Informal Technology Education for Women Transitioning from Incarceration

As society increasingly relies on digital technologies in many different aspects, those who lack relevant access and skills are lagging increasingly behind. Among the underserved groups disproportionately affected by the digital divide are women who are transitioning from incarceration and seeking to reenter the workforce outside the carceral system (women-in-transition). Women-in-transition rarely have been exposed to sound technology education, as they have generally been isolated from the digital environment while in incarceration. Furthermore, while women have become the fastest-growing segment of the incarcerated population in the United States in recent decades, prison education and reentry programs are still not well adjusted for them. Most programs are mainly designed for the dominant male population. Consequently, women-in-transition face significant post-incarceration challenges in accessing and using relevant digital technologies and thus have added difficulties in entering or re-entering the workforce. Against this backdrop, our multidisciplinary research team has conducted empirical research as part of technology education offered to women-in-transition in the Midwest. In this paper, we report results from our interviews with 75 women-in-transition in the Midwest that were conducted to develop a tailored technology education program for the women. More than half of the participants in our study are women of color and face precarious housing and financial situations. Then we discuss principles that we adopted in developing our education program for the marginalized women and participants' feedback on the program. Our team launched in-person sessions with women-in-reentry at public libraries in February 2020 and had to move the sessions online in March due to COVID-19. Our research-informed educational program is designed primarily to support the women in enhancing their knowledge and comfort with technology and nurturing computational thinking. Our study shows that low self-efficacy and mental health challenges, as well as lack of resources for technology access and use, are some of the major issues that need to be addressed in supporting technology learning among women-in-transition. This research offers scholarly and practical implications for computing education for women-in-transition and other marginalized populations.

CCS Concepts: • **Social and professional topics** → **Computational thinking**;

Additional Key Words and Phrases: Informal Technology Education, Reentry

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1 INTRODUCTION

While men continue to be the vast majority of the prison population in the United States, women's rates of imprisonment have been growing since 2000 [4, 19, 35, 65, 69]. Recent reports show that women have become the "fastest-growing" section of the incarcerated population, even when the total number of incarcerated people has declined following prison reforms since 2009 [69]. The growth is particularly salient in state prisons with women's state prison populations increasing by about 800% nationwide over the past 40 years and doubling the growth rate among men. Almost two-thirds of women in jail are women of color with 44% Black, 36% White, 15% Hispanic and 5% other racial/ethnic

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backgrounds [77]. The vast majority of the incarcerated women are for non-violent offenses, often related to mandatory minimum sentencing for drug-related crimes [41, 65].

Women with criminal justice history rarely have been exposed to solid technology education and have extremely limited preparation for engagement in the formal economy due to past criminal justice involvement [51]. There are several reasons why women in transition are not given sufficient opportunities for technology education relevant to them. The first reason is lack of educational programs designed to respond to the increasing rates of women imprisonments in recent years [19, 35, 65]. The relatively recent influx of women into the prison system has presented significant challenges for prison education programs and reentry programs, which have been designed with a male population in mind. Historically, incarcerated women's access to both health care and educational programs have been fewer and of poorer quality than those offered to similarly-situated men, despite that female inmates have a greater need for specific services in comparison to their male counterparts [35, 65]. Another complication for incarcerated populations is the restrictions on their Internet usage while in prison [14, 57]. This limitation, accepted and defended by prison officials as a necessary security measure, creates challenges when people leave prison and reenter a world that is increasingly dependent on digital access and literacy.

In this context, our research team has conducted a research study to understand challenges facing women recently released from incarceration in terms of accessing and using technology and how educational programs can be developed to support their technology learning. In particular, our results shed light on how COVID-19 influenced the women's technology use and learning. Empirical data for this study come from interviews conducted in winter 2019 and spring 2020 with 75 women who have been recently released from jails or prisons in three cities in the Midwest. More than half of the participants in our study are women of color and face precarious housing and financial situations. In this paper, we also discuss principles that we adopted in developing our education program for the marginalized women and participants' feedback on the program. Our team launched in-person sessions with women-in-reentry at public libraries in February 2020 and had to move the sessions online in March due to COVID-19. Our research-informed educational program is designed primarily to support the women in enhancing their knowledge and comfort with technology and nurturing computational thinking. Findings from this study offer important implications for supporting technology learning among women-in-transition and other marginalized populations.

The rest of the paper is organized as follows. We discuss the status of underrepresented and underserved populations in computing and technology education in Section 2. We explain our qualitative interview study methods and results, in Section 3 and Section 4, respectively. Guided by the findings, we describe our technology education program design and participant feedback in Section 5. Concluding remarks and future work are presented in Section 6.

