"I'm the Audacity Wiz!": Technology Identity Development in Minority Youth

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Key Words: Identity, Technology, Minority, Youth, STEM, Out-of-school

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Introduction

A critical challenge in science, technology, engineering, and math (STEM) education continues to be keeping young students on a pathway to a successful STEM career once they have entered it. Many students express an early interest in STEM and even start down the road to obtaining a STEM degree, only to change direction later, an aspect of the so-called "leaky pipeline." Underrepresented minority students, in particular, face serious roadblocks to entering and staying on the path. Often, in the absence of teachers, mentors, and STEM professionals who look like them, minority youth can have a difficult time envisioning themselves working in a STEM field. Their STEM identity, the condition of seeing themselves as a STEM person, is undeveloped. Moreover, the information technology (IT) field is exceptional in its lack of diversity, making the development of a strong technology identity extremely difficult for minorities. As part of a larger National Science Foundation (NSF)-funded study designed to examine how minority youth are impacted by participation in place-based digital humanities projects, we looked at whether and how the development of technology identity is affected by participating in digital humanities projects.

Purpose & Research Questions

The purpose of this study is to explore how engagement in place-based digital humanities projects impacts technology identity development in underrepresented minority youth. Specifically, we are following a cohort of urban middle-schoolers who participated in a three-year out-of-school time digital humanities program situated within their own community. Using both qualitative and quantitative methods, we are exploring the students' perceptions of themselves as users of technology, including their technology self-efficacy and competence and their intention to pursue a technology-related career pathway. Our main objectives are to 1) discover the extent to which participation in the digital humanities projects impacts a student's technology identity trajectory and 2) to establish the particular aspects of these projects that help or hinder this identity development. The study is guided by the following questions:

1. How does participation in place-based digital humanities projects impact the technology self-efficacy and competence of minority youth?
2. How does participation in place-based digital humanities projects affect minority youth's intent to pursue a technology-related career?
3. Which aspects of program involvement help students to develop a stronger technology identity?

