# The Benefits and Challenges of a Blended Peer Mentoring Program for Women Peer Mentors in Science, Technology, Engineering, and Mathematics (STEM)

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## Abstract

**Purpose**

Unequitable representation among genders in STEM degrees and careers remains a persisting challenge. Peer mentoring has been cited as one method for supporting women and racial and ethnic minorities in becoming interested in, experiencing self-efficacy in, and persisting in STEM. The current study was undertaken to explore how and in what ways peer mentors' participation in the program (namely, the mentoring experience) influenced their STEM self-efficacy beliefs, interests, skills, and behaviors, including their intent to persist and actual persistence in STEM.

**Design/Methodology/Approach**

Using a multi-site case study design, the current study implemented a blended peer mentoring program at two historically black institutions, established in the United States to serve the educational needs of black Americans.

**Findings**

The experience in the peer mentoring process increased mentors' self-efficacy, career interest, perceived mentoring skill development in most areas, and intent to persist in STEM. Evidence from the interviews and open-ended survey questions demonstrated that the peer mentoring experience had a direct influence on the mentor's self-efficacy, career interest, leadership and professional skills, and persistence. The thematic analysis of the data sources revealed that specific elements of the peer mentoring experience influenced mentors' beliefs,

interests, skills, and behaviors, including recognition, functioning as a mentor, developing an other's orientation, engaging in a sisterhood, and developing competencies.

**Originality**

Findings support the benefit of the blended peer mentoring program model among women who identify as a racial or ethnic minority across two historically black institutions. Peer mentoring programs should include training to increase competencies and skills, should provide resources targeted to specific mentor needs, and should include opportunities for self-reflection and components of faculty support.

## Introduction

There remains a disparity between the pursuit of science, technology, engineering, and mathematics (STEM) degrees and careers among genders (National Science Foundation [NSF], 2019). Data demonstrate that many women and racial and ethnic minorities who earn STEM degrees choose not to pursue or remain in STEM careers (Fouad *et al.*, 2016). This disparity in participation has been attributed to family responsibilities, misalignment between job and personal values, and an unwelcoming STEM climate, among other reasons (Brue, 2019; Dawson *et al.,* 2015; Fouad *et al.,* 2016; Jensen and Deemer, 2019). However, the most consistent reason cited for the gender and racial or ethnic disparities in STEM has been the "confidence gap" (Hand *et al.*, 2017; Hill *et al.,* 2015). Researchers have attributed women's lack of entering STEM degree programs (Falk *et al.*, 2017) and persistence in STEM programs and careers (Cadaret *et al.*, 2017; Dawson *et al.*, 2015; Falk *et al.*, 2017; Hill *et al.*, 2010) to a lack of confidence or poor self-efficacy. Thus, there exists a growing interest in enhancing the self-efficacy of women and racial and ethnic minorities to encourage broader participation. Mentoring has been identified as central to the development of self-efficacy and persistence (Carlone and Johnson, 2007; Hill *et al.*, 2010; National Academies of Sciences, Engineering, and Medicine [NASEM], 2019).

Research on mentoring in STEM has predominantly focused upon individuals who receive mentoring from highly experienced graduate students and faculty in a laboratory setting and among predominately white institutions (PWIs). PWIs are institutions in higher education in the United States in which white students account for 50% or more of student enrollment. Calls exist to broaden research on mentoring, external to the research lab and in contexts other than PWIs (NASEM, 2019) to better understand mentoring from the perspective of the mentor and as an intervention to support women, especially from racial and ethnic minority populations, professionally, academically, and personally (Ireland *et al.*, 2018). Researchers highlight the need to focus on women who also identify as racial or ethnic minorities rather than as mutually exclusive groups in efforts to encourage equitable representation in STEM (Ireland *et al.*, 2018). Therefore, this multi-site case study examines how and to what extent minority women mentors' participation in a blended peer mentoring experience at two historically black college or universities (HBCUs) influenced their STEM self-efficacy beliefs, interests and skills, intent to persist, and actual persistence in STEM.

## Review of Literature

### Defining Mentorship

Mentorship is "a reciprocal, dynamic relationship between mentor (or mentoring team) and mentee that promotes satisfaction and development of both" (McGee and Keller, 2007, p. 316). Mentorship is defined as a "professional, working alliance in which individuals work together over time to support the personal and professional [and academic] growth, development, and success of the relational partner through the provision of career and psychosocial support" (NASEM, 2019, p. 37) as well as academic support. In a peer mentoring relationship, the relationship includes one peer who is similar in age and is more skilled or experienced than the

other peer. The more experienced peers are referred to as the mentors. The current study focused on peer mentors among collective groups (i.e., one mentor and three mentees) in a blended format (NASEM, 2019).

Mentoring may occur 100% online, face-to-face, or via a blended approach of both online and face-to-face. Online and blended mentoring (i.e., virtual mentoring) are becoming increasingly popular approaches to mentoring, especially for women and ethnic and racial minority students, as these approaches enable access to mentors who match their demographic characteristics when otherwise inaccessible (Zambrana *et al.*, 2015). The use of virtual peer mentoring also enables peers who are at the same institution the flexibility and convenience needed to access peer mentoring programs. Virtual mentoring is a way for higher education institutions in the United States, which often have not had a positive history of accounting for the needs of women and racial and ethnic minority populations, to provide better access to activities shown to improve educational success and persistence (NASEM, 2019).