2 RELATED WORK

2.1 Background

Computer science education has been perceived as a promising path especially among young people. As the demand for technology professionals outpace the supply of skilled workforce by far [17], efforts have been made to diversify and increase the workforce in computing [26, 27, 38]. Furthermore, as the fourth industrial revolution accelerates the societal needs on technology for all aspects of our lives [79], technology skills and access to information and communication technology are more critical than ever. As governments or industries have initially focused on the communication infrastructures [3], the Internet penetration rate is close to saturation for developed countries. With the rapid and broad societal changes, however, digital divide becomes more detrimental for underserved populations. Understanding

diverse ramifications of digital divide and devising nuanced solutions have become important [16]. Studies show that despite increasing availability of the Internet and online services, its use and efficacy are not balanced especially for underserved populations such as those with particular race/ethnicity backgrounds, conditions of disability, and low socio-economic status [30, 32]. Recognizing these underlying social, economic and cultural aspects of the digital divide is a first step toward digital equity [5] and to tackle the *persistent social* inequality concern that goes beyond the basic availability of information and communication technology.

2.2 Women in Computing

The issue of underrepresentation of women in computing has been widely recognized for many years. A number of studies have been conducted to understand the factors and influences that repel women away from computing. Culture and climate of CS as being unwelcoming to women [83], images of CS as being male-oriented [84], lack of access, role models, and encouragement [39], social stereotypes and lack of a sense of belonging [13] and confidence [62, 63] have been reported as major factors of diminishing attractiveness of computing for women. A study in [45] finds that early exposure is critical for young women to be drawn to computing. There have been many social and cultural efforts aimed at making the discipline more inclusive of women such as Girls Who Code [43], Girl Scout coding programs [42], COMPUGIRLS [70], and networking groups of women in professional societies [10, 52]. However, the issue of gender imbalance still remains significant, and most of such efforts are centered around young women. Understanding the special needs of various underrepresented populations, and diverse and tailored social efforts are much in need.

2.3 Women of Color in Computing

Women of color form a small proportion of women in computing education programs and related career paths [61]. A recent study [67] shows that women of color, particularly black women's social experiences are often different from black men and non-black women in US. The racial and gender disparity in K-12 CS education is typically attributed to disparity of access to computing classes and technology [60]. Socioeconomic inequity further amplifies such digital divide mentioned among all women. Unlike for other groups, early exposures to computing before college in fact drives black women away from computing in their career choices. Instead, having friends in computing area and family support were more significant for their career choices in computing. Understanding the needs of different individuals and the importance of social support of family and friends are important for black women to be drawn to and stay in computing.

2.4 Existing Prison Education or Reentry Programs

There are several national prison education or reentry programs that have guided other related programs. Education Development Center (EDC) [34] is a global organization to advance long-term solutions for education, health, and economic opportunity. They design, implement, and evaluate various innovative informal education programs including prison and reentry educations. *The Prison Teaching Initiative (PTI)* at Princeton University [9] is a volunteer group teaching accredited college courses in New Jersey State prisons. *From Prison Cells to PhD* [40] is an organization that provides mentoring and educational counseling to individuals returning from incarceration, and aims to inspire them to excel beyond the norm of their life circumstances and societal expectations of them. *The Initiative for Race Research and Justice* [47] is a group studying unjust and inequitable policies and practices and conducting research to support equitable tools for formal and informal educations. *Operation Restoration* [66] supports women and girls and their

families impacted by incarceration with the resources necessary to make sustainable transition into society through higher education, employment training, job placement, case management, and advocacy.

Most of such programs are focused on general education areas such as history, psychology and math, and technology is a relatively new topic that is being incorporated in the existing curricula. Our research team's education program is unique in that we focus on technology education for women transitioning from incarceration.

2.5 Computing Education for Marginalized People

A study in [56] addresses the accessibility issue of people with cognitive disability, and reports that computing education through an informal code club provided a sense of empowerment for participants with cognitive disability. The program in [50] focused on computing education for marginalized youth, especially due to poverty. To the best of our knowledge, there is little research or programs on computing education for women transitioning from incarceration. This is an important area for further research, especially considering the increasing rates of women's imprisonments in the United States in recent decades.