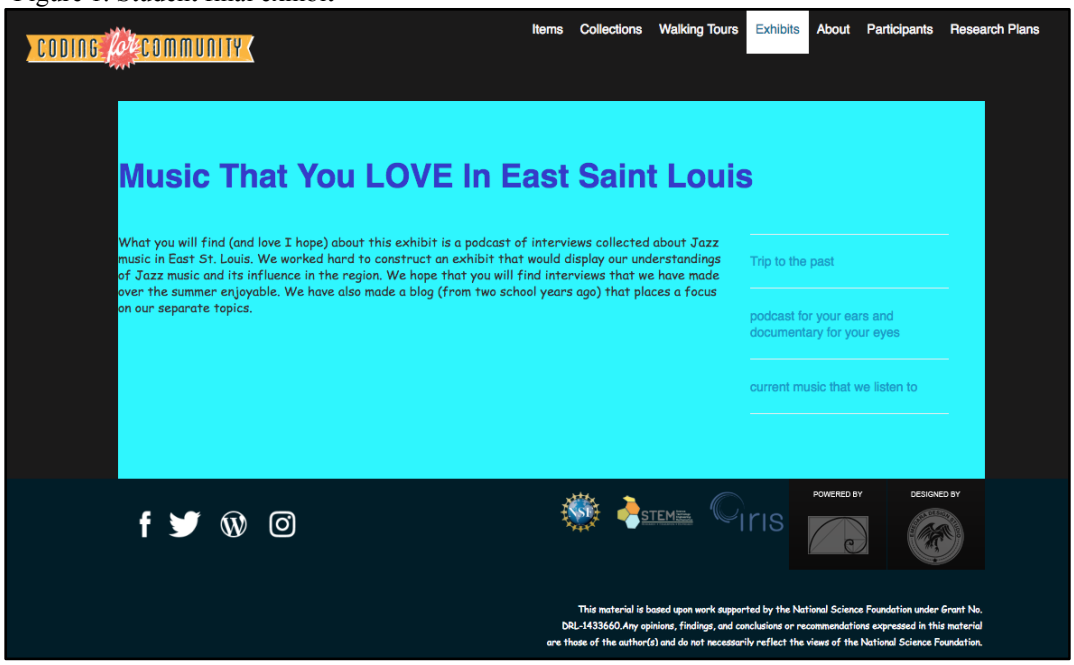
Theoretical Framework

This study uses the theoretical framework of identity development. Identity can be defined as "the 'kind of person' (i.e., 'technology person') one is seeking to be and enact in the here and now" (Gee, 1999, p. 13). According to another researcher, "identities are both ascribed by others and asserted by individuals. They are heavily influenced by social groups and historical circumstances, but they are also situational, flexible, and determined by individual choice. People define their identities in many ways, such as by gender, age, and ethnic, racial, religious, or other affiliations. Many individuals have global, cosmopolitan, or multicultural belongings and identities" (Banks et al., 2005, p.22). In their study of science identity development, Carlone and Johnson (2007) posited that in order to be a certain kind of person, one needed to have a certain level of competence, be able to demonstrate it, and be acknowledged for it by others, and they developed a model incorporating the three aspects of performance, recognition, competence. They also note, echoing Banks et al. (2005), that any particular identity (science, in the case of their study) interacts with and is affected by other identities (e.g., racial, ethnic, and gender), making the development of a strong science identity particularly challenging for underrepresented groups. Carlone and Johnson's model, with its three components of performance, recognition, and competence acting within the context of gender, race, and ethnicity, is guiding our data collection and analysis.

Context of Study

This study is embedded within a larger NSF-funded research project that developed an out-of-school-time digital humanities program for East St. Louis middle school students. The student program, *Coding for Community,* ran for three years and offered summer and school-year opportunities for students to participate in urban place-based learning as they investigated and shared aspects of their own community using various types of technologies. As part of this program, students have conducted interviews with community members, created videos and podcasts, and used the Internet to research the history and culture of East St. Louis. As a culminating project, students formed research groups around an area of interest and worked together to create a digital exhibit (Figure 1) for the project's website (eaststlouisculture.org) that showcased their years of data-gathering as well as their technological expertise.

Figure 1. Student final exhibit



Over the course of the larger project, the project team collected and analyzed a variety of data as part of the overall research and evaluation. The results formed a foundation for this study and are summarized below.

Summary of Findings from the Larger Study

During each year of the program, we administered short, periodic, online surveys designed to elicit student attitudes and perceptions around four constructs or scales: understandings of community, self-efficacy in using technology tools, exploration of digital humanities, and awareness and intentions related to technology careers. Surveys used a 7-point Likert-type response scale (strongly disagree to strongly agree) and were given at the beginning and end of the summer sessions, and then again at the end of the fall and spring semesters. Survey items included "I can do well in activities that involve technology like computers, digital cameras, and video cameras," "I plan to study computer science or technology in college," and "I can create a website." We also conducted semi-structured student interviews once each year to collect more detailed information about the students' technology experiences. Sample interview questions included "Can you tell me about some new computer programs or skills you've learned about while working on your project," "Do you think you could do some of these things on your own," and "How well do you think you will be able to complete your project?" In looking at the survey data from all the participants, paired samples *t*-tests comparing pre- and post-mean scale scores of each of the four

constructs were used to assess how program activities impacted students' perceptions in these areas. A significant increase in competency using computers and technology between pre- and post-scores was found during the summer of 2016. Differences in the other subscales were not found to be significant.

Each summer, the project evaluator interviewed the participants about their experiences in the program. Overall, students reported feeling more confident in their computer skills now than prior to joining the program. They are able to speak more comfortably about the technologies and use them more effectively. When talking about their growth, one student commented, "It's fun. My first day it was a struggle. Then I got used to it. It was getting easy. I ain't know how to do it at first until they taught us more about it and that's when I got used to it." Participation in the program has introduced some students to new career possibilities and helped these students develop positive self-efficacy related to their IT/computing abilities. When speaking about creating websites, one student noted, "the fact that I know how to do it, it makes me feel more advanced. If I wanted to make a website to start a business or something, I would know how to. You can be successful." Another student bridged their newly developed interest in computer science with their love for learning about their community, cultivating an ideal career path that incorporates the two. They would like to take the IT/computing and research skillsets they've acquired to become a documentarian vlogger, informing the public about their community. Though students have had a positive experience in the program, for some, computers and technology still "isn't their forte;" however, utilization of technology as related to learning about East St. Louis has maintained their interest. One student's decision to potentially pursue computer/IT career pathways stemmed from the program staff's praise of his developing abilities. When discussing this field as a career option, he said, "The staff told me I'm getting better and better with the research and stuff. So I'll probably consider doing it in college." Most students intend to take computing or IT courses in high school or college. The few without these intentions considered themselves to not be "computer or technology people."

