in classrooms with their learning in interest spaces, so that students can receive value for this learning and connect it to opportunities. Computer science in libraries is not necessarily about the creation of an end-product but about the underlying concepts, such as design thinking (Bowler 2014) and computational thinking (Brennan and Resnick 2012). Coding programs can be a great opportunity for the participants to learn skills that are vital in the twenty-first century, but also provide opportunities for young people who help with the programs to develop career-readiness skills, such as responsibility, agency, and leadership (Salusky et al. 2014).

The Study

Methods

The results presented are from a large ethnographic study of Scratch and its implementation in library programming. The Scratch community was chosen because it has low barriers for entry by participants. This section will start with a description of the research context of Scratch to help orient the reader. Scratch is an online visual coding language designed for people ages eight through sixteen, although the online community supports participants of a much greater age range.

Participants

The workshop participants held one of three roles: librarian facilitator, youth facilitator, or youth participant. All youth participants were attending school, and a majority of the total of 178 participants were in high school. The workshops were at eight public library branches. All participants in the workshops were offered the opportunity to participate in interviews. Through this study, I sought to understand what supports are needed for non-expert coding librarians to offer coding workshops in under-resourced public libraries. Each library offered Scratch workshops once a week over a four- to six-week period, at the discretion of the librarian. Workshops usually lasted from one to two hours, also at the discretion of the librarian. The library sites selected for the study serve under-resourced communities, with librarians who support mostly Black and Latino patrons.

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Observation and Interviews

Data collection for this paper included ethnographic field notes (Emerson, Fretz, and Shaw 2011) and interviews (Hammersley and Atkinson 2007) as a basis for the study. I conducted interviews over a two-year period with youth and public librarians who participated in the library workshops. I interviewed five librarians and twenty-eight young people who participated in or facilitated the workshops. This paper focuses on the experiences of librarians and youth facilitators of the workshops to demonstrate the challenges and benefits for novice coders implementing coding workshops. The interview recordings were transcribed by a professional transcriptionist.

Once the interviews were transcribed, I assigned all participants a pseudonym. The interviews were conducted using a protocol that I developed based on computational thinking (Brennan and Resnick 2012) and the connected learning framework (Ito et al. 2013), which focuses on equity in learning to code. Since this was a semi-structured interview protocol, questions and order were dynamically changed based on context and the unique experiences of the respondent.

Impact of Implementation

Librarians Leading the Way

Each library and librarian faced unique challenges for facilitating these workshops, but there were consistent themes across responses from the librarians. The librarians oftentimes dealt with serious technological limitations. They cited time as their biggest obstacle to trying new programs for which they were not subject experts. Stephanie said that learning to code before the workshops was "too large of a learning curve, while scrambling to learn new materials." A lack of time to prepare made the idea of learning a new skill set like coding so arduous that it seemed undoable for the librarians.

The librarians who participated in facilitating Scratch workshops had no or almost no previous coding knowledge. Several of the librarians commented on the importance of the level of detail in the facilitator guides provided to the public libraries as part of the research reported here (and available at <https://scratch.mit.edu/info/codingforall>). This availability of supporting resources must be emphasized. It is not easy for librarians with no subject expertise to feel comfortable facilitating a workshop in front of five to twenty young people. Successful librarians were willing to do the following:

1. Try something new
2. Be willing to fail
3. Make changes on the fly
4. Be OK with the idea of not being the expert

For some people, demonstrating this level of flexibility can be a challenge, especially while looking at a room full of workshop participants.

Librarians identified peer-based and creative, interest-driven learning as part of the success of the workshops. Stephanie said that Scratch workshops created great opportunities for "peer-based learning between participants." Claudia agreed, "Peer and mentor learning happened easily in Scratch through the problems [the participants needed to solve]." Lorenzo described the balance between teaching skills and supporting creativity. He said, "So to teach [content creation and skills] at once, it's kind of difficult for a first class. But my idea was…you teach…those very basic things [at the beginning of the workshop] and then you know you can create your own sprites, your own animations."

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The supports most cited as leading to successful completion of the workshops were easy-to-use preparation materials, embracing peer-to-peer learning as part of the facilitation strategy, and enlisting youth facilitators to facilitate the Scratch workshops. The next section reports on the youth facilitators' experiences.

Youth as Facilitators

To find the best youth facilitators, public librarians posted the positions at local schools and had students apply for the position. This requirement gave applicants experience in the process of applying for a job and, thus, provided a career-readiness experience for the youth—added value for participating as facilitators. Some of the interns were paid; others received credit for service hours. Each librarian leading a program made the decision about whether to use youth facilitators and whether to pay them. Of the eight libraries half used youth facilitators.

Two of the facilitators at one library explained how they became involved with the project and how the experience impacted them. Roderigo, a seventeen-year-old Latino high school senior who attended a science and engineering high school, described his existing interest in computer science. "I actually want to do this, well not Scratch, but I want to get into the computer science field as a career, because I really like computers and I like working on them. And I've actually been trying to build my own and stuff like that. I've self-taught myself in many different things. So yes, that's why I thought this kind of fit." He had developed an identity as a "tech guy," helping his teachers and receiving preferential treatment because of his tech abilities. His advisor at school also knew about Roderigo's interest in tech. She informed him about the opportunity to facilitate the Scratch workshops. "So I applied and I got in." This introduction created a sustained and impactful opportunity for him.