2.6 Performance Metric of Reentry Programs

The most common and natural performance metric of correctional or reentry programs is the rate of recidivism [55]. Broadly defined as reengaging in criminal behavior after receiving a sanction or intervention, recidivism is an important performance measure for justice agencies in their effort to evaluate the outcomes of Justice Resources [53]. Recidivism is mostly reported as a single statewide rate over various time intervals. The measurement of reoccurring criminal data is irregular and difficult to collect. Thus it is often insufficient for assessing the impact of changes to policy and practice. There are efforts to improve metrics for better data collections and for program evaluations. The efforts include assigning unique identifiers of cases, develop long-term records, collecting additional contextual information, and frequent update change in status. Data sharing agreement with FBI and Nlets [80] in 2008 allows researchers to obtain federally integrated criminal history information.

2.7 Our Program Background and Research Questions

In our research-informed technology education program for women-in-transition, we consider participants' needs and desires in learning technology as well as demographic and social psychological attributes of the participants. Our interview data on these issues guided the research team to develop a tailored technology education for women-in-transition. We note that our team is multi-disciplinary encompassing disciplines of digital and emerging media, computer science, communication, preventive medicine and public health, women's studies, policy and social studies, and adult learning. Our empirical research study and technology education program design are guided by the following research questions (RQ) related to women transitioning from incarceration.

RQ 1. What are primary barriers women transitioning from incarceration face before and during COVID-19 in terms of technology access and use?

RQ 2. How are social psychological characteristics and technology access barriers influence technology learning of women transitioning from incarceration?

3 INTERVIEW STUDY METHODS AND DATA

For this study, we conducted interviews with 75 women who have been released from jails or prisons in the Midwest in the past five years as of early 2020. Participants for the interview research were recruited in collaborations with community

organizations that support women's reentry and Departments of Corrections in three neighboring Midwestern cities. These entities shared our research team's program information with their clients, and then the research team followed up with women who indicated interest in participating in our interview research.

All 75 interviews were conducted between October 2019 and September 2020 with 48 interviews partially or fully conducted after COVID-19 stay-at-home orders in the three cities in March 2020. Each interview lasted for about 30-45 minutes and was composed of a structured interview and a close-ended questionnaire. For the structured interview portion, we had 35 open-ended questions that were asked following a consistent interview protocol. These questions were related to computer education experiences, Internet access, computing devices used, and technology confidence. All research protocols were approved by the Institutional Review Board (IRB) of the lead author's university.

Research team members who were approved by the IRB conducted the interviews, which were recorded with IRB permission and signed consent from each participant. ATLAS.ti 7.1.6, an analytics platform for organizing and interpreting qualitative data, was used to analyze interview transcripts. Specifically, we organized the coding of themes related to the topics of technology use and education. Using grounded theory approaches [48, 68, 76], we developed codes with the constant comparison technique and identified patterns of themes in the transcripts related to technology use and education as well as new or emergent areas. Specifically, participants' answers were analyzed inductively, using a combination of open coding of identifying relevant themes line by line as well as focused coding of searching for specific themes to group them into categories. The final set of codes included both pre-existing codes drawn from interview and research topics including technology use and emergent codes during the open-coding or in vivo process [20, 36]. Once a stable categorization of codes was generated, interview transcripts were coded in a second round of focused coding, with codes entered manually into ATLAS.ti.7.1.6. The analysis discussed below is primarily based on these focused codes and representative excerpts are included to illustrate the categories.

Participant Characteristics. Key characteristics of interview participants are summarized in Table 1. All 75 participants identified them as female. Of them, 68 participants answered education, age, and race/ethnicity questions. Ages of the participants ranged from 26 to 65 years old (M = 41.85; SD = 10.60; median: 40). Specifically, about 30.9 % (n = 21) were ages between 25 and 34; 29.4% (n = 20) between 35 and 44; 25% (n = 17) between 45 and 54; and 14.7% (n = 10) were 55 or older. In terms of their formal education, 30.9% (n = 21) said they had completed high school; 26.5% some college (n = 18); 19.1% some high school or less (n = 13); and 23.5% (n = 16) had vocational training, associate degree, or bachelor's degree. In terms of race/ethnicity, 41.2% (n = 28) said Black, 29.4% (n = 20) White, 19.1% (n = 13) Hispanic, 7.4% (n = 5) American Indian or White/American Indian, and 2.9% (n = 2) other. The time they spent in a prison or jail ranged from 3 months to 16 years.