Design of This Study

The study has a longitudinal case-study design, following a small group of participants over three years and collecting and analyzing a variety of data in order to paint a rich picture of the participants' experiences. Both quantitative and qualitative data were collected concurrently throughout the study; however, in the final year, we focused intentionally on conducting in-depth interviews with and examining student-produced artifacts from four participants, building up layers of data and forming a "thick description" (Geertz, 1973) of their experiences with the digital humanities program.

Participants

The study participants are four African-American youth (5th-10th grade) involved in the *Coding for Community* program. This place-based program was designed to provide meaningful, relevant technology-focused learning experiences in a community setting, and comprised both summer and school-year sessions. Students worked in groups, supported by university faculty and staff as well as K-12 educators, to research a topic or issue of interest to them within the context of their own community. As a culminating project, each group designed and developed a digital exhibit showcasing the results of their research. Over the three years, an average of 18 students attended each program session--slightly more in the summer and fewer during the school year. Some students attended all three years; others participated in just one or two years. Any program participant who had parent/guardian consent could volunteer to be in the research study. Since the start of the program, we have had 40 students give their assent to participate in the research study. We purposefully chose four of these students for this case study because of their length of time in the program, their consistent participation in program activities, and their comfort with an extended interview process, ensuring as much as possible high quality and detailed information.

Data Collection

For this case study, we administered surveys to students when they first entered the *Coding for Community* program, and then administered a final set of student surveys at the end of the program. These pre/post surveys were the same instruments used in the larger study described above. Additionally, we conducted an in-depth semi-structured interview with each participant--probing specifically for information related to their technology performance, recognition, and competence--as well as asking them to describe their final projects, the digital exhibits. Interviews were audio recorded and transcribed for analysis.

Data Analysis

Quantitative analysis of the survey data involved descriptive and inferential statistics, comparing results from the participants' first day in the program to their last. Three survey scales relevant to this study were examined: self-efficacy in using technology tools, exploration of digital humanities, and awareness and intentions related to technology careers. Mean scale scores from the last survey administration were calculated and compared to the mean scale scores from the participants' earliest surveys. We also looked at score changes for individual questions in order to gain insight into particular aspects of a participant's experience. Qualitative data from the semi-structured interviews were analyzed using a basic thematic analysis process (Braun & Clarke, 2006), guided by the study's framework of identity development, to look for aspects of and changes in the technology identities of the participants. We used NVivo software to assist with this analysis.

Results

We first present the results of the student surveys and then report on the qualitative findings from the semi-structured interviews. To ensure confidentiality, we use pseudonyms for the four participants: Bryan, Miles, Jackie, and Kelly.

Student Surveys

Analysis of the student surveys revealed an increase in each participant's mean scale score from their first survey (pre) to their final survey (post), showing some significant increases in individual scale scores and all significant increases in the combined scale scores (Tables 1a-1d, *significant at $p \leq 0.05$).

Table 1a. Student mean scale scores, Bryan

Scale	Number of Responses	Pre	Post	Difference	p-value
Technology SE	7	5.86	6.57	0.71	0.047*
Education/Career	6	6.00	6.33	0.33	0.363
Digital Humanities	7	5.86	6.14	0.28	0.356
Combined	20	5.90	6.35	0.45	0.016*

Table 1b. Student mean scale scores, Miles

Scale	Number of Responses	Pre	Post	Difference	p-value
Technology SE	7	4.86	6.14	1.28	0.163

Education/Career	6	6.00	7.00	1.00	0.175
Digital Humanities	7	5.29	7.00	1.71	0.045*
Combined	20	5.35	6.70	1.35	0.003*

Table 1c. Student mean scale scores, Jackie

Scale	**Number of Responses**	**Pre**	**Post**	**Difference**	**p-value**
Technology SE	7	5.71	6.71	1.00	0.004*
Education/Career	6	5.67	6.50	0.83	0.004*
Digital Humanities	7	6.71	7.00	0.29	0.172
Combined	20	6.05	6.75	0.70	0.000*