**The Benefits of Mentorship**

While virtual mentoring across higher education has become popular, peer mentoring programs in STEM that employ virtual approaches are only beginning to be piloted and investigated empirically (Haggard *et al.*, 2011; Leidenfrost *et al.*, 2014; Watts *et al.*, 2015). Research on peer mentoring in STEM that documents the benefits for women in STEM has been for the face-to-face context (Dawson *et al.*, 2015) and has primarily focused on the mentee within the research laboratory at PWIs (NASEM, 2019).

Research illustrates that mentoring improves factors that are often associated with reasons women and racial and ethnic minorities do not persist in STEM (e.g., poor self-efficacy, poor STEM identity development, and poor community). In a longitudinal study of minority

bachelor-level STEM degree earners, Estrada and colleagues (2018) found that being mentored was positively associated with the development of science self-efficacy and identity. Mentoring relationships can be central to women's development of self-efficacy and academic success (Castellanos *et al.*, 2016; Thomas *et al.*, 2007), and researchers have documented that social relationships, such as peer mentoring, play a role in identity formation (Hill *et al.*, 2010). Mentees' development of science identity within mentoring relationships has been linked to academic and career success in STEM (Carlone and Johnson, 2007). Peer mentoring also serves to enhance a mentee's community and reduces feelings of isolation (Tenenbaum *et al.*, 2014).

The positive outcomes of the relationship for mentors have been more scarcely researched. Literature focusing on peer mentoring in higher education shows that mentors reap benefits such as increased networking opportunities (Ehrich *et al.*, 2004) and improved self-awareness (Haggard *et al.*, 2011). Studies provide evidence that peer mentors benefit from enhanced personal and professional development (Penman and White, 2006) and an increased sense of confidence, self-esteem, and independence (Bulut *et al.*, 2010). Mentors also have opportunities to build connections with other mentors when participating in mentoring programs (Beltman and Schaeben, 2012). Research is needed to confirm the role that a peer mentoring relationship may play in the STEM self-efficacy and persistence of mentors.

## Framework

Tinto's (1987, 1993, 2017) institutional departure model (IDM) served as a primary framework for the current study. IDM suggests that students enter degree programs with personal attributes, familial backgrounds, and prior experiences. Each of these characteristics influences the students' ability to integrate both socially and academically into the respective institution and degree program as well as the development of belongingness and sense of community within

their selected discipline (Tinto, 1993). Students who are likely to persist and attain their selected degree are those who have become integrated into the university and into the discipline-specific community. This integration relies on social interactions, social support, and academic resources, which may all be supported through the peer mentoring process. STEM self-efficacy is also an important factor in the persistence of women in STEM, even more so than academic preparation, ability, or talent (Dawson *et al.*, 2015; Hardin and Longhurst, 2015). Self-efficacy, along with integration, may be promoted by participation in a peer mentoring experience.

Self-efficacy is a construct largely grounded in social cognitive career theory (SCCT; Lent *et al.*, 1994). SCCT illuminates the interactions between individual (e.g., race, ethnicity, gender) and environmental factors (e.g., providing support to the mentee, HBCU) that shape cognitive beliefs (e.g., self-efficacy), which in turn influence academic and career outcomes (e.g., persistence). Support exists for SCCT's application to STEM students across gender and ethnic populations (Byars-Winston *et al.*, 2011; Lent *et al.*, 2005).

Self-efficacy is the confidence a person has in their ability to successfully perform a task. Self-efficacy coupled with outcome expectations affect academic and career interests and goals, which in turn influence goal achievement and persistence (Lent *et al.*, 1994). Proximal contextual factors (e.g., supports, barriers) encountered at salient stages in the academic and career journey can also facilitate or inhibit interest, goals, achievement, and persistence. Direct, vicarious, and persuasive experiences can mediate and give rise to efficacy beliefs and outcome expectations. They can also affect mentors' beliefs about their STEM abilities, which mediate their interest and pursuit of STEM degrees and careers. Though these elements are intimately intertwined, for the purposes of this study, we examined the isolated peer mentoring relationship and its influence on the mentors' outcomes.

## Methodology

After obtaining institutional review board approval, a blended peer mentoring program was piloted across two HBCUs in the mid-Atlantic region of the United States in the 2018 to 2019 academic year. The aim was to broaden the participation of underrepresented racial and ethnic minority women (UREMW) in STEM. Invitations to participate were sent to all graduate students enrolled in STEM programs, as identified by the respective university registrars, across the two participating HBCUs. Six peer mentors provided voluntary informed consent and participated in the study. The peer mentors selected for participation were required to be UREMW in STEM, be enrolled in a STEM degree program, and have a cumulative program grade point average of 3.0 or higher. The peer mentors were invited to participate in an online, self-paced six-module training program during summer 2018. Two to three undergraduate mentees enrolled in STEM programs who were also women or racial and ethnic minorities were assigned to each peer mentor in fall 2018. During the 2018 to 2019 academic year, peer mentors met with individual mentees on a weekly basis. They also met at least bimonthly with their mentees for group mentoring. Meetings took place both in person and online via video conferencing and chat. Mentors kept notes and submitted them to the program's faculty coordinators. At four points during the semester, all mentors and mentees gathered for a luncheon where a STEM professional was invited to speak.