4 QUALITATIVE STUDY RESULTS

4.1 Primary Barriers of Technology Access and Use Before and During COVID-19 (RQ 1)

There was a wide range of experience among interview participants with regard to technology access and use. Participants reported using smartphones, their own computers, someone else's computer, or a public use computer to use the Internet. Several participants mentioned that computers provided by their children's schools for distance learning during COVID-19 were the only computers at home. About half of the participants reported owning multiple devices with the other half owning one or no digital device. The smartphone was the most widely used device used for Internet access with about 74.6% (n = 56) reporting owning a smartphone. A dozen participants mentioned that they had a cellphone with no Internet access. This shows that smartphone ownership rate among our participants is lower than

Table 1. Research Participant Demographics and Digital Media Use

Variable	***Value***	***Count***	***Percent***
Age	25-34	21	30.9 %
	35-44	20	29.4 %
	45-54	17	25.0 %
	55 or older	10	14.7 %
	Total	68	100 %
Race	Black or African-American	28	41.2 %
	White or Caucasian	20	29.4 %
	Hispanic or Latino	13	19.1 %
	American Indian or White/American Indian	5	7.4 %
	Other	2	2.9 %
	Total	68	100 %
Education	Nursery school to 8grade	1	1.5%
	Some high school	12	17.6 %
	High school completed	21	30.9 %
	Some college	18	26.5 %
	Vocational training	9	13.2 %
	Associate degree	5	7.4 %
	Bachelor's degree	2	2.9 %
	Total	68	100 %
Time Online	Not at all	8	10.7 %
	Less than an hour	6	8.0 %
	1 hour - less than 3 hours	15	20.0 %
	3 hours - less than 5 hours	17	22.7 %
	5 hours – less than 7 hours	9	12.0 %
	7 hours or more	20	26.6 %
	Total	75	100 %

*Note: A total of 75 interviews were conducted. Several of them declined to answer demographic questions.

that for the overall U.S. adult population which was 96% as of 2019 [74]. About half of the participants said they have a laptop or desktop computer, though some of them said they were not able to use their computer because they have no Internet connection or their computer is broken. Those who did not have functioning computers at home said they use a public library, an employment training center, or a friend or relative's computer when they needed to use a computer. Of the 75 participants who reported time they spent online on a typical day, 10.7% (n = 8) said they spend no time on the Internet, 8% (n = 6) less than an hour, 20% (n = 15) between 1 hour and less than 3 hours, 22.7% (n = 17) between 3 hours and less than 5 hours, 12% (n = 9) between 5 hours and less than 7 hours, and 26.6% (n = 20) 7 hours or more.

Pseudonyms are used in referring interview participants in this paper. Our interviews show the women's precarious housing and financial conditions affected their access to and use of relevant technologies. Moreover, COVID-19 worsened the situation, as some of the participants lost jobs. Moreover, public places including libraries where many of the participants utilized computers or the Internet were not open to the public. Many participants said financial difficulties are the primary barrier for technology access and use. For example, Keshon, 41, said, due to her deteriorating financial situation she had to cancel her at-home Internet subscription, which she described as *"not a necessity"*. Najwa, 40, said since she is *"broke"* she doesn't have Internet access at home. A few participants indicated they lost Internet access when their cellphones were disconnected or that they did not have a large enough data plan on their cellphone. Several

participants with school children indicated school districts provided free Internet access to their households so that the children can participate in online learning during the pandemic. For example, Latoya, a 38-year-old mother of a middle school girl, said her household is getting free Internet service for two months in fall 2020 and then she will need to pay $9.95 to continue to use the service. When asked whether she had Internet access at home before COVID-19, Latoya said, *"No, but our neighbor was letting us use his Wi-Fi."*

Precarious housing situations are added challenges for some of these women. For example, Cleotha, 43, said, she doesn't have stable Internet access, as she is homeless and stays in her truck or a homeless shelter. She added that she generally uses her cellphone or goes to businesses offering free Wi-Fi. Cleotha noted: *"I generally use my data or I have to go to McDonald's, which their Wi-Fi sucks because it doesn't allow you to go and do anything…I do have a government phone but it doesn't offer a lot of data."* Sidone, 34, who doesn't have a computer, said trying to look for housing relying solely on her smartphone was particularly challenging. Pointing out that she couldn't bring up a housing application or download documents on her smartphone, Sidone said: *"So far, all I've had is… in my house-hunting experience recently it has limited website accessibility that I can get on my cellphone, when I could really use a desktop with Internet access."*

Some participants mentioned that their financial and/or housing situations worsened due to the pandemic, as they were laid off or not getting enough work. Moreover, several women said they stopped job searches because looking for jobs and completing job applications are difficult without stable access to the Internet or computers. These women used to go to public libraries or community centers to access the Internet or computers. Tamika, 38, said, she is trying to purchase a computer now that public libraries are closed due to the pandemic. Tamika said: *"Money is tight. We have had some people cancel for cleans, so I am working only two or three days a week."* Similarly, Latoya said she is putting off her job search, adding, *"Just because everything is so up in the air now, I am just kind of stuck with this one job which I know I have more potential than just this one job I am doing."* Latoya pointed out that she used to go to an employment center to use a computer, fax or printer but the center was closed due to the pandemic. She said: *"No, they shut down and they are not taking any...it is hard...they are not taking any people."*

