

Reskilling and Upskilling Women in Emerging Technologies for the Future of Work

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Abstract: With the COVID-19 pandemic causing more than 31 million Americans to rely on unemployment, nearly eight times the number of women left the workforce compared to men the past two years. This growing inequality in America's economy opens an opportunity to broaden participation in computing by tapping into one of the largest untapped sources of talent today, which is the pool of women re-entering the workplace and/or academia. A recent study has shown that by 2030, about 50% of the employees may seek a career change or need training for reskilling/upskilling in their industry sector. Additionally, with the rapid employment growth within the computing fields, especially emerging technologies (EmTech) (e.g., cloud computing, data science, cybersecurity, and artificial intelligence), the demands of these jobs can only be fulfilled by creating opportunities for adult women. In March 2021, we hosted a three-day virtual conference in EmTech with 38 sessions, 63 women speakers across the industry sectors, 444 women registrants, and 2,125 total views across all the sessions. In this paper, we summarize the key findings pertinent to conference sessions' satisfaction and recommendations to provide insights and give a voice to (re-)entering adult women in the computing and technology field through upskilling and reskilling with the emerging technology gateway.

Introduction

As technology continues to advance, and computers and robotics are increasingly utilized to automate tasks, demand has risen for employees in computing fields (National Academies of Sciences, Engineering, and Medicine, 2017). Between 2019 and 2029, computer and information technology occupations are projected to rise at a rate of 11%, higher than other fields (U.S. Bureau of Labor Statistics, 2020). Apart from needing to develop a skilled workforce, the computing industry struggles to maintain an equal representation of women. Only 25.8% of computer and mathematical occupation employees are women.

COVID-19 has sharpened the existing industry gender gap. The pandemic has caused more than 31 million Americans to rely on unemployment and its attack on the labor market has impacted millions of women who have either lost jobs or left workforce voluntarily due to many unprecedented circumstances (U.S. Department of Labor, 2020). Literature has demonstrated that women who leave academia or workforce often do so because of financial constraints or personal commitments (Dwyer, Hodson & Mccloud, 2012; Khanam, Quraishi & Nazir, 2016). Nearly eight times the number of women left the workforce compared to men the past two years. Women are more likely to take on household chores/childcare, and as a result have left their career while switching to remote learning and taking care of other pandemic curveballs (Tappe, 2020). Women who are now making their comeback to the workforce are struggling to find relevant jobs that suit the demand and need of their life. Furthermore, returning women, very rarely choose to pursue computing education or cannot get into the computing profession due to several reasons (National Research Council, 1994; Clark Blickenstaff, 2005; Hill, Corbett & St Rose, 2010). The fast-growing demands of jobs in the computing field, especially EmTech, can be fulfilled by creating opportunities for one of the largest untapped STEM talent pools, which is 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 (Rahman, Billionniere, Marshall, Seo & T. Forman, 2021; Rahman & Billionniere, 2021), regardless of their technical background.

Background

The 2021 NSF RESET conference, a three-day national virtual conference, was held on March 4-6, 2021. It consisted of 38 sessions and 62 women speakers who presented during the conference. There were 444 women registrants, including 216 student participants, and 2,125 total session views. Due to the demands for millions of EmTech jobs across the industry sectors, it is important to understand the barriers and challenges faced by returning women to (re-)enter EmTech fields for better understanding their situations and identifying solutions to their problems in accessing EmTech education and employment. With such purpose, three main objectives were highlighted in Figure 1.

Research	• Identify and understand some of the (existing and new) issues and unique challenges that women (re-)entering EmTech education and workforce face
Inform	• Generate and share best practices and resources to equip women for EmTech education and future-ready workforce
Connect	• Network and collaborate with scholars, policy makers and leaders to make change in EmTech

Figure 1. NSF RESET Objectives

From these objectives, the conference brought together industry leaders, community partners, faculty, students, and community members to bring awareness and support the development of adult women talent pipeline in EmTech fields to stay competitive in the new global, innovation economy. Furthermore, the conference technical sessions aim to bring EmTech abilities to women and provide steadfast support during and after the conference. As a result of the conference, we developed actionable recommendations for actions that industry, academia, non-profit, policymakers and government agencies, can take to strengthen the pipeline for women (re-)entering into computing and technology domain (Rahman & Billionniere, 2021). In this paper, we focus on the qualitative and quantitative results on conference sessions' satisfaction level and impact to empowered (re-)entry women to take their future in their own hands by aligning their education and/or career with emerging and future technologies.

