The Impact of an Online Peer Mentoring Program on Stem Students at Two Historically Black Institutions During the COVID-19 Pandemic

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ABSTRACT

To address the continuing disparity in the representation of women and racial and ethnically minoritized populations in STEM, an online peer mentoring program, eSTEM, was developed, implemented, and tested among undergraduate and graduate students enrolled in STEM degree programs at two historically black institutions. Using a case study design, participants' experiences in the program were evaluated to determine the degree to which their participation impacted their STEM self-efficacy, sense of community, STEM identity, and intent to persist in STEM. Several themes were identified which demonstrate that the eSTEM program is effective in enhancing students' feelings of self-efficacy, sense of community and belonging in STEM, STEM identity and understanding of intersecting identities, and in sustaining their intent to persist in STEM degree programs and careers.

Keywords: peer mentoring, STEM, women

1 Introduction and Literature Review

To broaden participation in STEM degree programs and subsequent STEM careers, institutions must develop methods to encourage and support a diverse population of students as they engage in their STEM-related coursework. Currently, an inequitable representation of women and racial and ethnic minorities persists among the majority of STEM fields (National Center for Science and Engineering Statistics (NCSES), 2021). Numerous efforts have attempted to address the disparity in representation to various degrees of success. However, efforts to broaden participation are still needed, especially if the U.S. is to meet the future demands of the STEM workforce (Huderson & Huderson, 2019).

Mentoring programs have been shown to enhance the experiences of students in STEM and have led to numerous positive outcomes (National Academies of Sciences et al., 2020). Peer mentoring, "a reciprocal, dynamic relationship between or among peers where one peer is usually more skilled or experienced than the other" (Rockinson-Szapkiw, Herring Watson, et al., 2021), has shown particular promise (Rockinson-Szapkiw, Wendt, et al., 2021; Rockinson-Szapkiw & Wendt, 2021; SZAPKIW et al., 2020). However, few studies have explored the effect of peer mentoring outside of the research laboratory, in the context of historically black institutions, or in tandem with targeted training for both mentors and mentees in developing mentoring skills (Pfund et al., 2015). The purpose of the current project was to examine the effect of an online peer mentoring program (eSTEM) implemented at two historically black institutions on undergraduate and graduate student's interest in STEM, sense of belonging in STEM, STEM self-efficacy, STEM identity, and intent to persist in STEM degrees and future careers.

The eSTEM program (see www.udc.edu/estem/) consists of a series of eight modules, respectively, that were developed to provide targeted online training for students on how to engage in effective mentoring relationships as either a peer mentor or a peer mentee. The modules are grounded in several theories, including persistence, self-efficacy, and identity, with Social Cultural Career Theory (Lent et al., 1994) forming the foundation of the training content and design (Rockinson-Szapkiw, Herring Watson, et al., 2021; Rockinson-Szapkiw, Wendt, et al., 2021; Rockinson-Szapkiw & Wendt, 2021; SZAPKIW et al., 2020). The major premise of SCCT (Lent et al., 1994) is that interest promotes intention, which then leads to engagement in and persistence in a particular pathway (citing (Fouad et al., 2016)). Interest further motivates action, generating feedback that influences an individual's self-efficacy and performance outcomes. "Self-efficacy, the belief that an individual has about his ability, in tandem with an individual's beliefs about the likelihood of a specific behavior leading to a specific outcome, then influence motivation, goals, and, ultimately, persistence toward a STEM degree and career" (Wendt et al., 2021). High levels of self-efficacy correlate with an increased likelihood that an individual will engage in and persist in STEM and, importantly, develop a science identity. "Mentoring is one method that can be utilized to support the development of self-efficacy and science identity, especially as they relate to social identities that must be negotiated in tandem with STEM identities" (Wendt et al., 2021). To attend to the SCCT, self-efficacy, and persistence, each module was designed to include three main components: 1) a topical discussion that included an overview of the module and the related research; 2) a case study that provided a demonstration of how the content could be applied practically and encouraged motivation, emotion, and volition; and 3) a personal application and reflection that provided an opportunity to apply content.

2   Methodology

In the Fall 2020 semester, undergraduate and graduate students enrolled in STEM degree programs were recruited from two historically black institutions ($N = 34$; $n = 8$ mentors, $n = 26$ mentees). The participants completed the online training for mentors or mentees, respectively, during the Fall 2020/Spring 2021 semesters. As the COVID-19 pandemic forced both institutions into emergency remote learning postures, the training was well-suited given the online nature of the eSTEM program. During the training, participants were provided the opportunity to engage in discourse via groups hosted on the Slack platform to facilitate networking, reflection, and a sense of community. After completing the training, participants were assigned to mentoring groups consisting of one peer mentor and three to five peer mentees. The mentoring groups engaged in peer mentoring until the end of the Spring 2021 semester. Throughout the eSTEM program, a series of online STEM Webinars were also offered which featured talks provided by successful racially and/or ethnically minoritized women in STEM. Participants were provided the opportunity to hear from these successful women and engage in a question-and-answer session after each Webinar. A total of 7 mentors and 22 mentees completed the eSTEM program in its entirety ($n = 29$) including training, engaging in mentoring relationships, and attending at least one STEM Webinar.

Open-ended interviews and focus groups were conducted with participants. Data were collected until saturation was reached and subsequently transcribed for analysis. Using a combination of inductive and deductive coding, the data was coded, and codes were

subsequently grouped into themes using Delve software. Following a qualitative case study design (Saldaña, 2016), the following research questions served as guiding questions:

RQ1: How, if at all, was participation in the eSTEM program useful in furthering students' STEM self-efficacy?