According to our interview participants, the COVID-19 pandemic has significantly influenced how use digital technologies. Dericia, a 41-year-old mother with three school children, said her children had to rely on one computer that was available at their grandparent's home when they started to take classes online from home due to the pandemic. She said her desktop in the basement of her home was damaged due to flooding. Dericia said trying to figure out how all family members can complete their tasks online only with one laptop at the grandparent's house was *"crazy"*. Dericia explained: *"Well, mostly they went to their grandparent's house who had a laptop. So one would just use it there and the other would just get on the phone. So you just had to make it work. It was crazy but you had to make it work."* She said now each child has a laptop provided by their school which they need to return when the school activities go back to normal.

Most participants reported spending more time online during the pandemic. For example, Lakin, 27, said: *"I probably use computers and apps and all that so much more now because of COVID-19."* Dericia echoed the sentiment, noting that she is online *"a lot more"* than she used. In particular, many participants indicated that they spend more time on social media sites. Dericia said: *"Facebook is one that I spend a lot of time on. Just being able to connect to other people."* For Niesha, 33, social media sites became important sources of information related to the COVID-19 pandemic. Niesha said: *"My social media feeds are filled with Coronavirus-related news and information."* Similarly, Ronnell, 31, said she is reading a lot about COVID-19 online and as she clicks stories related to the pandemic she is getting more updates on that via email and social media sites. Several participants expressed concerns that having limited data plans on cellphones when they had to do more activities online amid COVID-19. For instance, Jennifer, 34, said that the only way she can access the Internet is on her *"tiny iPhone"* but that the data plan on her phone is limited.

Despite these and other challenges in using digital technologies, participants emphasized that having reliable access to the Internet and computers is important. Several participants mentioned that *"You can't live without the Internet these days."* Karen, 41, said a computer with Internet access is *"more of a necessity"* to her, and she can accomplish a lot more by using a computer than a cellphone. To Emma, 59, the Internet is *"like a security blanket"* that she wants to have all the time.

In summary, most interviewees mentioned that lack of access to digital devices and the Internet are major barriers to their technology use and that these barriers are directed related to their precarious financial and housing situations. Despite these financial, technological, and environmental challenges, most of them demonstrated interest in learning about technology even during the pandemic.

4.2 Social Psychological Barriers of Technology Learning (RQ2)

According to our interviews, some participants had no experience with a computer while others used computers on a daily basis for professional or personal purposes. Whether they are familiar or experienced with technology or not, the majority of the participants identified specific barriers facing them in terms of learning about technology. One of the more frequently identified barriers was lack of self-confidence or self-efficacy in learning technology-related skills. Self-efficacy refers to a person's belief in her competence to handle different situations necessary to accomplish desired outcomes [12]. Our finding is in line with previous research that showed low levels of self-efficacy among marginalized older adults in terms of technology learning [71]. In addition, research has shown that individuals with higher self-efficacy are more likely to actively utilize the Internet and other digital resources and participate in social activities online [73].

Some participants discussed not being smart enough or getting irritated in discussing technology learning experiences, while others said they don't know much about technology but are learning. Several participants mentioned mental health challenges such as anger issues in discussing their experiences of learning how to use computers and the Internet. For example, Susan, 50, mentioned that she gets *"irritated too quickly"* and she doesn't *"believe in"* herself. She said: *"I don't believe in myself. I don't believe I can do it so I just don't do it."* In particular, she expressed frustration at learning to use a cellphone. Susan said: *"I've been in the penitentiary all of my life, so I don't know too much. I don't know about this phone. I get mad about this phone. I want to throw it."* To Dorothy, 53, creating and remembering passwords for different online sites is *"challenging."* Dorothy said: *"I just can't remember all these darn passwords or where I wrote them at."* Similarly, Donna, 47, said learning to use a computer at a community center was *"overwhelming,"* especially as she was not up-to-date on technology-related matters due to several years of isolation from the digital world while being incarcerated. Some participants mentioned specific mental health conditions such as paranoia and schizophrenia and how these conditions have influenced their technology learning.

