Women of Color in Emerging Technology: Breaking Down the Barriers

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Abstract

These past two years, COVID-19 has added to the industry's gender and ethnic underrepresentation issues. The pandemic's reallocation shock has caused more than 31 million Americans to rely on unemployment. A recent study estimates 32-42% of these layoffs will become permanent, which will be felt more acutely by minority communities. As the pandemic continues to sharpen inequalities in America's economy, nearly eight times the number of women left the workforce compared to men last year. These rates were higher for women of color. To broaden participation and fill a growing need for skilled workers in computing, it is important to consider innovative pathways that delve into untapped pools of talent for training and recruitment. It has been estimated that by 2030, approximately one-third to a half of employees may desire new occupations or may need to either reskill or upskill. Some niches within the computing fields, like emerging technologies (EmTech) (e.g., cloud computing, data science, cybersecurity, and artificial intelligence), are expected to grow job opportunities more quickly than others. The demands of these jobs can only be fulfilled by creating opportunities for one of the largest untapped Science, Technology, Engineering, and Mathematics (STEM) talent pools: adult women.

We conducted a series of four virtual focus groups with 18 adult women of color in total, specifically Hispanic and Black women. These women are (re-)entering the computing field through emerging technology pathways. The goal of the focus group interviews was to identify the reasons for their career and/or educational breaks, barriers they faced and/or are currently facing in their studies and/or employment, and suggested strategies and actions to mitigate these barriers.

In this paper, we present the details of the focus group findings summarized based on the qualitative study. The proposed mitigations voiced by the participants can be used as a baseline to build or increase the pipeline in the computing field by providing a suitable and flexible learning environment for returning and adult women.

Introduction

As technology continues to advance, and computers and robotics are increasingly utilized to automate tasks, demand has risen for employees in computing fields [1]. Between 2019 and 2029, computer and information technology occupations are projected to rise at a rate of 11%, higher than other fields [2]. Apart from needing to develop a skilled workforce, the computing industry struggles to maintain an equal representation of women, especially women of color. Only 25.8% of computer and mathematical occupation employees are women. Among those, only 23.1% are Asian, 8.7% are Black/African American, and 7.8% are Latinx [3].

COVID-19 has added to the industry's gender and ethnic underrepresentation issues. The pandemic's reallocation shock has caused more than 31 million Americans to rely on unemployment [4]. A recent study conducted by the University of Chicago estimates 32-42% of these layoffs will become permanent, which will be felt more acutely by minority communities

[5]. Literature has demonstrated that women who leave school or career often do so because of finances or personal commitments [6, 7, 8]. As the pandemic continues to sharpen inequalities in America's economy, nearly eight times the number of women left the workforce compared to men this year. These rates were higher for women of color [9]. Women are three times as likely to take on household chores/childcare, and as a result have left their career to attend to virtual learning and other pandemic curveballs [9].

To broaden participation and fill a growing need for professionals in computing, it is important to consider innovative pathways that delve into untapped pools of talent for training and recruitment. It has been estimated that by 2030, approximately one-third to a half of employees may desire new occupations or may need to either reskill or upskill [10]. Some niches within the STEM fields, like EmTech, are expected to grow job opportunities more quickly than others [11, 12]. The demands of these jobs can only be fulfilled by creating opportunities for one of the largest untapped STEM talent pools: adult women. Part of the solution is ensuring equitable access to education, training, and mentorship for jobs that are in demand in an environment tailored specifically to returning women [13, 14].

Background

The number of jobs in the United States requiring substantial STEM expertise has grown nearly 34% over the past decade and employers are having trouble filling jobs in occupations that depend on skilled technical workers [need a source]. To address this gap, Syracuse University partnered with Miami Dade College to develop the NSF RESET 2021 conference. The targeted audience was (re-)entering women who have returned to the workforce or engaged in non-technology industries looking to enter and fill computing/tech jobs nationwide through preparation for EmTech field.

The NSF RESET conference aimed to explore and discuss challenges encountered by returning women with the objective of better understanding their situations and identifying solutions to their problems in accessing EmTech education and employment (see Figure 1).