The current study was undertaken to explore how and in what ways peer mentors' participation in the program influenced their STEM self-efficacy beliefs, interests, skills, and behaviors, including their intent to persist and their actual persistence in STEM. The mentor training was investigated in a previous inquiry (see Sharpe, Rockinson-Szapkiw, & Wendt, forthcoming). The focus of this current study was the mentoring experience:

RQ1: To what extent, if at all, did participating in the blended peer mentoring experience influence peer mentors' STEM beliefs, interests, skills, and behaviors?

RQ2: How, if at all, did participating in the blended peer mentoring experience influence peer mentors' STEM beliefs, interests, skills, and behaviors?

A mixed-methods, multi-site case study approach was used (Yin, 2014).

## Participants

A total of six peer mentors participated in the study, which allowed for a sufficient analysis of in-depth data while mitigating dilution of individual analysis (Creswell, 2013). Five of the mentors identified their race as black, and one mentor identified her race as Hispanic. Table 1 describes the mentors' demographics and institution. Pseudonyms were assigned to participants to protect confidentiality. These peer mentors were enrolled in psychology, economics, information technology, and speech-language pathology graduate-level degree programs.

Table 1.

*Mentor Demographics*

| Pseudonym | Race | Age | Gender | Case |
|---|---|---|---|---|
| Jerica | Black | 26 | Female | HBCU 1 |
| Marcia | Black | 25 | Female | HBCU 2 |
| Catherine | Black | 28 | Female | HBCU 1 |
| Grace | Black | 23 | Female | HBCU 2 |
| Penelope | Black | 22 | Female | HBCU 2 |
| Linda | Hispanic | 31 | Female | HBCU 1 |

***note that HBCU 1 and HBCU 2 refer to the particular participating institution in which each participant was enrolled in a STEM degree program*

## Instrumentation

Data were collected from the peer mentors via a survey pre and post program. The survey consisted of open-ended questions as well as assessments to measure self-efficacy, STEM career interest, mentoring skills, and intent to persist. During the final week of the program, five of the six mentors participated in semi-structured interviews. To ensure further trustworthiness of the data, the mentors' weekly mentoring notes were examined (Yin, 2014). The multiple sources of data allowed for triangulation to ensure trustworthiness, and use of six participants was deemed sufficient in providing an in-depth analysis of cases within bounded systems (Creswell, 2013).

**Survey**. A researcher-developed scale was used to assess mentors' STEM self-efficacy. Bandura's (2005) guidelines were followed in the development of the 54-item scale aimed at measuring mentors' STEM self-efficacy in the areas of achievement self-efficacy, career self-efficacy, and mentorship self-efficacy for the mentors. Respondents were asked to rate their level of confidence on an 11-point Likert-type scale on statements such as "Persistently work toward my STEM degree even when I get frustrated." They were also asked to rate their level of agreement to a series of affective focused statements such as "Enjoy being a STEM mentor." Higher scores on the overall scale and subscales reflected higher self-efficacy. The instrument's face and content validity was established by three person expert review, and Cronbach alpha coefficients were calculated to establish reliability. All values for the study sample were over .81 for all subscales on both the pre and post surveys, demonstrating good internal reliability of the instrument.

The survey also consisted of the STEM Career Interest Survey (STEM-CIS; Kier *et al.*, 2013), which was used to measure interest in STEM classes and careers. The STEM-CIS is a 44-item survey that uses a five-point Likert scale that has good construct validity (Kier *et al.*, 2013);

higher scores indicate more interest. Cronbach alpha coefficients calculated for the current study sample for all subscales on both the pre and post surveys demonstrated good reliability, with values being over .85. Mentorship skills were assessed on the surveys with the Principles of Adult Mentorship Inventory (PAMI; Cohen, 2003). The PAMI is a validated self-report, 55-item, five-point Likert-type scale inventory that measures six behavioral functions that constitute a mentor's role (i.e., relationship emphasis, information emphasis, facilitative focus, confrontation focus, mentor model, and student vision; Cohen, 2003, 2008). Higher scores on the overall scale and subscales reflect more effective mentoring skills. The PAMI was deemed appropriate for use with this population as the instrument has previously been used in STEM mentoring programs (Feldhaus & Bentrem, 2015) and in higher education with graduate and undergraduate students (Chen *et al.*, 2016). Moreover, all mentors were graduate students over the age of 21, mentoring undergraduate students over the age of 18. The instrument also had good reliability in this study, with Cronbach alpha coefficients being over .75 for all subscales on both the pre and post surveys.