Table 1d. Student mean scale scores, Kelly

Scale	**Number of Responses**	**Pre**	**Post**	**Difference**	**p-value**
Technology SE	7	5.86	6.43	0.57	0.231
Education/Career	6	3.33	5.17	1.84	0.020*
Digital Humanities	7	5.71	6.29	0.58	0.103
Combined	20	5.05	6.00	0.95	0.002*

Interviews

Elements of technology identity development appearing in the earlier interviews were examined further with four participants as part of the case studies. Interview questions focused, in part, on the three components of Carlone and Johnson's identity model: performance, competence, and recognition. We also asked about the students' final project, the digital exhibit.

To report results from the interviews, we first share themes from the qualitative analysis of the four student interviews as framed by the Carlone and Johnson (2007) model of identity (Table 2), and then we address each research question separately.

Table 2. Themes for Identity Development

Identity Construct	Topics/Concepts [definition]	Participant Quotes
Performance (What did participants DO in the program involving technology?)	Coding/Editing	I would say coding and putting the colors together and the font. [Kelly] Code. I like to go and play with websites I use. I don't really use a lot of websites but clothing websites I will go on there and will change the name and colors and make it my own. [Jackie]
	Create/Build [podcasts, videos, website, virtual exhibit]	It was faster to create the documentary than anything else. All I had to do was cut pieces from the interviews, put them where I wanted grab video of the house, take out some of me talking in the videos, add music. It was probably one of the easiest projects. [Miles] This is the project. I've got a football page, too. About Bryan Cox, James Harris, and this is the football field in Jones park. And this one of the football players that play for East Side... And then I got a track [page]... I've got Joyner-Kersee and Dawn Harper, the two greatest track and field champions in East St. Louis. Then I've got a basketball page. There's Darius Miles and Cuonzo Martin. They attended East Side. East St. Louis High school. [Bryan]
	Design [Working with color, shape, text formatting, and various website options to form something new and artistic in nature.]	We are probably going to end up changing the color because this up here, you can't really see it, and yellow doesn't really go with it. But that is something we will do last because we want to make sure the information part is good first. (Jackie) First, I decided what the tabs were, well first I decided how I want to make it look to make people want to actually want to go on that page and then to click on the tab. [Kelly]
Recognition (Who observed and/or acknowledged the participants' technology work?	Family, friends, self? Showing project to friends	Probably my mom because I am always on my phone in her eyes. And it when it comes to school projects, some of my friends would label me as a tech person because I would rather type it than write it most of the time because writing is a lot of work. [??] They [friends] said it was really creative how I did most of it [exhibit] by myself. They were actually really supportive. [Miles]
Competence (What skills/knowledge have been learned? What do the participants think they can do? Self-efficacy/confidence)	Coding Solving a problem (repairing hardware, fixing a glitch, figuring out how to change something) Editing	It was coding. Cause I felt like that one was the hardest. Now that I can do it I am proud of myself. [Kelly] Coding. I didn't really work on environment or education at home but coding I did work on at home because if I didn't understand it I knew we had Kahn Academy to use. [Jackie] It was faster to create the documentary than anything else. All I had to do was cut pieces from the interviews, put them where I wanted grab video of the house, take out some of me talking in the videos, add music. It was probably one of the easiest projects. [Miles] Trying to fix the words. I will also probably be trying to fix my buttons, and fixing these words here. Making it so you can click on these and you can go back anywhere. [Bryan]

1. How does participation in place-based digital humanities projects impact the technology self-efficacy and competence of minority youth?

The *Coding for Community* program provided students with an opportunity for technology self-efficacy development by engaging them in digital humanities activities perceived by the students as relevant and valuable while giving them resources that built confidence. For example, when asked about program activities, students often talked about coding, viewing it as a key technology skill. Although they admitted it was sometimes a difficult task, the program instructors let them see where they could get help, allowing the students to work independently and make progress on their project. This both increased their technology competence and strengthened their technology self-efficacy. As this student said:

> I don't think I've mastered anything, but something I really think I'm good at is the actual coding. Because I know the different websites to use or the different things to look up to get me to where I need to be. [Jackie]

When asked to describe a technology skill that they really knew well, this student also talked about coding:

> It was coding. Cause I felt like that one was the hardest. Now that I can do it I am proud of myself. [Kelly]

For her, coding was not easy, but that made it a meaningful accomplishment and something to be proud of.

