Preparing STEM Students for Peer Mentoring: Lessons Learned and Future Directions

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Abstract: Efforts to broaden participation in science, technology, engineering, and mathematics (STEM) have remained at the forefront of initiatives across the United States (U.S.) and elsewhere. The importance of creating a STEM workforce that is reflective of the cultural, ethnic, and racial diversity of the overall population has been recognized. Peer mentoring has been demonstrated to be one effective method for encouraging and sustaining STEM participation. Studies have also demonstrated the importance of training peer mentors and mentees in best practices and arming them with the skillsets necessary for creating and maintaining effective peer mentoring relationships. This proceeding paper examines one such program, eSTEM, which was implemented across three historically Black institutions within the U.S. across two federally funded grant awards. In this proceeding: a) the structure of the virtual peer mentor and peer mentee training modules will be described, b) the overall outcomes of peer mentor and peer mentee training on undergraduate and graduate STEM students will be summarized, c) lessons learned from the implementation of the eSTEM program across multiple historically Black institutions will be shared, and d) future directions for refining, scaling, and providing public access to the peer mentor and peer mentee training resources will be discussed.

Keywords: STEM, Peer Mentoring, Historically Black Colleges and Universities, eSTEM

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Introduction

As global innovations move forward at unprecedented speed, it is of utmost importance that the science, technology, engineering, and mathematics (STEM) workforce keep pace with such growth. Within the United States (U.S.), the National Center for Science and Engineering Statistics (NCSES) reports that, while participation in STEM among historically underrepresented populations (e.g., women, minorities, and persons with disabilities) has increased in the past decade, the pace of such increase has not yet led to equitable

representation within STEM degree programs or the STEM workforce (NCSES, 2023). Of great concern is whether the current STEM workforce is representative of the diverse cultural, ethnic, racial, and gendered population (National Science Board [NSB], 2022).

If the U.S. intends to remain competitive within the STEM arena and socio-scientific issues that impact the overall world population are to be properly attended to (e.g., global warming, unprecedented climate change), then the STEM workforce must encompass the diverse pool of talent that is inherent within the overall population. The problem is, though, that women and those who identify as ethnically and/or racially non-White have been historically underrepresented within STEM degree programs and within the STEM workforce (National Academies of Sciences, Engineering, and Medicine [NASEM], 2019; NSB, 2022). "A diverse workforce provides the potential for innovation by leveraging different backgrounds, experiences, and points of view" (NCSES, 2023, para. 1).

While many initiatives have been explored to broaden the participation of diverse populations within STEM, peer mentoring is one intervention that has demonstrated benefits (NASEM, 2019). Peer mentoring is defined as "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, p. 174). Peer mentoring has been shown to lead to enhanced student outcomes, ranging from academic achievement to psychosocial outcomes (see NASEM, 2019). Thus, peer mentoring is one method for supporting the participation of those who have been historically underrepresented in STEM.

The eSTEM Peer Mentoring Program

The eSTEM Peer Mentoring Program was the product of two federally funded grant awards (NSF Award No. 1717082 and 1912205). The program was first implemented at two historically Black institutions (e.g., Historically Black Colleges and Universities [HBCUS]) in the 2019/2020 academic year. For the initial pilot implementation, the online peer mentor training was developed, implemented, and tested, with a specific focus on a) the impact of the online peer mentor training on graduate student mentors and b) peer mentoring relationships on both graduate student mentors and undergraduate student mentees.

The second implementation of the program occurred at two HBCUS—one of which was included in the original pilot project and the second of which was new to the implementation—in the 2020/2021 academic year. For the second implementation, the online peer mentor training was revised, and the online peer mentee training was developed. The peer mentor and peer mentee trainings were then implemented and tested, with a specific focus on a) the impact of the online peer mentor training on graduate and undergraduate student mentors, b) the impact of the online peer mentee training on undergraduate student mentees, and c) the impact of the peer mentoring relationships on both mentors and mentees.

Structure

For each of the respective training programs (e.g., peer mentor training and peer mentee training), 8 total modules were ultimately created, implemented, and tested. Each module consisted of three main components: a) a topical discussion, b) a case study, and c) a personal reflection. These components attended to the major guiding theory undergirding the research—Social Cognitive Career Theory (SCCT; Lent et al., 1994; see Rockinson-Szapkiw, Wendt et al., 2021 for further discussion on the alignment of the training with theory). The training modules were offered and completed as online asynchronous 'courses'. Participants in each implementation of the program were asked to complete the online peer mentoring training depending on their assigned role in the program—either mentor or mentee. In general, those who were graduate students or more experienced undergraduate students were assigned the role of mentor. Those who were undergraduate students were assigned the role of mentee.

After completing the training, peer mentors and peer mentees were assigned mentoring 'communities' (e.g., groups) within which they then participated in reciprocal peer mentoring. While the structure, frequency (minimum of twice per month), and mode (e.g., online, face-to-face, phone) of such peer mentoring was largely left up to individual groups, participants were encouraged to utilize the structure and skills developed through completion of the peer mentoring training. This flexibility was key to allowing peer mentoring communities to craft goals and methods of reaching those goals tailored to their specific experiences and needs.