**Semi-structured interviews**. Individual semi-structured interviews provided an opportunity for the mentors to co-create additional understandings of how the mentoring experience influenced them (Creswell, 2013). The interview began with three general questions about the mentor's experience in the program, with six follow-up questions related to how the program experience influenced their self-efficacy, STEM career interest, skills, and intent to persist in STEM. All questions were developed considering STEM mentoring literature and the theoretical literature that grounded the program and the study (e.g., Bandura, 1997; Chemers *et al.,* 2011; Eccles & Wigfield, 1995; Lent *et al.*, 1994; Tinto, 1987, 1993, 2017).

## Analysis

The data analysis process began with the process of setting aside biases by bracketing personal experiences. While researchers cannot remove all personal biases (Jones *et al.*, 2006), we attempted to recognize personal beliefs and ideas that could have potentially deleterious effects to improve the study's credibility and trustworthiness (Bloomberg and Volpe, 2012). Before and throughout the data collection and analysis process, we engaged in weekly reflective journaling about personal experiences relevant to STEM experiences and mentoring. We discussed personal experiences and biases in regularly scheduled meetings with one another as we worked on the project.

An additional measure helpful in maintaining trustworthiness, or more specifically dependability, was the use of analytical memos in digital format uploaded via a shared folder. Memos were taken throughout the data collection and analysis and provided the opportunity to take notes regarding how interpretation of data took place, what led us to make sense of the data in specific ways, and how and why data analysis decisions were made (Creswell, 2013).

For analysis, descriptive statistics and percentage of change were calculated for the quantitative data to determine if peer mentors' self-efficacy, mentorship skill development, STEM career interest, and STEM persistence changed from pre to post program. Coding cycles were then used to analyze the qualitative data (Saldaña, 2016). Analysis within the first cycle was open and inductive. Descriptive coding (Creswell, 2013) was then used to label each significant word, theme, and passage. Then, a deductive pattern-coding process (Creswell, 2013) was used, resulting in identification of six themes. To further ensure credibility, member checking was employed throughout in the analysis process of this study (Creswell, 2013). Twice during the analysis process, one of us emailed the mentor. The first email was sent to clarify

verbiage and ideas in the interview scripts. In the second email, we provided a list of themes for feedback. Three mentors provided feedback via email on their interview scripts; two mentors emailed their agreement with the themes.

## Findings

### Research Question 1

Participation in the program increased mentors' STEM self-efficacy, which in turn strengthened their mentorship skills and STEM career interest. This resulted in an increased intent to persist and actual persistence from pre to post program. The experience in the peer mentoring process increased mentors' self-efficacy, career interest, perceived mentoring skill development in most areas, and intent to persist in STEM (see Table 2).

Mentors experienced the greatest percentage change in their career interest in engineering (23.47%), their conceptualization of their personal mentoring model (19.15%), their STEM career self-efficacy (16.56%), and their STEM achievement self-efficacy (16.14%) from pre to post program. Prior to the program, only four mentors indicated their intent to persist in their degree and a STEM career. All six mentors indicated that they intended to persist in their degrees and careers after participation in the program. By the end of the program, all the mentors had applied to their respective institutions to graduate from their chosen STEM degree programs.

Table 2.

*Descriptive Statistics for Pre and Post Assessments*

| | Pre Training | | Final | | | |
|---|---|---|---|---|---|---|
| Scale | *M* | *SD* | *M* | *SD* | % of Change | Score range |
| PAMI Relationship | 42.33 | 2.73 | 43.67 | 4.46 | 3.17% | 10–50 |
| PAMI Informative | 46.83 | 3.76 | 47.00 | 3.95 | .36% | 10–50 |
| PAMI Facilitation | 27.50 | 2.51 | 27.67 | 2.73 | .62% | 6–30 |

| | | | | | | |
|---|---|---|---|---|---|---|
| PAMI Confrontation | 53.83 | 5.74 | 53.83 | 7.33 | 0% | 12–60 |
| PAMI Mentor Model | 23.50 | 1.97 | 30.00 | 28.00 | 19.15% | 6–30 |
| PAMI Student Vision | 51.00 | 4.94 | 51.00 | 6.79 | 0% | 11–55 |
| STEM SE | | | | | | |
| Achievement | 111.50 | 15.24 | 129.50 | 14.54 | 16.14% | 10–140 |
| STEM SE Career | 110.67 | 12.69 | 129.00 | 13.07 | 16.56% | 10–140 |
| STEM SE Mentorship | 213.83 | 27.94 | 228.97 | 29.59 | 7.08% | 26–260 |
| CIS Science | 46.00 | 6.99 | 47.83 | 5.56 | 3.98% | 5–55 |
| CIS Math | 40.83 | 8.33 | 44.00 | 10.84 | 7.76% | 5–55 |
| CIS Engineer | 29.83 | 12.56 | 36.83 | 7.05 | 23.47% | 5–55 |
| CIS Tech | 44.17 | 5.85 | 46.00 | 5.48 | 3.98% | 5–55 |
| | Yes | No | Yes | No | | Res. |
| Do you plan to pursue a career in the area in which you are obtaining a degree? | 4 (66.7%) | 2 (33.3%) | 6 (100%) | 0 (0%) | 50% | Yes/No |
| Do you intend to graduate from your STEM degree program? | 4 (66.7%) | 2 (33.3%) | 6 (100%) | 0 (0%) | 50% | Yes/No |

