



Brite Case Study: Exploring Girls' Experiences with Diverse Women STEM Role Models in an Online Setting

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Literature Review

The Inequities in STEM

Women, particularly Black, Latina, and Indigenous women, continue to be underrepresented in science, technology, engineering, and mathematics (STEM) fields at the college and workforce level (National Center for Science and Engineering Statistics, 2021). Black, Latina, and Indigenous women make up approximately 17% of the U.S. population (U.S. Census Bureau, 2020), and while they earn 14% of the bachelor's degrees in STEM fields (National Center for Science and Engineering Statistics, 2021), they represent less than 10% of the STEM workforce (National Center for Science and Engineering Statistics, 2021). The greatest gender disparities across the STEM workforce occur in the fields of computer sciences, engineering, and physical sciences (National Science Board, 2022). In turn, women, most notably Black, Latina, and Indigenous women, are disproportionately excluded from high-paying sectors, and these sectors are deprived of their diverse perspectives and experiences, which could lead to greater advancements (Hill et al., 2010; Master et al., 2016).

The inequities across STEM disciplines in higher education and the workforce are not the result of gender, racial or ethnic differences in abilities. Instead, differences exist for girls of color in their perceived sense of belonging and perception of future success in STEM, beginning in the middle school years (Archer et al., 2013; Calabrese Barton et al., 2013; Farland-Smith, 2015; Kang et al., 2019; Tan et al., 2013). These differences are largely rooted in the intersectional inequalities of gender, race, ethnicity, and class, operating within a larger system of patriarchy and systemic racism (King & Pringle, 2019; Wing, 1997), which often discourage or hinder girls' identification with and participation in STEM (Archer et al., 2012; Carlone et al., 2015; Kang et al., 2019; Ladson-Billings, 2006; Tan et al., 2013).

Engagement with Diverse Women STEM Role Models

Research shows that engagement with diverse women STEM role models can yield a variety of positive outcomes for girls and young women, including shifting perceptions about who belongs in STEM, facilitating the development of STEM identity, and increasing awareness of STEM fields, however, there is a lack of clarity on how this transfers to an online setting.

Engagement with diverse women STEM role models can shift girls' perceptions about who participates in STEM. When girls interact with role models from diverse backgrounds and various STEM disciplines, this can challenge gender and racial stereotypes about who belongs in STEM (Hughes, et al., 2013; Hughes et al., 2020; Jethwani et al., 2017; O'Brien et al., 2016). Hughes and colleagues (2013) found that exposure to diverse role models, especially those underrepresented in STEM, and participation in or witnessing their research, helped girls to expand their perspectives of STEM professionals and careers.

Interaction with women role models can also yield a variety of positive outcomes related to girls' STEM identity development, including positive shifts in girls' attitudes, increased interest, a greater sense of belonging, improved self-concept in STEM, and a greater sense of fit in STEM (Farland-Smith, 2015; Hughes et al., 2013; Jethwani et al., 2017; Kessels 2015; Levine et al.,

2015). Role models can demystify the association of STEM and masculinity, and in turn, foster positive identification and attitudes with STEM. Kessels (2015) found that exposing girls to women STEM role models weakened the association between STEM and maleness, which positively shifted girls' attitudes toward STEM subjects and resulted in stronger implicit identification with STEM. Moreover, when girls relate and perceive similarities between themselves and a role model, this can shape their beliefs about being successful in STEM (Cheryan et al., 2011; Dasgupta, 2011; Lockwood, 2006).

Lastly, role models can provide a more “authentic understanding of STEM careers”, helping girls see the diversity of career options (Broadley, 2015) and countering stereotypes of STEM fields, such as computer science as “isolating” or “rigid” (Jethwani et al., 2017). Studying a cybersecurity summer program for girls, Jethwani et al., (2017) found that engagement with women role models showed the field as fun and collaborative and contributed to girls' increased interest in the field. Girls referred to the women as “powerful” and “inspiring” and “really relatable” (Jethwani et al., 2017).

Although research shows that role models can have a positive impact on supporting and encouraging girls in STEM, there is a lack of clarity on how this transfers to an online setting. While much attention in the past decade has been paid to the various ways in which young people are engaged in learning online (Kardefelt Winther et al., 2019; Pew Research Center, 2021), and some of this research has looked explicitly at issues of identity and community (Erstad & Sefton-Green, 2013; Ito, et al., 2018), minimal research has focused specifically on girls' online engagement with women STEM role models and its potential for encouraging and supporting girls in STEM. Given the rapid move to online learning instigated by the COVID-19 pandemic, the expected continuation of online learning, and the possibilities for connecting with diverse girls around the country through online programming, it is timely and critical to explore girls' online engagement with diverse women STEM role models.

About the Brite Program

Brite was an online program for self-identifying girls ages 13-16, which centered on collaborative learning with diverse women STEM role models. The program was organized around two themes: Art x Science, featuring role models and activities at the intersection of art and science; and Dream Big, Take Risks, featuring role models and activities that introduced girls to pioneering, interdisciplinary careers in STEM.