Once students could do some coding, they used that skill to design and build their culminating project: the digital exhibit. Working with WordPress sites, the students manipulated text, images, and space as they created a web page for their research and developed the exhibit pages. This required creativity and making many function and design decisions, as described by these students:

> We are probably going to end up changing the color because this up here, you can't really see it, and yellow doesn't really go with it. But that is something we will do last because we want to make sure the information part is good first. (Jackie)

> First, I decided what the tabs were, well first I decided how I want to make it look to make people want to actually want to go on that page and then to click on the tab. [Kelly]

> [I'm] trying to fix the words. I will also probably be trying to fix my buttons, and fixing these words here. Making it so you can click on these and you can go back anywhere. [Bryan]

By learning a skill, not in isolation but as something needed for their digital humanities project, students could connect the skill to its function. They could see its value and how they could use it to develop and modify their exhibit. Using the skill, in turn, let to increased understanding, as described by this student:

> And using things once you learn it, it helps you get a better understanding of it. So instead of them [program instructors] just teaching us well here is how to code have a good day, they showed us how to use it and incorporate it into our project. So, learning that… it definitely helped. So, if I am at Upward Bound and I am on a computer, I would start coding stuff to see if I still know how to do it. [Jackie]

Putting a technology skill to use as it is being learned builds competence and self-efficacy.

2. How does participation in place-based digital humanities projects affect minority youth's intent to pursue a technology-related career?

By participating in projects that were focused on relevant topics and involved building something viewed as useful and valuable, students began to see the various ways in which technology could be used and could be useful to them. One student gave this example of using her new skills in her schoolwork:

> So, let's say you have to come up with a project for school and you want to go out of the box and you want to create your own website. It's not that difficult if you think about it. [Jackie]

They began to see the connection between art and design and coding and web site development, broadening their awareness of what a career in IT may involve.

> Over the summer we did java script when we literally went on the computer and created something. To me it's fun how people can create something out of thin air without barely a finger for real… yeah, like creators make video games and apps just random stuff that we use every day and don't really think of where they came from. [Miles]

Although some students did not have an IT career as their first choice, even after completing the program, our participants became aware of the many ways they might use technology in the future:

> I like baking. And you want to advertise your business, and I can make a website because of this program. I like coding and coding can get you a lot of money if you find the right thing to do. But I can definitely see myself doing that in the future… like I said before for a project or for a business or maybe to help somebody else out… I can show them how to code. That'd be pretty cool. [Jackie]

They saw that technology was a part of everything and could be a tool that would be useful in their future. Finally, students developed enough interest in technology to consider a technology career as a backup plan, an alternative if their first career choice did not work out. This student told of how her newly acquired technology competence and awareness gave her a second career option:

> I don't really plan on working with computers, but you always need a plan B. So, I think if I don't make it where I want to then computers and technology would be a second choice because I already have information on that and I already know how to do stuff on it. So yeah that would be a second choice. [Kelly]

> If I don't make it with basketball, I might make my career in technology. [Bryan]

3. Which aspects of program involvement help students to develop a stronger technology identity?

The *Coding for Community* program provided many opportunities for technology identity development, in line with Carlone and Johnson's model. First, students increased their **competence** in technology by learning skills such as coding, digital video/audio recording and editing, and searching Internet sites. They learned how to use programs such as Audacity and web platforms such as WordPress and Omeka. Then, throughout the program, students were engaged in the **performance** of these skills, giving purpose and relevance to their learning. Students used their skills to create and edit websites, conduct research on their community, video and audio record interviews, and construct virtual walking tours of their neighborhoods. For the culminating project, students were able to bring these various products together to create a digital exhibit about one aspect of their community's culture. Finally, students received **recognition** by others as developing technology experts. Students worked in groups where they could share their knowledge, teach others a new skill, or help fix a problem. Program instructors encouraged students with questions and problems to find a peer who could help. Students got to see their peers as resources, learning who was good at what. Often groups would split up larger tasks, assigning jobs to those with the right skills. The final student project—working in groups to build digital exhibits for the program website--involved all three identity constructs, allowing students to achieve competence with technology skills, perform those skills in a relevant and interesting way, and be recognized by others as experts.