Research Methodology

The study methodology included two main data collection components: anonymous post-sessions surveys and the session chat transcripts for all conference sessions. The evaluation focused on session satisfaction based on content and resources as well as on meaningful recommendations to better support re-entry for EmTech women into both academia and industry settings. The number of participants included in each of the data collection sources are provided in Table 1.

Table 1. Participation in data collection for NSF RESET conference

Assessment Instrument	Data Collection
Post-Session Surveys	1360 responses
Session Chat Transcripts	At least 127 unique attendees actively* contributed

**Attendees who engaged in meaningful conversations*

Part of the evaluation included a post-session survey that was administered to conference attendees for 31 out of the 38 conference sessions (daily opening and closing remarks sessions were not surveyed). 1360 responses were provided by attendees. To develop the survey, the Evaluation Team first referenced priorities and goals of the surveys discussed during the project launch and reviewed the evaluation questions pertinent to the conference goal. The Evaluation Team then generated survey questions, and once finalized, the survey was transferred to the conference virtual platform, Whova, and reviewed again for final edits. The survey was assigned to the appropriate sessions within the platform. The survey was embedded into the system and was administered to attendees after the sessions. The surveys were closed two days after the conclusion of the conference. Once the surveys were closed, data was exported from the Whova platform into Excel for analysis. Frequencies (i.e., the number of times a value occurs) and percentages were identified for closed-ended responses. The post-session surveys used the same eight questions for all sessions, which included five multiple choice questions (Q1-Q5) and three open-ended questions (Q6-Q8), as follows:

- Q1. Please rate your level of satisfaction with this session.
- Q2. This session increased my knowledge/understanding of computing education and workforce.
- Q3. This session has made me more interested in pursuing education or a career in the computing disciplines.
- Q4. The presenter(s) was/were engaging.
- Q5. I will be able to apply key takeaways from this session to my own life.
- Q6. What are your biggest takeaways?
- Q7. Any other topics that could have been covered in this session?
- Q8. Additional Comments

The session chats were available and open for all session attendees to ask questions, comment on the content and resources, and provide recommendations. Additionally, attendees also commented on each other's comments to share their own experiences and opinions. For this study, we only analyzed the recommendations made by the attendees by coding the Zoom chat transcript text files.

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 (Brewer & Hunter, 2006; Denzin, 1978). Triangulating results from multiple sources creates more credible evaluation results and is considered critical to the validity and reliability of findings (LeCompte MD & Schensul, 1999). Findings that have been corroborated through triangulation tend to be sufficiently robust and credible (Harry, Sturges & Klingner, 2005).

Key Findings - Outcomes and Discussions

Conference attendees were overall very satisfied with the sessions they attended. 27 of the 31 sessions that attendees completed post-session surveys for had a satisfaction of rate of 90% or greater (see Figure 2). Additionally, six of the conference sessions has 100.00% satisfaction rates:

- Exploration of Intersectionality and Computer Science Demographics: Understanding the Context of Shifts in Participation
- EmTech Education and Skills
- Training the Trainers: Faculty Professional Development for Newer Programs in EmTech
- Non-Profit Organizations Role in Diversifying the Future Tech Workforce
- Google #IamRemarkable
- Secure and Privacy-Preserving Data-Driven Systems.



Figure 2. NSF RESET Sessions' Satisfaction Rates (n = 1360)

The challenges of women re-entering the workforce are disproportionately in need of upskilling or reskilling for EmTech high demand roles. Seven strategies have been drawn from the assessment outcomes to strengthen the pipeline, for returning women, to upskill or reskill in future-ready skills.

Certifications. Technical and/or industry certifications should be encouraged, and resources should be provided to learn, train, and certify.

- “Certifications are a good way to close that bridge for people who cannot or do not wish to go through school whether for time or money purposes.”
- “Getting a certification in one of the leading cloud technologies, like AWS, would be great to boost my application”
- “Certifications are reachable and can be a great addition to the resume, and the talk made certifications seem less daunting.”

Returnship programs. Programs, like return-to-college or back-to-work, that provide field relevant competency-based education and training should be made more widely available and promoted.