Simultaneously, guest speakers were made available to participants through STEM Luncheons (face-to-face, held in academic year 2019/2020) and STEM Webinars (virtual, held in academic year 2020/2021). During the STEM Luncheons and STEM Webinars, the guest speakers—women who demonstrated a record of success in a STEM career field—shared their experiences and recommendations for success with participants. Guest speakers also engaged in a question-and-answer session with participants and provided participants with opportunities to tap into the speakers' professional networks.

Overall Outcomes

Throughout the program, participants engaged in a series of pre- and post-surveys as well as individual interviews and focus groups. The specific results of each implementation separated by role (e.g., peer mentor or peer mentee) and gender (e.g., female and male) are reported in detail elsewhere (see Rockinson-Szapkiw, Herring Watson et al., 2021; Rockinson-Szapkiw & Wendt, 2020; Rockinson-Szapkiw, Wendt et al., 2021a; Wendt et al., 2021b). Overall, the first implementation demonstrated that peer mentors and peer mentees experienced increases in STEM self-efficacy, sense of belonging, interest in STEM, and intent to persist in STEM. The second implementation demonstrated that peer mentors demonstrated increases in STEM self-efficacy, sense of belonging, interest in STEM, and STEM identity. While peer mentors in the second implementation did not report increases in intent to persist in STEM, they did report that their intent to persist in STEM was maintained. In the second implementation, peer mentees reported increases in STEM self-efficacy,

sense of belonging, interest in STEM, intent to persist in STEM, and STEM identity.

Lessons Learned

The overall outcomes of the two implementations of the eSTEM Peer Mentoring Program have demonstrated the benefits of students' participation in the peer mentoring training, peer mentoring communities, and STEM Luncheons/STEM Webinars. The findings are significant as they attend to the experiences of historically underrepresented groups while enrolled in STEM degree programs situated within HBCUs—a severely under-researched and historically under-supported context. The findings shed insight into one intervention that can be utilized to better support students as they traverse their STEM degree programs and prepare to enter the STEM workforce. Importantly, the findings also attend to the benefits of peer mentoring that exists outside of the research laboratory, focusing not only on academic outcomes, but psychosocial outcomes as well.

Participants did offer suggestions for further revising the program. For instance, while geographic location (first and second implementation) and the advent of the COVID-19 pandemic (second implementation) presented challenges for participants engaging in the face-to-face environment, most participants reported a desire to have opportunities to meet with peers and supporting faculty members face-to-face. Simultaneously, participants reported the benefits and flexibility afforded by online participation. They desired more of a balance between the two. Further, participants appreciated the flexibility in crafting mentoring experiences that met their particular needs with guiding structures in place. Finally, participants reported the benefits of engaging with peers, but also expressed the desire to have regular check-ins with supporting faculty. Thus, they appeared to desire a balance between peer mentoring and faculty mentoring.

Remaining Questions and Future Directions

As mentioned earlier, the pace of the increase in participation in STEM among historically underrepresented populations has not yet led to equitable representation within STEM degree programs or the STEM workforce (NCSES, 2023). As HBCUs remain under-researched and historically under-supported, continuing efforts to implement peer mentoring programs around the country at HBCUs improves the chances of eliciting equitable representation in STEM degree programs and the STEM workforce. Research has shown that peer mentoring programs, including the eSTEM Peer Mentoring Program, have the potential to play a crucial role in increasing underrepresented populations in STEM fields. By continuing to support skilled peer mentors who share similar backgrounds, experiences, and identities to peer mentees, peer mentoring programs can help create a sense of belonging that leads to increased engagement and persistence in STEM degree programs and the STEM workforce. Additionally, implementing peer mentoring programs at predominantly white institutions (PWIs) and targeting underrepresented populations could potentially provide similar results as those experienced by students at HBCUs. Having role model representation at PWIs for underrepresented populations can ensure that minoritized and marginalized students can be inspired by creating a sense of possibility and increasing STEM self-efficacy, along with interest in STEM and STEM identity.

Future research should consider implementation at PWIs as well as other minority serving institutions. Future research should explore the longitudinal impact of participation in the eSTEM Peer Mentoring Program. It may also be beneficial to explore the potential impacts of implementing a peer mentoring model that connects peer mentors in higher education to peer mentees in K-12 (specifically, high school). Continuing the implementation, revision, and testing of peer mentoring programs gives hope that the problem or persisting inequitable representation in STEM can eventually be solved.

Conclusion

It is important to recognize that there is not a single one-size-fits-all approach to supporting diverse representation within STEM degree programs and the STEM workforce. While peer mentoring and, more specifically, the eSTEM Peer Mentoring Program, has demonstrated positive outcomes among the HBCUs at which it was implemented and tested, other contexts and other populations may require their own unique supports. Peer mentoring is one potential intervention for supporting equitable representation in STEM, however, and should be further tested and examined. If we are to collectively embrace the myriad perspectives, skills, and talents needed to attend to pressing global needs, though, it is essential that the overall STEM workforce be appropriately prepared and supported.

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