Note. SE = self-efficacy, $N = 6$, Res. = response, $M$ = mean, $SD$ = standard deviation

**Research Question 2**

Evidence from the interviews and open-ended survey questions demonstrated that the peer mentoring experience had a direct influence on the mentor's self-efficacy, career interest, leadership and professional skills, and persistence. The thematic analysis of the data sources revealed that specific elements of the peer mentoring experience influenced mentors' beliefs,

interests, skills, and behaviors, including recognition, functioning as a mentor, developing an other's orientation, engaging in a sisterhood, and developing competencies.

**Recognition as a role model for women of color.** Every mentor in the study recognized herself as a role model. Recognition of not only herself as a role model, but meaningful and affirming recognition by the mentees, served to build mentors' self-efficacy, determination to be successful in her chosen program and career, and intent to persist as a woman in STEM. For instance, Penelope reflected that being seen as a role model by her mentees compelled "me to focus and achieve [more as] one of the few black women in my field" and "continues to solidify my identity as an educated, black woman in STEM." She placed importance on "not [being] a hypocritical person" and was mindful to apply the advice she provided to her mentees to her own life in order to better position herself for both academic and career success.

Similarly, Catherine expressed that being "genuine" and "approachable" was central to her effectiveness as a mentor as well as fundamental to her mentees seeing her as a role model. She reflected that her willingness to share not only her successes but also her mistakes was what made her a role model that her mentees wanted to emulate. She noted, "They don't want infallible role models. They want ones who have challenges just like them, and despite these challenges, still succeed." Catherine increased her confidence in her ability to be a leader in her STEM profession.

Jerica and Linda also found their mentees' recognition was central to their confidence as a mentor and determination to persist in STEM. Linda recalled a mentee telling her, "Oh, wow. I do appreciate you," and in turn thinking, "she really does look up to me and finds what I am doing helpful." She articulated that this experience helped her to develop confidence in herself as a woman of color in STEM. Jerica also purported that being a role model and in a leadership role

had “carryover” into her academic and professional responsibilities, including leadership in professional and student organizations. Being seen as a role model made them acutely aware to “practice what you preach.” That is, mentors realized that they also needed to be following the recommendations that they were giving to their mentees.

Motivation to exemplify the attitudes, behaviors, and skills needed to be successful women of color in STEM was also strongly influenced by the wish that mentors had women of color as role models themselves. Grace, for example, stated during her interview, “I personally feel like I was mentored on a research level, but not a very personal level. Being a black woman in STEM is more than being a researcher, and I’ve got to model that for my mentees.” Then, later in the interview, she continued, “I am uplifting other STEM women in the field to pursue what they want to do.”

**Functioning as a mentor.** Interests, skills, and behaviors, functioning as a mentor, were also salient themes. Engagement in mentoring functions occurred by various modalities, and the mentors engaged with each mentee and their groups of mentees differently based on the needs and goals of the mentees. As each mentor detailed her performance and functions as a mentor during the interview, she noted that setting expectations, building rapport, self-disclosing, identifying and providing resources, setting and facilitating goals, and problem solving influenced their beliefs, interest, skills, and behaviors. Linda found that providing information and helping her mentees find internships resulted in improved “self-esteem as a mentor” and self-efficacy as a STEM student, while Jerica found that actively listening to her mentees encouraged her interest in her chosen STEM field. For several mentors in the study, functioning as a peer mentor helped them redefine what it meant to be a black woman in STEM.

Catherine explained through her self-disclosure and provision of resources and information that she began to solidify her confidence as a black woman in STEM, and this helped her identify herself as a scientist. Catherine went on to explain that functioning as a mentor also encouraged her to reflect on her own persistence and career aspirations, which in turn helped her affirm her STEM career trajectory:

> I guess one of the things that was really helpful about being a mentor and doing things for my mentees was just that it caused me to reflect, a lot. When I asked them to reflect on their aspirations and set goals, I found myself asking, "Where I have been?" ... This experience and the reflection it inspired was just a very helpful piece. It was affirming.

When mentees were not responsive to functions the mentors performed, mentors' confidence, especially in their mentoring and leadership abilities, faltered. Some, like Catherine, found themselves discouraged: "It was difficult when there wasn't reception from my mentees, and meetings didn't go as planned. And, I think for me, I battled with discouragement and questioned my skills and abilities as a leader."

However, Catherine, and others, did not allow this discouragement to interfere with their desire and determination to be effective mentors. All the mentors voiced that they had resources within their arsenals to meet the challenges or unresponsiveness they faced. Linda discussed her determination to be an effective mentor despite the fact that her mentee appeared shy, giving one-word answers to questions, at their initial meetings. She discussed how her reflection about what she learned in the training helped her identify skills to better facilitate her mentees:

> I thought it would be more, I guess, easy. I thought I would make a better connection with my mentees right away. Well, I feel like we did connect, it was not easy. It was almost like ... They were really shy, and they wouldn't talk much at first. So, I found

> myself having to think, "How can I get them to open up?" … So, I found myself having to do a lot of reflecting and thinking about what I learned during the web training.