Objective 1: Identify barriers for returning women to enter EmTech education and workforce

Objective 2: Inform best practices to create effective re-entry strategies in EmTech for returning women

Objective 3: Connect with scholars, policy makers and leaders to make change in the EmTech fields
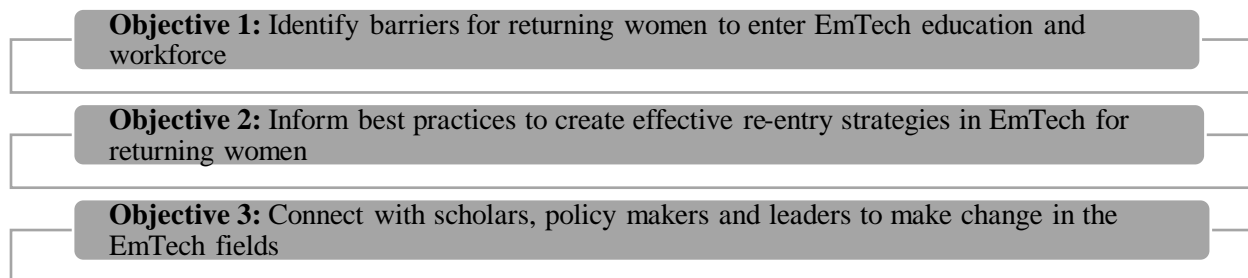
Figure 1. NSF RESET Conference Objectives

The theme topics of the sessions were drawn from these objectives, which included, but not limited to [15]:
- Current state of computing/technology
- Curriculum initiatives
- Upskilling and reskilling in EmTech

- Non-traditional paths in EmTech
- New initiatives for tech diversity
- Diverse routes to EmTech
- Tech re-entry lessons learned
- Women tech initiatives
- Work ethic for the 21st century workforce

Additionally, a series of virtual hands-on labs in EmTech fields and technical interview preparation workshops were provided on the last day of the conference with a focus on:
- Mastering the tech interview
- Winning virtual interview
- Introducing CI/CD with Google Cloud Build
- Introducing data science and visualization in healthcare
- Building a Chatbot with AWS Lex
- Preventing cyber-attacks with cryptography, forensics, and web exploitation
- Assessing trustworthy AI with Z-Inspection®
- Securing and privacy-preserving of data-driven systems

The three-day conference took place on March 4-6, 2021 with 62 women tech speakers, 38 sessions, and 444 registrants, including 216 student participants, in the computing/EmTech fields. It was a conference for women, by women to women. The presenters and invited participants were from the National Science Foundation, academia, industry, social science and policy fields, and support organizations.

As a part of the evaluation and assessment of the conference, there were three primary data collection point, which consisted of: (1) post-session surveys for all conference sessions; (2) post-conference session survey; and (3) focus groups. For this paper, we are reporting the key findings of the focus groups discussing participants' experience attending the conference and their perspectives on career breaks for women in computing/EmTech fields.

Research Methodology

Focus Group & Analysis
The virtual focus groups took place in April 2021 with volunteers who attended the conference. Four focus groups with a total of 18 attendees participated in the 90-minute focus group (see Figure 2). Focus groups were semi-structured with a majority of open-ended questions and probing, conversational inquiry. Participants signed up to the focus groups based on their availability.

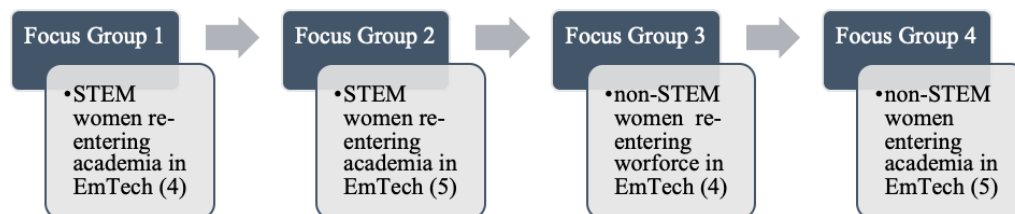| Focus Group 1	Focus Group 2	Focus Group 3	Focus Group 4
•STEM women re-entering academia in EmTech (4)	•STEM women re-entering academia in EmTech (5)	•non-STEM women re-entering worforce in EmTech (4)	•non-STEM women entering academia in EmTech (5)

Figure 2. Focus Group Participants

Data collected from the focus groups was analyzed using a general inductive thematic approach. This approach was selected because it is particularly useful in drawing links between research questions and data collection results. Emerging themes were developed through a review of the notes taken during the focus groups according to the coding frame. Following this initial development of these themes, the Evaluation Team reviewed the results, adding contextual details and examples. To solidify and strengthen the credibility of the findings, the Evaluation Team relied on triangulation and collaborative inquiry.

Limitations
Qualitative research methods offer good insights, but are, by nature, partial and biased. To attempt to address this limitation, the Evaluation Team took advantage of an opportunity embedded in mixed-methods evaluation, the triangulation of data [16], [17]. Triangulating results from multiple sources, such as comparing findings among multiple stakeholder interviews and with documents reviewed, creates more credible evaluation results, and is considered critical to the validity and reliability of findings [18]. Findings that have been corroborated through triangulation tend to be sufficiently robust and credible [19].