Another major challenge in learning technology was not knowing about how to protect themselves online and thus preferring to stay offline. Online privacy and security concerns came up frequently during the interviews. Some participants expressed discomfort in being online, noting they feel their online activities are surveilled by others on the Internet. Several women commented that others are *"watching"* or *"listening"* online. Examples cited in discussing concerns about being surveilled include others tracking their online behaviors through cookies or examining their social media posts. Some participants, who have been more recently released, expressed particular concerns about government surveillance of their online activities. Several other participants indicated that they became more cautious about being online due to their experiences of being scammed or misled online not long after being released from incarceration.

Many participants were interested in taking computer classes on privacy online. In particular, they indicated desire to learn how to set privacy and security settings on social media sites and to better protect their financial and other sensitive information. Betty, 59, said she wanted to take courses on online privacy and security so that she does not open up *"any doors that doesn't need to be opened up."* Echoing this sentiment, Tamika noted that understanding implications of having her locations available on web and mobile apps would be important for her to take proper measures for better protecting herself online. Tamika said: *"I'd probably like to know how much damage I am doing by hitting allow every time you know. Whether it is completely safe to be doing that or if I should be more cautious."* Several other participants mentioned that they would like to learn what safety measures they should take when they use public-access computers at libraries or community centers. This was a particular area of concern, as these participants generally use public computers for job applications and financial transactions as they don't have computers or Internet access at home. Other topics that participants indicated interest in learning include apps for securely saving passwords, anti-virus software programs, and how to protect themselves from phishing and scam attempts. Ronnell said: *"I've got to learn how people actually get access to people's networks just so I can maybe learn more about how to detour it really."*

Overall, low self-efficacy and concerns about online privacy and security most were salient among our interview participants. Often, these issues discouraged them from being active online or having any presence online. Taking into account these concerns and technology access barriers among our participants, we have developed our instruction strategies and education program that are described in the next section.

5 DEVELOPMENT OF TECHNOLOGY PROGRAM FOR WOMEN-IN-TRANSITION

Based on our formative research aimed at understanding interests and needs of women-in-transition in technology learning, we developed a curriculum for the group. Since February 2020, we have offered technology education for a total of 21 women of the 75 women interviewed for the formative research. Some of the 75 women were either not interested in the program or not available due to professional or personal responsibilities. In addition, the small number reflects the fact that our technology education program, which began as an in-person program, had to move online due to the outbreak of COVID-19 in the United States in March 2020. As discussed above, many women interviewed for the formative research lacked access to digital devices to reliably participate in the program. Most of all, due to public library closings amid COVID-19, they could not use public-access computers. Below we summarize the principles that we used in developing our curriculum and participants' reactions gathered during progress interviews.

5.1 Technology Education Curriculum Development

In developing our curriculum, we adopt an interest-driven learning design framework [28, 33, 82]. Interest is an effective motivator for learning, and this framework designs learning activities by drawing on learners' specific interests. Previous research in technology education [28, 33, 82] and our own experiences of offering digital education to women-in-transition and other underserved populations in the Midwest suggest that properly understanding program participants' learning interests and incorporating them into the curriculum is essential to positive learning outcomes. Through our interviews with women-in-transition and interactions with them via our prior technology education programs, we learned that skills relevant to employment are the most desired type of training they want to receive. This follows from the fact that women-in-transition have difficulty in finding jobs not only because of societal bias against them but also because they often lag behind in terms of experiences and skills required in this digital age. This leads to the vicious cycle of high rates of recidivism and low levels of continuous employment.

Table 2. Sample Course Topics

Level	*Area*	*Sample Topic*	*Sample Hands-on Exercise*
L1: Introductory (online security, information search and verification, etc.)	Searching online	Privacy and security settings with web browsers	Managing web browsing history, browsing in Incognito mode, etc.
		Content search	Searching health/employment information, news articles, pictures, video, etc.
	Assessing online information credibility	Information verification	Checking author's reputation and reliability, the publication's reputation, sources cited and their credibility, publication date, and one's own bias
L2: Intermediate (website building, using social media for professional development, computational thinking)	Digital Media and HTML	How to use digital media for professional development; Introduction to HTML	Developing a foundational vocabulary, exploring relevant resources, etc.
		How to create a simple web page	Exploring syntax rules for reading and writing HTML files, incorporating basic website elements (attributes, headings, paragraphs), etc.
L3: Advanced (data format and style description coding, computational thinking, etc.)	CSS	CSS syntax	Exploring syntax rule-set (Selector and Declaration), incorporating fundamental style sheets (Internal, External, Inline), etc.
		Set up web pages with CSS	Creating a website with three different CSS style sheets.
		CSS styling text, font and properties	Managing CSS fonts, text, links, colors, borders, etc.