Laretha, a sixteen-year-old African American junior attending a magnet school, found out about the opportunity to be a mentor and facilitator for the workshop through her tech teacher who talked about it in class. "I saw the flyer online, and then it said there was only space for two people. So at first I was a little discouraged, but then I realized that nobody else in the class was really taking interest in it. So I took advantage of that. I went to the library as soon as possible, and I got my resume and cover letter, sent it in, and that's how I ended up here." Laretha, for whom computer science was not part of her identity, did not feel confident in applying at first. Realizing that the competition was low because not many students from her class were applying encouraged her. Her confidence grew as she moved through the interview process and through her time as a facilitator.

The youth facilitators were responsible for preparing and delivering the workshop under the supervision of the librarian, and each facilitator had an individual approach to it. Roderigo described his process, "I like how we have time beforehand in order to make sure everything is going well. And we basically debug it ourselves in a way the day before. And it's enough time. We're not rushing or anything like that." He also described his theory on teaching. "The number of kids makes it easier for us to not be, you know, flooded with kids, but at the same time we have enough to have time with each one individually and get to know them, the people that I've known from here. I know some of them like games, and some of them like decorating and stuff like that. So that's actually been kind of nice

to get to know them instead of just talking to everyone at once and get a little bit of time with each one." He understood, just from his interaction with the youth, how important it was to make a connection with learners and the power that connection could create for both the learner and for the facilitator.

Teaching also had a profound effect on Laretha. "It's really interesting and kind of ironic because I always told my mom, 'I'm never going to be a teacher, or this or that,' or 'I don't work well with kids.' But after I came here I realized that I do actually have a little interest in that because I find a way to guide them through, and they acknowledge that. And at first I thought I was really going to not like it, but then I ended up teaching. I'm, like, 'Oh, this isn't that bad.' "

The youth facilitators analyzed their practice of leading the workshops and described the challenges they have faced. Laretha described working with groups of young people. She lays out the challenges of what the first day can be like, "Well, at first one of the most challenging aspects was to get them to talk. I noticed that at the very beginning everybody was quiet. And it was really awkward because it sounded like only the interns were the enthusiastic ones. And, you know, like, there's cliché situations where, like, there's a class teaching and then all the kids are just, like, staring at each other, like, 'What?' And so it took time. Like, we had to…slowly get them to speak up, and we had to find out their interests. Like, it takes time and patience. And you have to also give them… space, too. But it ended up being a blessing because now everyone's all happy."

Roderigo agreed "Even if they had a problem they'd rather just stay quiet and sit there than actually ask us for help. And when we went to them they'd just be, like, 'No, I'm okay.' And now they've opened up, so whenever they have a problem they ask us. Or when we walk around they'll be, like, 'How do I do this?' or 'How do I do that?' So that was the hardest part in the beginning." Roderigo also talked about the open explorative structure of the workshops. "They just sort of expected you to teach them stuff," instead of exploring, problem solving, and working together. Although Laretha and Roderigo were inexperienced educators, they saw the importance of peer-to-peer learning, exploration, and agency for the attendees, and included space for these practices in the workshops that they helped facilitate. The librarians gave the youth facilitators agency to lead the workshops the way they saw fit and to make adjustments. This freedom created opportunity for growth and development in the facilitators' leadership and facilitating skills as well as positive experiences for the youth participants.

Conclusion

In light of persistent under-representation of women and people of color in coding and computer science jobs, it is important for school and public libraries to consider ways to change this reality. Exposure to STEM-related fields like coding and computer science has been shown to have an impact on the types of careers young people envision for themselves (Modi, Schoenburg, and Salmond 2012). Offering workshops in coding is an obvious way for libraries to provide this exposure. In this paper, I have demonstrated how librarians with no prior coding experience

("It is important to remember who the workshops are for and why it is important to offer all youth opportunities for exposure to coding and computer science. Small exposures can lead to large impacts over the long run.");

can facilitate coding workshops. The librarians need well-written facilitators' guides providing support for novice coders, to be comfortable not being the expert, and to be flexible in facilitating. Relying on peer-to-peer learning and problem solving as issues arise are also important strategies.

One librarian said that if you were unprepared for something to not go as planned you were not prepared to facilitate a coding or technology workshop. Librarians should also consider hiring young interns to help facilitate, which is a benefit to the interns, the librarian, and the workshop participants. It is important to remember who the workshops are for and why it is important to offer all youth opportunities for exposure to coding and computer science. Small exposures can lead to large impacts over the long run. Creating opportunities for programming—opportunities that librarians can implement easily—helps them support youth in the twenty-first century.

Crystle Martin *is a postdoctoral research fellow at the Digital Media and Learning Hub at the University of California, Irvine. Her research focuses on equity for youth learning through information practices and computational thinking in interest-driven environments, with particular focus on supporting underserved youth as they connect informal learning to academic and future opportunities. Her current research explores the paths of youth—especially those from non-dominant communities—into, through, and out of Scratch, a free online visual coding language. She is also secretary of the YALSA Board of Directors.*

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