Selection bias is inherent in the sampling methods deployed for the focus groups. To address the threat of non-response, the Evaluation Team relied on the program leadership to recruit participants for the focus groups. This approach introduces the potential for research participants to be selected based on their willingness to speak favorably about the program. Neutral and critical feedback from participants, however, supports the notion that these research participants were chosen primarily for their willingness to participate rather than the likelihood that they would cast the program in a favorable light.

Key Findings - Outcomes and Discussions

Reasons for an Educational Breaks for Women in Tech Fields
Participants reported that family obligations were a common cause for women who took breaks from educational pathways in tech industries. One participant explained that women often must choose to return to school while juggling other obligations, which is not a choice that all are able to make. "Our lifestyle [can be a barrier], most of the time, if you have children, you have a home that you have to maintain and things that you have been accustomed to over certain period of time, and then, when you decide to go back to school [...]," elaborated one participant when explaining why family obligations may be a barrier for some women. One faculty member who attended the focus group echoed these challenges and noted that some of her students have had to balance both students and school at the same time. "I've had students who have brought kids to exams [...] because they've had to take care of them," she reported.

Participants also noted that when returning to school after a prolonged break, they had to relearn how to be students and how to study. Others explained that, particularly for women, there is a negative perception about STEM education and to how succeed in this field of academia. "I saw women, both young women and also those who are not just straight out of high school, were fearful of math and science," explained one participant. "A lot of people that I tutored would say, 'This is not my favorite subject.' It's hard for a lot of people to see the application of what their education is doing for them." Additionally, participants discussed that the ever-evolving fields of

STEM and technology move forward rapidly and feeling of being left behind could be a daunting barrier, especially without embedded supports. "If you missed two years, that's it, you're obsolete. You need to get back on that horse, and fast, but there's not a lot of people out there telling you 'you're going to make it. You're going to get through this.,'" explained one participant.

Reasons for a Career Breaks for Women in Tech Industries
Participants reported that they struggled with being perceived as qualified, or perceiving themselves as qualified, for the jobs they are applying for after a career break. "One of the challenges is just being taken seriously and understanding that you are knowledgeable of the job you're trying to pursue and that you're committed to being a part of this new community [...] a lot of people dismiss your thoughts and ideas based off of the fact that that you didn't come from some long line of computer engineers [...] and you may have started the community college level and worked your way up." Additionally, participants expressed that woman seeking jobs often pursue openings for which they meet all the qualification requirements, whereas their male counterparts may not hold themselves to the same standard. "Women try to check off every qualification [...] they make sure they have the right years, they have the certifications, they have everything that's on the list for the job requirements. Whereas male cohorts are like, 'I don't care if I have it, I just want the job because I know that that job is going to give me a better salary. I am going to fake it 'til I make it.' But women don't have that perspective, I think it holds them back," explained one participant.

Similarly, participants reported that they struggled with how to explain career breaks or changes in career on their resumes, and that in some cases the resume screening software that many companies use will reject resumes due to that gap. "The technology field is constantly changing," reported one participant, "so that gap you have in your work history or education, it is being viewed as a hinderance to you being current with what's going on." Another elaborated, "I have been out of the tech field for about 10 years, and I do work with technology on a day-to-day basis in my current job, because of all the databases that we use and the research that we do, but on my resume [...] the last time I worked in an IT field was 10 years ago. It definitely comes with a perception."

During focus groups, participants cited the lack of flexibility in work schedules as a barrier for women who have familial obligations. "The most challenging part of finding a job was childcare," explained one participant, "how do I get done by 3:30pm so I can get home in time for the school bus to drop off my kid?" Another noted that in many cases, even women who have job offers may have to take a less appealing offer due to their need for flexibility in their schedule. A participant shared that a colleague who had a child when interviewing for a job had to consider more than just the salary of the offer to decide to re-enter the workforce. "She had to be really careful, she had three job offers, and she didn't take the highest paying one," the participant shared. Another noted, "the opportunity to on-the-job training is difficult, and trying to balance a 40-hour work week and then my home responsibilities has been an uphill challenge for me." Participants also noted that women with family obligations may have less flexibility to relocate for a job, as they may lose their local support networks. "Some women have challenges in moving upwards [in their careers] because they may not have the flexibility to move [...] their support groups and care for their children goes away if they relocate," explained one participant.