The Brite program was implemented during two weeks of the summer of 2021, with three hours of programming each day from Monday-Thursday. Each day of Brite, participating girls (approximately 80 girls from diverse racial, ethnic, and socioeconomic backgrounds) came together via Zoom to learn and interact with role models for 60 to 90 minutes. Role models shared the personal and professional aspects of their STEM journeys: the risks taken, the challenges encountered, the excitement and enjoyment they have for their work, and the twists and turns in pursuing a STEM career. The role model interaction was designed guided by (and role models were trained in) gender equitable and culturally responsive approaches to STEM learning. Role models' intersectional identities and the interdisciplinary aspects of their STEM journeys were an intentional part of the program's design.

About the Case Study and Methods

This Brite Case Study aims to demonstrate how girls perceive and experience engagement with role models in an online setting, and to unpack factors which make the experience meaningful to them. We explore how girls derive meaning from an online role model experience, employing a qualitative analysis (content analysis) and an intersectional feminist lens, placing girls at the center of analysis: Considering the unique ways girls experience STEM due to their gender, ethnicity, race, and socioeconomic status. This exploratory study will contribute knowledge to the field related to integrating online STEM role models into programming, their potential impact, and key factors to consider to optimize impact.

Methods

The Brite Case Study consisted of four focus group sessions with a total of ten participants. Each focus group included three members of the research team; two conducted the interviews and one recorded notes. Focus group sessions took place over a two-week period in August 2021, following the end of the Brite program, and each lasted between 30-50 minutes. Focus group participation was entirely voluntary; participants were identified by program leaders in three of the participating Brite Groups.

Case study participants were asked the same series of questions related to the Brite role models they interacted with during the two weeks of the Brite program:

1. How would you define a role model/ What do the words role model mean to you?
2. What do you think makes the Brite role models 'role models'?
3. How did talking with and listening to the Brite role models make you feel?
4. Did you learn something new or surprising when talking with the role models?
5. What was your favorite aspect or highlight from the Brite role model talks?
6. Are there STEM topics or careers you are interested in learning more about after talking with any of the role models?
7. Other than talking with the role models through the Brite Talks and Brite Fests online, what other ways would you like to interact with role models and why?
8. Do you have anything else you would like to share?

Focus group transcripts were reviewed and clarifications and edits were made as necessary. Content analysis was conducted on the focus group data, resulting in the coding of **twelve topic areas**, including interdisciplinary/unique STEM careers or topics, the journey of role models, role models being an example or inspiration, taking risks or overcoming challenges, and learning something new.

Further analyses of focus group data resulted in the identification of two core themes:

- Brite participants value learning about interdisciplinary and diverse STEM career pathways taken by role models; and
- Brite participants find meaning in and relate to role models' personal and professional journeys.

Summary of Findings

Theme 1: Learning about interdisciplinary and diverse STEM career pathways taken by role models was meaningful to girls.

Findings related to the first theme center on the interdisciplinary nature of and diverse pathways of the role models' careers. Case study participants reflected on how role models combined multiple careers or disciplines, including combining STEM with the arts. Participants emphasized how they learned of new career pathways and discovered how some pathways are not linear. In addition, to the diversity of careers, participants also reflected on the diversity of role models, in terms of race and ethnicity and expressed positive feelings related to their interactions with role models who have interdisciplinary careers.

For example, focus group participant 10 expressed how she was inspired by a role model's nonlinear career path, which involved a combination of disciplines she herself is interested in but did not know she could combine:

"I just kind of thought it was pretty cool that she was able to combine art, science, and entertainment, and personally those are three fields I'm really torn between right now. So, I was, it was kind of cool that she combined all of them to make her own journey. And how she showed that the path to some STEM career isn't always straight. That was pretty inspiring (Focus Group Participant 10).

Focus group participant 4 shared how she learned something new and looked up to a role model who combined two seemingly unrelated interests of painting and space:

"...the astronaut who was able to take watercolors up the space, that's not something you see every day. And maybe a girl wants to incorporate both of those things together so having that kind of role model, having that kind of person they can look upon and see that someone else was able to do it, especially a female, is just very, I'd say heartwarming" (Focus Group Participant 4).

Several participants explicitly mentioned the diversity of role models' identities, in addition to the diversity of careers. For example, focus group participant 1 noted there were women of color, and focus group participant 2 emphasized how she appreciated seeing role models from diverse "nontraditional" backgrounds.

"I loved how broad it was. There were people color, and they were coming from so many different backgrounds and all of them were like in different fields, and [unclear]. How it related to stem it was just really cool to see" (Focus Group Participant 1).

I was like, okay, I also have a different background, so maybe I can also, like, do something like that, and, like, I can combine stuff in my future" (Focus Group Participant 2)

Theme 2: Girls find meaning in and relate to role models' personal and professional journeys

Findings related to the second theme center on girls' connection to the personal and professional experiences shared by role models, as well as participants' connections to role models' identities and interests. Participants expressed positive feelings, such as being inspired or interested in a specific experience shared by a role model, including when role models took risks and overcame challenges.