RQ2: How, if at all, was participation in the eSTEM program useful in furthering students' sense of community in STEM?

RQ3: How, if at all, was participation in the eSTEM program useful in furthering students' development of a STEM identity?

RQ4: How, if at all, was participation in the eSTEM program useful in furthering students' intent to persist in a STEM degree program and, ultimately, their intent to pursue a STEM career pathway?

3   Results

The analysis demonstrated that, overall, all participants reported that their experience in the eSTEM program was positive. Several participants indicated their appreciation of the online nature of the eSTEM program, especially during the COVID-19 pandemic, in allowing them to engage in mentoring despite the challenges inherent to emergency remote instruction at their respective institutions. Many participants expressed the desire to continue in their mentoring relationships and, importantly, to utilize their mentoring skills to 'pay it forward' to other students and, in some cases, younger family members. When identifying themes, several salient themes were identified, including An 'I Can Do This' Approach: Confidence and Self-Efficacy, Motivation through Reciprocity, Utility of Like Others, 'Beacons of Light': Intersecting and Malleable Identities, and Skills Development. Each of these themes is described briefly below.

3.1   An "I Can Do This' Approach: Confidence and Self-Efficacy

Mentors and mentees expressed that their participation in the eSTEM program assisted in supporting their self-confidence and STEM self-efficacy. The STEM Webinars, especially, were noted as integral to this support. One participant noted in a focus group: "seeing that they [the speakers] were able to do it, that definitely encouraged me to think, yes, I can totally do this as well". One mentor shared, "just hearing that these people got through a different circumstance, and everything wasn't perfect, it helped me understand that the road to being a medical doctor, it's not going to be perfect, and I just have to keep going".

3.2   Motivation through Reciprocity

Most participants indicated that they experienced either an increased sense of motivation or encouragement to sustain their current levels of motivation through their participation in the eSTEM program. Importantly, mentors and mentees reported reciprocity in their relationships. That is, the relationships were a give and take, with all parties experiencing benefits. One mentor, for instance, noted "we have the same goals, around the same age. We were majoring in the same things I'm a person that moves off vibes and everyone's vibe was the same as mine" when speaking about her mentee.

3.3 Utility of Like Others

All participants indicated that they gleaned benefits from being exposed to and engaging with other individuals that looked like them, especially Black women. One participant shared, "There's so many other people are doing it with me—women of color." Another participant articulated, "It really is encouragement that you can do this, you can be successful, even being at an HBCU."

3.4 'Beacons of Light': Intersecting and Malleable Identities

Most participants indicated that their STEM identity was influenced and supported by their participation in the eSTEM program. Simultaneously, intersecting identities were also influenced and supported. One mentor, for instance, shared, "My current identity will probably be a beacon of light. There are just a lot of things that are encompassed with being an African American woman that is a doctor. And, when I say that, I say that because I believe that I hope to serve as an example." Another participant stated, "It is hard to be a woman of color in STEM because they are often looked down on, but I feel like this program did help me to define my identity due to the people that I worked with in the program and also due to the fact that I do go to an HBCU."

3.5 Skills Development

Most participants also expressed that their participation in the eSTEM program helped them identify and develop mentoring skills that would be beneficial to them in their STEM degree programs and subsequent careers. One participant shared, "It gave me a chance to expand outside my comfort zone." Another stated that they appreciated the development of skills related to "planning, prepping, listening, you know, being a sounding board."

4 Conclusions

The findings of the current study support previous research that indicated the benefits of the online peer mentoring model, especially among peer mentors, (Rockinson-Szapkiw, Herring Watson, et al., 2021; Rockinson-Szapkiw, Wendt, et al., 2021; Rockinson-Szapkiw & Wendt, 2021; SZAPKIW et al., 2020) and add to the current body of knowledge on methods for encouraging broader participation in STEM. The current eSTEM program has demonstrated that online peer mentoring can encourage STEM self-efficacy, a sense of community, and STEM identity and to support intent to persist in STEM degree programs and subsequent careers. Even with the challenges presented by the COVID-19 pandemic, participants found benefits in the model, remaining connected via virtual means and engaging in meaningful mentoring experiences. The qualitative approach utilized in the current study afforded insight into the nuanced experiences of students while engaging in the eSTEM program and, importantly, the various components that were perceived as most effective. Overall, the eSTEM program shows promise in supporting students' interest in STEM, sense of belonging in STEM, STEM self-efficacy, STEM identity, and intent to persist in STEM.

While participation in the eSTEM program while simultaneously experiencing a pandemic was not without challenges, participants overall gleaned multiple positive benefits from their engagement in the online training, STEM Webinars, and mentoring communities. The COVID-19 pandemic altered the planned timeline for the project, allowing for less time to

engage in mentoring relationships than was initially planned. However, the findings from the current study indicate that the program was successful in supporting a diverse sample population of students in their current STEM degree programs and, hopefully, in persisting in their future STEM careers. Future research is recommended, however, to determine the replicability of the current findings, especially among different populations. Future studies should attempt to utilize a larger sample size, extend the timeframe for engaging in mentoring communities, and explore the longitudinal effects of participation in the eSTEM program.

5 Declarations

5.1 Acknowledgements

5.2 Publisher's Note

AIJR remains neutral with regard to jurisdiction claims in institutional affiliations.

How to Cite

Wendt, J. L. (2023). The Impact of an Online Peer Mentoring Program on Stem Students at Two Historically Black Institutions During the COVID-19 Pandemic. *AIJR Proceedings*, 51-56. https://doi.org/10.21467/proceedings.148.5

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