She also noted that many working women rely on family or neighbors to assist with childcare, bus stop pickup, or other supports.

Focus group participants also noted that racism, sexism, and ageism may be barriers for women reentering STEM careers. "When women take time off, when they go back, their supervisors are 25 years old [...] there's a lack of understanding for your situation because you're coming back older and it's kind of discouraging," explained one participant. Another noted that they experienced sexism in technology fields, "I have a PhD behind my name, and I still have students challenging me because I am a woman," one reported, "and they would never do that to male professors." Another wondered if her ethnic last name may become a barrier when seeking job opportunities in the future, "I have a Latino last name, a very Hispanic last name, and I just wonder if that will be a hindrance for me as well."

Mitigating Barriers for Women in Computing and Tech Fields
If barriers are reduced for women entering or re-entering computing/EmTech of study and employment, participants noted that women would have more opportunities to succeed in their careers. One participant expressed that reducing barriers for women would allow them to have options and opportunities that they would not have had otherwise. "It would give them a choice," explained one participant, as "they can choose [a job] where they pay is higher, or on the other hand, if they want to have more vacation time because they know that their summers are busy, for example, they could pick a job environment with that, instead of saying 'Oh, I have to take this job because I've got to be home for the bus drop off.'" Focus group participants also reported that mitigating barriers would help to increase representation of women in the computing/EmTech workforce. "Women are in the minority [...] so I think that if a lot of these things were put in place, it would definitely increase the pipeline for females. I know that [companies are] talking about things that they're doing in diversity and inclusion programs, and things like that, so this would be a big push for widening that pipeline," stated one participant.

Suggested Strategies and Actions that Academia and Industry Could Take to Mitigate Barriers
Several key suggestions from the focus group respondents provided feedback on the ways in which academia and industry could create a smoother transition for women entering or re-entering computing/EmTech fields. Sample responses are provided for each suggestion.

Academia could help mitigate barriers for women in STEM or technology fields through acting on the following recommended strategies:

- Provide flexibility in scheduling

"Under certain circumstances, students can do remote work and they can succeed. We have had the ability for students to be remote [during the pandemic] and it worked out great for them [...] we can do more."
"They could offer more remote resources and extended mentoring/office hours."
"Just working with students to arrange exam times would be helpful. Having core classes scheduled when childcare is available would be a great help. Recording lectures, like we are doing due to COVID, would be a great help to parents during spring break and other times when K-12 students are home and universities aren't."

- Increase pathways into computing/EmTech education

"I see more and more certificate programs, either beyond or within the bachelor's level."

"Offer more courses for women interested in reskilling or upskilling. Offer micro-credentials or certificate, and hands-on activities."

"Provide more customized programs than one-size-fits-all degrees."

- Create more connections to industry partners

"Academia has two sides. One is they teach you the knowledge and help you develop your skills, but they also have another side [...] that's the connections to companies. I see them as a connector."

"Partner with businesses in the computing/EmTech fields to offer students exclusive opportunities."

"They could employ more women in computing/EmTech positions. They could provide more women lead research opportunities in EmTech and provide more internships for women."

- Provide mentoring

"To see other women involved in computing/EmTech make those that are coming after them to be encouraged and reduce the mental pressure because they are role model to keep up."

"Provide mentors who truly understand the mindset and concerns we face about re-entering and create a clearer set of expectations for us."

"More program and networking opportunities to present to women how they can accomplish the re-entry into computing/EmTech fields."

- Improve student culture for women

"Academia could promote diversity in computing/EmTech fields by not simply marketing to women but including them in the field."

"More opportunities like this conference."

"Promote a more respectful culture, especially for women. Breaking stereotypes."

- Offer more support, like scholarships, to women

"They can offer more equitable practices [...] so if there's a student who needs a resource, and without that resource they cannot go to college, maybe it's a laptop or help with tuition, they can help with that."

"Scholarships tailored to women and minorities."

"Financial incentives that pay for certifications, learning materials (books and software), technology (supply new laptops), and hardship stipends that cover miscellaneous costs such as childcare, internet bills at home, etc."

Academia could help mitigate barriers for women in STEM or technology fields through acting on the following recommended strategies:

- Increase flexibility in work environments

"A more flexible work environment [...] flexible becomes more family friendly."

 "Companies should provide on-site daycare facilities."

"Consider more female friendly working conditions (mainly, flexible hours)."

- Instill a willingness to take a chance on less-traditional candidates

"When you submit a resume, applicant tracking systems don't handle a break well. People who are returning to work or who are looking to switch have a lot of enthusiasm and energy to do this, and they really want to make this work out [...] so being more open to people from alternative backgrounds and not only from traditional routes."