Linda went on to describe how she also recognized the responsibility that both she and her mentees had in the peer mentoring process, further explaining her growth and development:

> I think it's just on me to facilitate, and then they had to put in the work. It was difficult for them to kind of get that rhythm going … So, it was more just like being their cheerleader, just not nagging them, but trying to like empower them. I did my part as a mentor, and then left it up to them to take responsibility. So, reflecting on what I could do better and then trusting them to take responsibility was what I did.

**Development of an other's orientation.** As each mentor engaged in mentoring functions, they either further cultivated or developed a deep interest in their mentees' well-being and growth. Some mentors began the program motivated by their altruistic values or others' orientation, while other mentors began the program "not know[ing] what to expect" or desiring a professional opportunity. By the end of the program, almost all of the mentors described a deep interest in their mentees' well-being and success. They expressed "empathy" and "compassion." Consequential to mentors' interest, "empathy," and "compassion" for their mentees was the development of an other's orientation, which became a primary motivation to persist in their STEM degrees and careers.

The peer mentors were motivated to serve and advance the mentees' STEM opportunities, interest, and persistence, as well as their mentee's social, emotional, and cognitive well-being. Catherine's quotation illustrates the mentor's desire to assist each mentee:

> I wanted to see them benefit and grow as individuals and in their careers. I cared about them. I want to make a difference and give back to women in STEM. I learned how little

> … few women there are, especially women like me, and so I think it's important to help others be successful in their fields like I have been.

Linda's comment relates the same theme as she describes in detail how she facilitated a mentee's growth:

> I just wanted them to know, I'm here for you academically and vocationally but also personally … Like, with one of my mentees, I was suggesting she work with her classmates because she was behind. I asked, "Do you know anyone?" … While we were in a session, we called a classmate for a study date. She was like, "Really cool. I have someone to study with?" And, when that didn't work out, I [said] … there's a tutoring center on campus somewhere. So, she started going to that, which was good because I wanted to see her be successful and pass the class. … Another mentee, I could tell she was having frustrations at home. … So, I was encouraging her about how to communicate – to talk to her parents about her feelings. I gave suggestions [and] helped her see her feelings were normal. … And, then, I think I gave her the confidence to talk to them ... she was really excited. Doing this work, working with my mentees, it's motivating.

For most of the mentors, the other's orientation extended beyond the mentees. Almost every mentor noted in both the interview and survey that, whether it be from the training, luncheon speakers, or through the process of mentoring, they developed a motivation or sense of "duty" to continue to be mentors and role models to represent women and ethnic and racial minorities in STEM fields. As Catherine noted, "The longer I participated in this program and worked with my mentees, I wanted to give back and do more." Over 50% of mentors noted their

interest in continuing to mentor and be a role model for their mentees beyond the program and continue to find ways to broaden the participation of women in STEM.

**Engagement in a STEM sisterhood.** Engagement was not only inclusive of traditional functions associated with mentoring (e.g., facilitation, providing information, etc.), but also in developing a sisterhood with the mentees and other mentors, with most participants suggesting the importance of others being like them in terms of gender, race, and field. Words and phrases such as "bond," "connected," "I am a part of something," "community," and "sisterhood" were words used to describe the relationships that mentors shared with one another and their mentees. Every mentor, despite expressing a lack of time and difficulty balancing numerous responsibilities, expressed a desire for "more interaction" with other mentors, mentees, and role models. Several recommended formal and informal outings for mentors and for the mentor–mentee groups. Almost all mentors recommended that the program include opportunities to simply "hangout off campus" or "tour STEM labs."

Within the HBCU 2 group, mentors described the "camaraderie" and "connection" they experienced with one another "just talking." The mentors in HBCU 1 did not experience the same connection given that they did not interact as regularly; however, they did find interaction with one another invaluable when it occurred. Jerica, from HBCU 1, explained that she struggled with how to best coordinate meetings with her mentees. She explained that through her conversations with another mentor, she developed ideas for scheduling meetings. Through interaction and sharing struggles with another mentee, Jerica experienced a sense of "rapport" and "connection" with her fellow mentor. All mentors across both HBCUs recommended and expressed a desire to "share a sisterhood" or have a better connection with other mentors.

Mentors also discussed how the community they shared with their mentees influenced their beliefs, interest, skills, and behaviors. Grace explained, "We get to learn about each other, and they basically help me and I help them …We are a community." Penelope shared, "What I found surprising throughout the process is they were helping me and encouraging me just as much as I was, hopefully, doing to them." She continued by sharing an example of how her mentees' disclosure about their own isolation as black women in the field normalized her experience, which increased her self-efficacy and motivated her to persist in her STEM career:

> That encouraged me … I'm not the only one who's in this kind of scenario. A lot of times, they also, in their degrees, careers … feel like they're isolated, so it was like we're in isolation, having the same kind of experience together. We found community in this together. I think that really helped build my hope in continuing in the STEM field … [they] also boosted my confidence.