As for the teaching strategy, our team developed a weekly session format to be used by multiple instructors to make each lesson consistent, coherent and to easy to follow. Also the instructors were mindful in conducting sessions in an empathetic and respectful manner, and avoided remarks that might hurt the participant's self-efficacy or self-esteem such as 'this exercise is very simple'. In addition to an instructor, there were at least one observer from the project team to support and monitor a session. For iterative processes of improving the program, the instructor has kept a teaching journal reflecting on interactions with participants and participants' reactions in each session. We incorporated computational thinking practices throughout the program, helping the participants understand general analysis of problems through decomposition, pattern recognition, abstraction, and algorithm design. Each weekly session included a small assignment for them to practice the learned skills and for the research team to better assess participants' learning.

Not only participants' learning interests but also levels of existing knowledge and skills are reflected in the program design. At the beginning of the technology education program, participants were asked to take part in a placement interview which includes some hands-on exercises to assess their current technology skills level. Based on interview results, participants were placed into an introductory (Level 1) or intermediate level course (Level 2). After completing the first phase of the program, each successful participant receives a certificate of completion issued by the project team.

Sample topics for courses at different levels are shown in Table 2. We begin with technology-related topics and skills that women-in-transition have demonstrated interest in learning and then introduce them to deeper STEM topics. In covering these topics, we help them understand how experiences with deeper STEM topics such as basic coding principles (both graphical and command line), computational thinking, and elementary computer architecture can empower them to be more efficient creators and users of digital content and information [64, 71]. Most of all, acquiring knowledge and skills in these areas will open doors for furthering their education and gaining employment in various areas, including technician positions and digital communication positions. These skills may also help them access information about their finances and health more efficiently and thus better support their children.

Level 1 topics include online information search and validation, online resume building, online privacy and security, and Microsoft Office Programs. These are popular topics among women-in-transition and are directly relevant to job applications and employment opportunities. Level 2 topics include website building and using social media for professional development as well as computational thinking practices. Our program guides incorporate resources available through Google Computational Thinking for Educators [46] as well as our own examples for our participants to support their development of computational thinking. The Level 3 program, which is currently under development, will cover deeper technology topics including elementary graphical, command line, and script coding and basic computer architecture as well as computational thinking. Coding is considered one of the most important job skills of the future, as an increasing number of businesses rely on computer code [29].

These courses are offered by professors and Ph.D. students in our project team who have experiences in teaching technology for women-in-transition or other marginalized populations. For each level of the program, participants complete weekly readings, lectures, and assignments. When our programming was offered at a public library, participants used laptops rented from the library. Since moving online due to COVID-19, participants relied on their own digital devices. Through our conversations with participants, we learned that most participants used their smartphones to participate in the online education program. To better support program participants' learning online, we have built our learning management system [2] based on an open source learning platform [1]. The features include individual and group communication between instructors and students, use of avatar for privacy, and emoji support for expressiveness. We also avoided some intimidating menu names such as 'Grades' (used 'Progress' instead) and 'Exams', and included 'badges' to encourage step-by-step achievements. We ensured natural accessibility through small mobile devices, and Dynamic Adaptive Streaming over HTTP (DASH) for our participants who solely rely on phones for the Internet access and are with constrained data plan. A screenshot of the LMS image is shown in Figure 1. Instructors communicate participants through our learning management site and text messages. In addition, we created a private Facebook page to encourage interactions among participants. Facebook was our participants' preferred method of communication.

5.2 Program Participant Feedback

While our technology programming is ongoing, here we report some preliminary results from our progress interviews. First of all, our participants demonstrated motivations to continue the program despite COVID-19. They mentioned that participating in the program helped them to stay the course. For example, Alison, 35, said, *"I am now in a place in*