"Look at people holistically. Credentials like certifications and degrees are not always indicators of success. Change interviewing strategies: don't grill folks on technical questions. Support folks like you want them to succeed in a technical interview: coaxing answers via leading questions is a gentler approach to ensure women can give their best. Peer feedback is that, at times, that an interview can sound like an interrogation."

"A standard would be great. A lot of jobs ask for a specific year count of experience, but that isn't useful. [...] A company might not know what they really need. A lot of people go through boot camps instead of traditional degrees, but a lot of jobs still ask for a bachelor's degree."
- Provide more mentorship and at-work advocates for women

"Give more advice and information on how to go about becoming successful in entering the workforce in computing/EmTech fields and sharing any opportunities that colleges we attend may not otherwise share."

"Provide more networking and mentoring opportunities and partner more with education institutions even though it isn't always all that easy."

"Creating support programs for these women to have others like them as help."
- Create returnship and apprenticeship opportunities for on-the-job learning

"Developing programs like IBM that help women re-enter the computing/EmTech fields."

"I believe apprenticeships are an amazing way to allow many people to enter or re-enter computing/EmTech fields. It would help industries find capable and driven people quicker to fill the roles they desperately need people for."

"More returnships for women who do not have a computing/EmTech background! I have a B.S. in chemical engineering, but I do not have the coding/tech skills. I would love a returnship where I could develop those skills and have a cohort to work with and then work in tech."
- Drive a company culture change:

"I think some awareness of internalized bias in hiring managers is necessary."

"Give women more respect in the computing/EmTech space. Giving more managerial roles in the industry creates representation."

"Educate employees on toxic stigmas associated with women (especially women with children) re-entering computing/EmTech and how to mitigate these stigmas."

Conclusion

Focus group participants reported key barriers, both from their own lived experiences and from what they learned in conference sessions (see Figure 3). Meaningful recommendations were provided by the NSF RESET conference attendees in focus groups to inform the field of ways to better support re-entry for EmTech women into both academia and industry settings. Throughout the focus group data, participants noted the value of the connections they made with other attendees and presenters, the importance of networking, and the ways in which an intentional network of support is meaningful as they further their pursuits in the field.
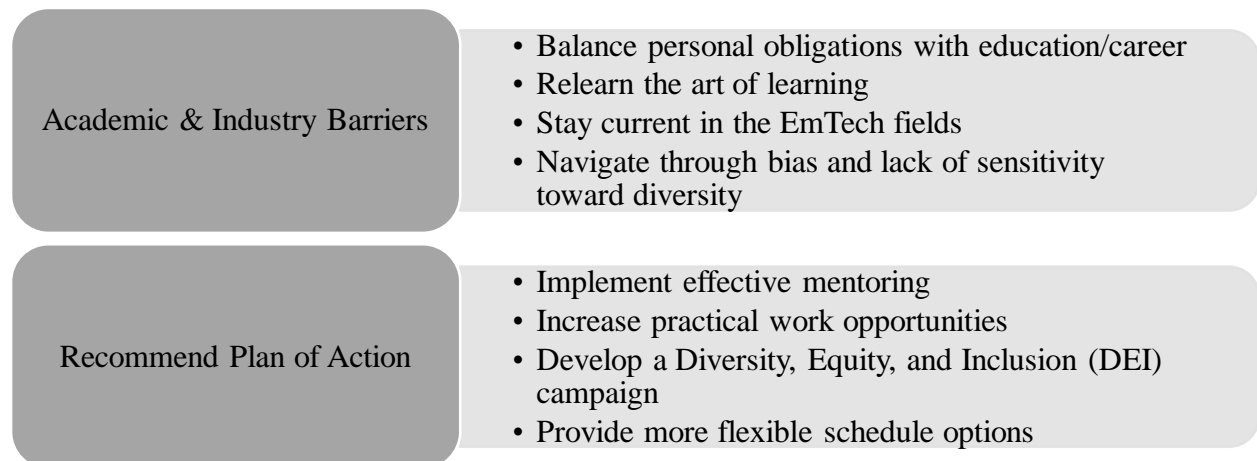
Academic & Industry Barriers	• Balance personal obligations with education/career • Relearn the art of learning • Stay current in the EmTech fields • Navigate through bias and lack of sensitivity toward diversity
Recommend Plan of Action	• Implement effective mentoring • Increase practical work opportunities • Develop a Diversity, Equity, and Inclusion (DEI) campaign • Provide more flexible schedule options

Figure 3. Focus Group Findings Summary

Acknowledgements

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