Even though the program addressed all three parts of the identity model, students did not always see themselves as a technology person. Students' responses were tentative and conditional. For example, this student didn't consider herself a technology person because she didn't know about all types of technology:

> No. No. Well, kind of, I wouldn't say a technology person but a person that can help you with certain problems on certain technologies. Yeah 'cause I wouldn't know how to work every technology that I come across. [Kelly]

> I'm not sure. A little bit in between because I use my phone but I don't use it that much. It's more of a communication device. But as a technology person, I watch Netflix a lot and I have to use the TV, but I don't know. I definitely like coding. So, I don't really know if I would consider me as a technology person. [Jackie]

> I do… when I'm on my phone I do… when I'm helping my mama on her phone I do. But just walking around and somebody asks for help to fix it, I don't think that way because the only thing I really know about is the computer and my phone. But if comes to phones I could fix it. [Bryan]

> Not really… I don't really know why. It's just, technology is the new thing, so it's just something to kind of dive into. It's just not right now I don't consider myself a techy. [Miles]

It is essential, therefore, to also consider 'the kind of person' they view as a technology person. For these students, a technology person is the ultimate expert. As this student describes:

> …he's the best at computers. If something on there doesn't work, he will make it work, he will find multiple ways to make it work, he's just awesome at it. Not only fixes it but knows about it… knows its history, knows what it can do, why it does that. [Kelly]

> Always using technology but not always for useless reasons. They actually, some people are interested in taking an entire computer apart and putting it back together. I would love to do that but I don't know if I have that much patience. I would lose my mind. But finding different ways to use technology because I didn't know on Google I didn't know you can change something to say it is within that year or within that week. I didn't know that. So being a tech person you can actually... [you] are interested in the different ways to use technology. So, a phone, you can use it in more ways than just trying to call somebody. I don't know what else you would use it for beside the Internet but just finding out how to do that is good. [Jackie]

Discussion:

This study found that participation in digital humanities projects can help middle school students build a better awareness of what technology (and an IT career) involves, how it can be used to support and enhance other careers, and how it is useful in many aspects of their lives. Pre/post surveys suggested that participation in a digital humanities OST program can increase participants' technology self-efficacy in using technology tools, exploration of digital humanities, and awareness and intentions related to technology careers. Interview responses indicated that although students enjoyed learning technology skills and performing technology-related tasks as part of a relevant and interesting project, they did not necessarily see themselves as technology persons. However, they could sometimes see themselves that way, especially if it involved a type of technology that they knew well and could help others to use such as a smartphone. Our participants viewed a technology person as someone who had expertise with *all* types of technology and who could fix any device and solve any technology problem. Our participants realized that they were not at that level yet.

Although staying very engaged throughout the *Coding for Community* program, three of our four particiants did not plan to pursue an IT career. However, seeing the connection between art/design/creativity and technology expanded their view of how technology skills could be useful in

many aspects of their lives. They also gained a realistic awareness of technology's shortcomings: it does not make everything easier, it requires patience. Finally, they also came away with a realistic assessment of their own ability in technology.

Regarding the development of a technology identity in *Coding for Community* and the 3-dimension model, program participants engaged in a student-centered curriculum where **Performance** overlaps greatly with **Competence**. Learning and putting the learning into practice were concurrent events, helping students see the relevance and the usefulness of the content.

Finally, students learned skills and engaged in project tasks that they thought a "technology person" would do. Whether accurate or not, students saw coding as what a technology person does. As they learned and became good at coding, a perceived authentic technology skill, they were starting to develop a technology identity.

Conclusion

Building and sustaining a strong STEM identity may make the difference between staying on a STEM path and exiting it, and a growing number of education researchers are examining student identity work as a key component to student success. Using technology identity as a lens, we explored the experiences of four African American youth who were working to create community-focused digital exhibits in an out-of-school time program. While these students made progress in developing certain aspects of a technology identity, they have farther to go along this trajectory. Students learned technology-related skills, specifically coding and web development, gained confidence in working on technology projects, and shared their expertise with others, but still did not always consider themselves to be a "technology person." Most were not planning on an IT career. However, participants gained valuable insight into the creative side of IT and how technology might enhance their future lives and be useful in careers outside of IT.

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