- “I learned about apprenticeship opportunities that are available with companies like IBM and about online education courses that is offered by AWS and Microsoft. I will use this information to my benefit.”
- “My biggest take away from this session were the knowledge of different nonprofits and their initiatives to workforce development training, mentorship, building visibility for women of color and more. I learned that women resumes are often overlooked due to large career gaps, which I suffer from, but I learned that I could add reasons for the gaps on my resume. It is important to be a member of these education programs because they focus on making resources affordable and accessible especially to minorities.”
- “Re-entry programs, like the one from IBM, offer free courses and hands-on practice to master skills”

Academia-industry partnerships. More effort should be made to form sustainable academia-industry partnerships.

- “[...] there are many opportunities and pathways towards a career in computer disciplines; my options are not limited, and my goals are very possible. I need only utilize the proper tools and opportunities for my benefit.”
- “The work environment is moving more towards remote working for Tech/computing fields. And that major companies like Amazon, IBM and Microsoft are getting creative with the ways they are allowing workers entry into the job positions.”

- “I did not know how much big tech companies were placing a lot of value in helping communities to learn programming/coding skills. Top 500 companies like Microsoft, IBM and Amazon have so many resources to help us obtain those skills. I will definitely be following up with a lot of those websites.”

Bridge programs. Conversion programs that offer alternative pathways for individuals with no prior computing education should be created.

- “A bridge program that can increase the diversity of the future CS workforce. People with no STEM background can go through the bridge program to step into a CS career.”
- “I like the idea of the bridge program for students from other disciplines. In our department we do have a problem with students who have undergraduate degrees from other disciplines as they have to take too many deficiency courses. Having a similar bridge program would definitely help.”
- “I learned so much from the different speakers on how being a mom and having those skills can transition into tech. Studying tech is super hard, but they definitely dropped some knowledge on how to see everything we do in tech and at work we do it for our kids directly and indirectly. We want to make the world a better, more secure place for our future generations.”

Hackathons. Friendly contests or competitions encourage collaboration and tinkering that can lead to holistic development and new idea germination.

- “Hackathons can be a way to practice strengths and learn from mistakes in a social environment.”
- “I am honestly inspired to attend a Hackathon now due to the disproportionate representation. I want to see what the experience will be like for me and hopefully help to change the format for other women with children.”
- “There are virtual hack-a-thons and all female hack-a-thons. These events should not be daunting to women but more engaging and the space should be safe for women to participate.”

Bootcamps. Informal training can be the catalyst for returning women to attain computing jobs and careers.

- “[...] the resources that were shared [on] pathways, access to free or low-cost education were fantastic! I couldn't have asked for more, I didn't even think we would have access to so many resources but for a stay-at-home mom like myself without a degree who might think that attending college for a degree is a long-term goal, [bootcamps] have opened my eyes to ways that I can upskill myself and gain the necessary knowledge I need to achieve my short-term goals.”
- “[...] Accenture is providing an amazing bootcamp program; people like myself can be a part of it to receive the appropriate cloud knowledge and skills. I have no previous exposure to Cloud, and this broadened my understanding of what it takes to be a well-rounded computing student.”
- “There are many non-profits that provide resources to meet the needs of women who are in varying phases of their academic and/or professional careers. Some non-profits offer free resources, such as bootcamps, while others rely on low-cost memberships.”

Reward strategies. Incentivized women in forms of schedule flexibility, free (leadership) training programs, and achievements based on rewards should be introduced.

- “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.”
- “Reevaluate incentives as there is a growing interest in remote work, especially for women who have children like myself, and so an increased focus on workplace flexibility and how this ties to reward and talent strategies should be made more transparent.”
- “The opportunity to on-the-job training is difficult and trying to balance a 40-hour work week and then my home responsibilities have been an uphill challenge for me. Also, there are some challenges in moving upwards [in my career] because of the lack of flexibility to move [...] my support groups and care for my children goes away if I relocate.”

Conclusion

The NSF RESET conference met its three main objectives, and participants were very satisfied with the event itself and the ways in which it empowered them to think more proactively about investing in their future with EmTech so they can take advantage of the exciting new jobs being created in the United States. Participants also reported that they learned first-class EmTech literacy via degree programs, professional development initiatives, and network opportunities with business and industry leaders looking for new talent. The knowledge and skill set in

EmTech will equip them to compete in rapidly changing career landscape. The presenters, the networks established, and the knowledge they gained from the sessions will benefit them as they begin or further their journey in computing education and career through EmTech moving forward.

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