Mentors' engagement with STEM professionals at the luncheons also allowed the mentors a greater opportunity to develop a sense of kinship with one another and the STEM community. Through engagement with other UREMW who shared their STEM career journeys, the mentors had the opportunity to learn about and normalize their unique struggles in STEM fields. The mentors were able to learn about various opportunities in STEM that they had not previously recognized as career options, with Catherine noting, "This produced new images of what I could do with my degree." The generation of "new images" for almost all of the mentors helped them to better align their career aspirations with their sense of self and values. They were better able to imagine themselves as UREMW fitting into the STEM community, and several mentors, like Penelope, were inspired to persist in the field. In discussing the luncheon experience, she said,

> Knowing that other people also experience difficult social aspects related to a black woman in STEM helped encourage me. … She [STEM professional invited to the luncheon] showed us the statistics of black women in different fields and their success rate and different things like that, pursuing higher education, etc. … I think, for me, that really encouraged me. It gave me a spark to continue … I'm in a unique situation and I need to make the best of it as I can.

**Competency development.** Through the training and the experience of mentoring, several mentors, including Jerica, Grace, Linda, and Penelope, described how the training helped them develop skills and knowledge that further developed and solidified their mentoring. As Grace noted in her interview, the opportunity to develop skills and knowledge through the experience resulted in increased STEM career self-efficacy:

> The mentoring experience itself was definitely a compliment to the training … Because of the training and the experience, I got to build skills that I had as a person but needed to develop [as a professional] like … empathy, good communication skills and things like that … I am now better prepared and more confident in my ability to get a job.

While some mentors noted that the mentoring experience only served to improve their competence as STEM professionals, others noted that while the training served to support their competence and confidence, it was moderated by the "first year" mentoring experience. Catherine likened the experience unto her first year of teaching:

> I used to be a teacher, and it's like first time you do something, you're just navigating, figuring it out. And I feel like sometimes when you have a second time to come back around, you can pick what you've learned from the first experience and make your second

time better. So … if I would have the opportunity to do it again, I would definitely take that opportunity to further develop my skills.

**Challenges.** Challenges of the blended peer mentoring program were also identified from the open-ended survey and interviews. Personal and program challenges were both recognized by the mentors. The mentors identified their own schedules and time management as one of the most significant personal challenges they faced. Jerica purported during her interview that "I was helpful to my mentees. But, maybe, my current schedule may have not allotted me to be as available or as helpful or as invested as I wanted to." Catherine further explained that balancing personal and program responsibilities with mentoring responsibilities inhibited her effectiveness as a mentor:

> I think my effectiveness was definitely impacted by just my availability. This last semester, I was in a really intensive internship at a hospital. It ended up being 35 hours a week, and the internship, personal responsibilities, and being a mentor was just very hard to navigate.

Catherine went on to explain her own schedule coupled with that of her mentees often made meeting as a group challenging, whether it be online or in person. She noted that she, thus, did a lot of one-on-one rather than group facilitation with her mentees, "just due to scheduling and timing and a … personal availability."

Some mentors noted that having a faculty facilitator's support to address this personal challenge may have been helpful, and all the mentors agreed that additional faculty facilitation and program resources would have supported their effectiveness as mentors as well as their personal growth. Jerica and Linda noted that having a structure for the peer mentoring process set forth by the faculty facilitators would have been helpful. As one of Jerica's struggles was

time management, she desired additional assistance “finding time and coordinating things.” Others noted that their limited technology skills often meant meeting in person or on the phone was easier for them; however, it was not always convenient. Therefore, additional technology support would have been helpful so that they could better communicate, beyond using text, online with their mentees.

Catherine’s quotation exemplifies the desire for more intentional leadership and facilitation from faculty that most of the mentors expressed:

> We received the training, which was so helpful in development as a mentor, but after the training I felt like we were on our own. So, I think, maybe, I would have liked regular mentor meetings and a little bit more interaction from leadership. [Our faculty facilitator] was great, she was awesome, and she made herself available. But, I think there's a difference between making yourself available and actively being engaged. ... I think maybe facilitating the process over the year would have been helpful, whether it'd be meeting with all the mentors in person or online or bringing all the peer mentoring groups together for discussion and training outside the luncheons.

Linda, Grace, and Catherine, and the other mentors, also expressed the desire to have more materials, videos, and meeting ideas to share with their mentees, or alternatively have regular meetings where they and the other mentors could collaborate and share ideas. However, in making these recommendations, Linda, Grace, and Catherine noted that a challenge in doing this would be time and scheduling, even if meetings took place via videoconference.