Several focus group participants shared how they were inspired by how role models followed their dreams and achieved success by taking risks, for example:

“My favorite aspect of Brite was the fact that they were like so many role models just talking about their experiences and like how they got where they are. And that was just like kind of amazing like, like they didn't know where they were going to get to, like just following kind of like their dreams and what they love to do, but it like, we did it though. And then they can like come back and share it and then just inspire other people. It's just amazing” (Focus Group Participant 9).

Similarly, another participant thought about her own future and said:

“I was super inspired, I was like oh, they took these risks, and they actually were successful, without thinking that “will they be successful?” And so, I was like okay, I should have a different mindset then. So, whenever I am like going to take any risks or anything I should like be open minded and be like I'll do my best, and everything is going to come after me. And so, I feel like that inspired me a lot” (Focus Group Participant 2).

Focus group participant 10 reflected on herself in the context of the role models’:

“I was like, wow, this could be me. I could do all this fun stuff and I was kind of realizing that I was second guessing myself a lot because I thought, hey I can't do this and then, yes, last year, because of Covid, I was like oh there's so much going on, hybrid schedules, making it so hard and I was realizing that was just an excuse, so I wouldn't be able to get to do some things I wanted to. And that's why this year I'm going out for robotics”. (Focus Group Participant 10)

Focus group participant 6 commented on her impression of a role model's personal story:

“I remember her [Astronaut Nicole Scott] saying that she didn't get her period in space, but she always felt like she was about to get it, and when she came back to earth, it was very heavy and that was interesting” (Focus Group Participant 6). In addition, focus group participant 3 expressed surprise through learning about the unique personalities of role models, “I found out that you can be funny doing science, I thought it was just all serious” (Focus Group Participant 3). Moreover, focus group participant 1 shared how she learned there will be support for her as a woman of color, “I learned that there are a lot of different branches I can go into, and there's a lot of different opportunities. And knowing that there are going to be people that support me. Even as a female of color, I'll be able to find the support I need and really do what I want to” (Focus Group Participant 1).

Discussion

Findings from the experiences of girls in the Brite Program demonstrate how online engagement with diverse women role models broadens the notion of STEM, STEM professionals, and career pathways. Brite role models helped shift girls' perceptions about who participates and belongs in STEM, disrupting the influence of gender and racial stereotypes and norms associated with STEM.

The diverse pathways of role models helped girls reimagine STEM disciplines as fluid, interdisciplinary, varied – breaking down the association with masculinity and whiteness and

highlighting how STEM intersects with various subjects or disciplines, such as the arts. There is a long history of reproducing androcentric and white-centric notions of STEM and its participants, and too often girls who do not embody stereotypical representations are often discouraged or excluded from STEM spaces. However, through conversation with diverse role models during Brite, girls learned there are multiple ways to “be” a STEM person and “do” STEM.

The diversity of Brite role models in terms of race, ethnicity, interest, experience, and career stage provide tangible examples of how being a STEM person is varied and unique, and involves a range of skills. While STEM fields have often valued stereotypical forms of masculinity, Brite role models embody how their multiple and overlapping identities are central to their STEM journeys, and how a wide range of skills are valuable and necessary for STEM careers, breaking down the dichotomous and hierarchical construction of STEM as masculine and for men. Moreover, when role models share their personal and professional journeys, and girls have authentic conversations with them in an online setting, this provides unique opportunities for girls to relate to them through a combination of their shared identities, overlapping interests, and commonalities in lived experiences. Many girls expressed that they learned about new and exciting ways to pursue STEM or use STEM skills. Girls also commented on how role models followed their dreams despite various challenges, finding ways to pursue their passions – “doing what they love”. In multiple ways, role models introduced girls to a wider realm of possibilities for STEM and their futures.

The Brite Case Study adds new findings to the research on girls’ engagement with women STEM role models, notably adding voice to the positive and potentially transformative impacts of online engagement with women STEM role models who are diverse in terms of race, ethnicity, interests, career pathways, and STEM fields. An intersectional lens underscores how intentional program design rooted in gender equity and cultural responsiveness can shift girls’ perspectives about STEM people and careers, debunking gender and racial stereotypes. As diverse girls interacted with diverse Brite role models through a conversation-style format, girls had multiple opportunities to relate to the role models’ multiple identities and experiences. The role models embodied the intersectional forms of oppression women in STEM experience, demonstrated how they overcame challenges and showcased the nonlinear and interdisciplinary aspects of STEM career journeys. Through conversation, girls had opportunities to connect to the lived experiences of role models, as top-down (and gendered) power dynamics were replaced with a safe and supportive environment of collaborative learning. The Brite Case Study underscores the need for further intersectional forms of inquiry to explore and unpack the impacts of girls’ online engagement with diverse women STEM role models.

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