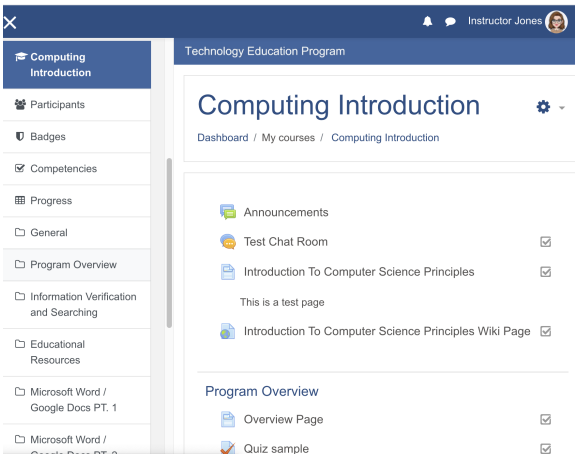

Fig. 1. A screenshot of our learning management system

my life where if I start something, I want to finish it." She credited this motivation to her sobriety and recovery. She said she had the time and energy to continue the program even in the online format and she was wanting to complete the program because she knew it would be beneficial to have a certificate of completion from the program to put on her resume. Other participants also said that they were motivated to continue during the pandemic because they learned helpful skills and also want to earn a certificate of completion. Many participants mentioned that the lessons on online privacy and security including online phishing and scams were *"extremely helpful,"* as those lessons helped them to better protect online. One participant specifically mentioned that she used the knowledge she gained from those lessons when she was trying to purchase a car online. Some participants mentioned that what they learned from the program immediately helped them to make money. One participant, who works as a house cleaner, said her client offered to pay her to help him learn how to set online privacy settings for his digital devices and social media accounts.

Participants mentioned specific challenges they faced due to the COVID-19 pandemic. Throughout the sessions, many participants voiced their concerns that they have to rely on their phones to complete their assignments, as public libraries are closed. For example, Jessica, 27, reported that her Wi-Fi at her home was slow which would sometimes cause her to take longer on lessons than she had anticipated. She also has three younger brothers in her household which sometimes made it difficult for her to find a quiet place to be able to concentrate on the lessons. She also said that she often helps her brothers with their schooling since their schools were closed due to COVID-19 and they are still expected to continue doing their work from home. Several participants mentioned that it was difficult to lose in-person interactions that were available when the technology education program was offered at a public library. They felt that they worked better in a classroom setting because it is easier for them to concentrate and get help right away if they stuck on a problem. Other participants mentioned the difficulty of completing their drug addiction treatment, as narcotics anonymous meetings were cancelled due to the pandemic. They mentioned that they are not receiving support in this area as they did before the pandemic.

Overall, even though the number of participants in our technology education program was smaller due to COVID-19, participants' comments suggest that the program helped them better protect themselves online, become more thoughtful consumers of information online, and even enhance employment opportunities. In particular, as the program

is developed based on thorough research on participants' interests and needs in technology learning, participants reported that they found the content particularly relevant and useful.

6 CONCLUSIONS AND FUTURE WORK

In spite of various efforts for improving inclusiveness and representation of women in computing, to the best of our knowledge, there is little research or programming on computing education for women transitioning from incarceration. This is an important area for further research, especially as the rates of women's imprisonments in the United States have increased in recent decades. Our interviews with women-in-transition in the Midwest enhance understandings of specific challenges and barriers facing these women as they try to reintegrate back into society which has become increasingly dependent on digital technologies. Specifically, our findings show that social psychological characteristics of the women including self-efficacy as well as their precarious financial and housing situations should be properly taken into account in developing a tailored and holistic technology education program for them. The feedback from those who participated in our technology education program suggests that a high retention rate could be achieved when relevant materials are presented to them and they are engaged through multiple communication channels including the learning management site, phone conversations, text messages, and social media platforms such as Facebook. Conducting thorough research to understand participants' interests and needs in learning technology and adopting an interest-driven learning design framework have been essential for our program's success so far. Though the number of regular participants in our program became smaller due to COVID-19, our participants have demonstrated passion for continuing the program as much as they can.

There are several important implications that flow from this project. First, empirical research findings and technology educational materials from this project can inform reentry programs helping women leaving incarceration better adjust to this increasingly digital society. Technology education is particularly important for this population, as 60% of women in incarceration are responsible for primary care of young children [44]. Technology education for women-in-transition can help them educate their own children in the area. Second, this project can serve as a template for developing evidence-based STEM education for other marginalized or underserved populations. Third, online education mechanisms developed under this project inform efforts for scaling up STEM education programs for underserved populations. Multiple demands (e.g., childcare, employment seeking) on participants' limited time make it essential to permit flexible learning hours as offered by the online environment. Finally, since 80% of women with criminal justice involvement are in the community, this project will contribute to community efforts to support women-in-transition.

We plan to incorporate more online learning tools and strategies to scale up our technology education program. Recruiting participants remains as a challenge especially due to the pandemic. However, we have already observed that our program participants encourage their acquaintances to join the education program. Through these peer-to-peer referrals and continued collaborations with community partners, we hope to reach a broader group of women-in-transition. Other challenges and future work include retaining participants for advanced courses on web programming after their successful completion of introductory and intermediate courses, continuing to foster deep computational thinking skills, and supporting their stable employment. Ultimately, we hope that this program will contribute to reducing recidivism.

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