## Discussion

Since little research has previously examined the impact of mentoring on mentors, the findings extend prior literature and support the reciprocal nature of peer mentoring. Overall, the

mentors found the experience in the blended peer mentoring program beneficial. Having the opportunity to develop competencies and functions associated with mentoring (e.g., empathy, communication, problem solving) increased mentors' self-efficacy, STEM career interest, and STEM-related leadership and mentoring skills, and ultimately influenced their persistence in STEM. As the graduate students functioned as peer mentors, they cultivated a deep interest in their mentees' well-being and growth. They received meaningful and affirming recognition by the mentees, which in turn served to further build mentors' self-efficacy and determination to be successful. Further, recognizing themselves as role models for other women and racial and ethnic minorities in STEM, and developing a deep interest in helping others to be successful in STEM, became a primary reason the mentors developed confidence and self-efficacy—central to why they decided that they wanted to persist and become leaders in STEM. These findings align with previous research that supports the benefit of mentoring relationships between "like others"—those who share gender and racial and ethnic identities (Mondisa, 2018). Further, for black females specifically, mentoring relationships among black females support the building and maintenance of sense of community as well as the development of STEM identity (Mondisa, 2018). The findings also align with research that indicates engaging in peer mentoring may contribute to increased satisfaction with students' selected field of study, foster participation and commitment to the field, and enhance professional identity (Holland *et al*., 2012).

The mentoring experience was also salient to the mentors' sense of belonging and integration into the institution and chosen STEM field. The mentors described experiencing a "sisterhood." Engagement in sisterhood, specifically the description of engagement with STEM professionals, illuminates what Wenger (1998) identified as imagination—a mode for developing belonging in a community and an aspect of solidifying one's identity within a community.

Imagination is “the creative process of producing new ‘images’ and of generating new relations through time and space that become constitutive of the self” (Wenger, 1998, p. 177). This aligns with previous research that has explored the relationship between sense of belonging and persistence (Astin, 1984; Graham and McClain, 2019), specifically noting that individuals who experience belonging, and thus a high level of involvement, also experience high levels of integration (Milem and Berger, 1997). And, as integration relies on social interactions and social support, the feedback received from mentees by the mentors helped solidify their belonging in the STEM arena (Tinto, 1987).

While challenges were noted, including the difficulty of coordinating schedules, the need for more time to devote attention to the mentoring relationship, and the desire for increased faculty support, the findings overall demonstrate that a blended peer mentoring model is helpful in supporting women and racial and ethnic minorities engaging in STEM degree programs. The flexible nature of the blended program, which allowed for both face-to-face and distance components, enabled the peer mentees to balance the mentoring with commitments external to the program. As the literature has demonstrated, women often find that they experience a “double shift,” balancing familial and professional expectations (Ward and Wolf-Wendel, 2012). The flexibility inherent to the blended model allowed for participation in the mentoring relationship that may not have otherwise been feasible with family and work responsibilities. However, despite the difficulties cited by mentors in juggling multiple commitments and feeling as if they had insufficient time to devote to the mentoring relationship, all of the mentors shared a desire to be engaged in mentoring components more often through interaction with other mentors, increased opportunities for face-to-face meetings with mentees, and increased opportunities for interaction with faculty. This finding highlights the delicate balance required in

order to enact a successful peer mentoring program—the need for sufficient support and interactions while also affording flexibility and convenience.

**Implications**

The findings of the current study demonstrate that the competencies developed by peer mentors were central to increasing self-efficacy, interest in STEM, intent to persist in STEM, competence, and confidence. This finding reinforces the importance of providing peer mentors with training, resources, and ongoing faculty support in order to ensure an effective peer mentoring experience and, ultimately, to broader participation of UREMW in STEM. Peer mentoring programs should, thus, offer specific materials and resources that address areas in which peer mentors identify needs and, importantly, include faculty support. However, faculty should be cautious in not dominating the peer mentoring relationship, recognizing that there exists a delicate balance in providing support while simultaneously allowing for independence and autonomy of the peer mentor. Future research might include additional faculty support as one additional resource for peer mentors. Examination of the impacts of engaging in mentoring from a longitudinal perspective is also needed to determine what lasting impacts, if any, are imparted through the current model. Future research might also examine whether the current model is effective at other institutions, such as minority-serving institutions, and among other marginalized populations.

Peer mentoring programs should also consider the context used. Peer mentors benefitted from the flexibility of the virtual environment as meeting online enabled the mentors to meet with their mentees at any location and at non-traditional times (e.g., late at night). In addition to appreciation of the virtual environment, the value of face-to-face interactions between peer mentors and mentees should also be considered. Given the peer mentors' struggles to balance

work, school, and other life responsibilities, institutions might consider providing academic credit for peer mentoring service as either a course or course component. However, the current study supports that UREMW may be interested in and benefit from engaging in peer mentoring relationships. Further study should explore the effectiveness of engagement in peer mentoring at other HBCUs in other geographic locations.

Finally, while qualitative analysis did not include reflection as a theme, several mentors often mentioned the importance of self-reflective components both within the mentor training and during the mentoring process. Building in intentional opportunities for self-reflection can assist in the psychosocial development of mentors and, in turn, increase their confidence in mentoring and their sense of belonging in the field. Thus, peer mentoring programs (formal and informal) should include opportunities for self-reflection.

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