A Case for A Virtual STEM Peer Mentoring Experience for Racial and Ethnic Minority Women Mentees

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Abstract

Purpose

While previous research has examined the effectiveness of peer mentoring from the mentee's perspective, more research is needed to uncover how and why the interplay of the peer mentoring relationship in a virtual format, especially for racial and ethnic minority (REM) women in HBCUs seeking a STEM degree impacts STEM success. This study seeks to address weaknesses in the mentoring literature by presenting a through and thick description of the peer mentoring experience for REM women in HBCUs pursuing STEM degrees.

Design

A multi-site case study approach (Yin, 2014) was employed to explore to what extent, if at all, and, if so, how participating in the virtual STEM peer mentoring experience influences peer mentees' STEM beliefs, interests, skills, and behaviors.

Findings

Findings demonstrated that the experiences of undergraduate REM women mentees supported engagement in virtual STEM peer mentoring as it was beneficial to developing a sense of belonging, enhancing interest in STEM, encouraging STEM identity, building STEM self-efficacy, and ultimately, promoting STEM persistence. The current study provides a rich picture of how and why peer mentoring is perceived as effective by mentees in STEM programs at HBCUs.

Originality

The findings from this study contribute greatly to the body of knowledge and will serve as a foundational model on which future virtual STEM peer mentoring relationships can be built and fostered among populations at other HBCUs, with the potential to broaden participation in STEM.

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While there is a continued disparity in the number of racial and ethnic minority (REM) women who engage in science, technology, engineering, and mathematics (STEM) compared to the number of White men (National Science Foundation [NSF], 2019), a rise in this population across higher education is occurring (NCES, 2018). If these encouraging patterns of enrollment and graduation are to transfer to the STEM fields, where large disparities occur, traditional systems and programs need to be transformed. Research is needed to understand programs and structures within higher education institutions that support the experiences of REM women.

Research on mentoring programs is no exception. Researchers have documented that mentoring programs can be beneficial in supporting the persistence and success of REM women, especially when programs consider the unique types of psychosocial and instrumental (e.g., career and academic) support needed to address the isolation and discrimination REM women often experience in STEM (Grant & Ghee, 2015). Limited research is also beginning to demonstrate that virtual mentoring programs may make mentoring more accessible to REM women. For, traditional, residential mentoring programs are often out of reach to many REM and women as meeting times and locations are inflexible and are typically structured in such a way as to benefit mentees that represent the majority in STEM fields of study: White, heteronormative, and male (Lancaster & Xu, 2017; Remy et al., 2018). Because many REM women have familial and job responsibilities that inhibit them from engaging in on-campus mentoring experiences, mentoring programs that are more flexible in both time and location need consideration. Virtual peer mentoring can be used to increase access to mentoring and develop inclusive environments that support all mentees' success in STEM fields (Gregg et al., 2017).Thus, the present study seeks to contribute to the mentoring program literature by examining the experience of REM women in a virtual STEM peer mentoring program piloted within the context of two historically black colleges and universities (HBCUs). Specifically, the aim of the present study is to determine to what extent, if any, does participation in a virtual STEM peer mentoring experience influence peer mentees' STEM beliefs, interests, skills, and behaviors.

Definition

The term mentoring has been ambiguous throughout the literature, referring to functions such as passive observation of a mentee, a reciprocal relationship between a mentor and mentee, and role modeling (Eby et al., 2007). While there is no single definition of virtual mentoring, Gershenfeld (2014) suggested that a strong mentoring definition should 'specify the functional aspects of the program' in the study (p. 383). Therefore, we begin by presenting the definition of mentoring that is used to frame this study. We define mentoring 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" (National Academies of Sciences, Engineering, and Medicine [NASEM], 2019, p. 37). As the focus of this study is virtual peer mentoring, we refer to peer mentoring as a reciprocal, dynamic relationship that occurs between or among peers where one peer is usually more skilled or experienced than the other and referred to as a mentor. The less experienced peers are referred to as the mentees, which are our focus in this study. Moreover, virtual mentoring is defined specifically as a blended approach where professional meetings between mentors and mentees occur in a 1:1 and 1:3 ratio both digitally (e.g., social media, messaging) and face-to-face.

A Conceptual Framework

In addition to being grounded in a solid definition of virtual peer mentoring, an effective mentoring program must also be framed by a theory to guide the program outcomes. This study is grounded in Tinto's (1987; 2017) Institutional Departure Model, which surmises that personal attributes (i.e., race, gender) and previous experiences influence individuals' performances, experiences, and STEM degree attainment. These factors influence an individuals' ability to integrate both socially and academically into the STEM community and experience STEM success (Tinto, 1993). Students whose personal attributes and experiences do not match the prototypical STEM identity (i.e., White, heteronormative, male) face marginalization and isolation, which become obstacles to persistence and success (Kim et al., 2018). This is particularly true for women. Peer mentoring may provide social interactions, social support, and a source of belonging (i.e., integration), especially when matching REM women mentees with REM women mentors (Blake-Beard et al., 2011; Hernandez, Bloodhart, et al., 2017). Connecting with successful REM women in STEM through the peer mentoring relationship can reinforce mentees' socialization and integration in STEM, and thus, their success in STEM (Hernandez, Bloodhart, et al., 2017).

The study is further grounded in Social Cultural Career Theory (SCCT; Lent, Brown, & Hackett, 1994). SCCT upholds that individuals' interest promotes their intention, influencing the pursuit of a STEM degree and career. Interest inspires action, and experiences provide feedback that cyclically influences self-efficacy. An individual's self-efficacy and beliefs influence the attainment of specific STEM outcomes, motivation, goal setting, and persistence (Fouad et al., 2016). Self-efficacy is especially important as, more than ability, self-efficacy predicts REM women's success (Fouad, Fitzpatrick, & Liu, 2011; Ireland et al., 2018).

However, we focus not only on self-efficacy, STEM career interest, and persistence as desirable for the mentoring program under study, but also mentees' desired beliefs, skills, and behavior growth. We acknowledge that effective mentoring is not limited to a single career interest or persistence within a specific degree or career pathway, and that the effectiveness of the relationship may also be defined by achieving the goals that the mentor and mentee set forth together. Further, the mentee's satisfaction with mentoring relationships is dependent on their perception of the quality of the relationship and frequency of contact (Eby et al., 2013; Hernandez, Estrada, et al., 2017), and peer mentoring relationships and their outcomes are influenced by gender, racial and ethnic backgrounds, as well as context (e.g., HBCU, virtual environment).

The Contribution to the Mentoring Literature

While previous research has examined the effectiveness of peer mentoring from the mentee's perspective, more research is needed to uncover whether, how, and why the interplay of the peer mentoring relationship in a virtual format, especially for REM women in HBCU seeking a STEM degree, impacts STEM success. Most research has focused on faculty mentoring of students within the context of the research laboratory at predominantly White institutions (PWI) and has been conducted in primarily face-to-face environments (Gershenfeld, 2014; Linn et al., 2015; McGee, 2016; NASEM, 2019). For example, Patton (2009) interviewed eight female African American graduate students from a PWI about their experiences with mentoring. All the participants perceived an African American woman as the ideal mentor, as she would possess the capacity to relate to their experiences, share advice, and 'offer observations from her own experiences to help them avoid pitfalls and mistakes' (p. 530). Grant and Simmons (2008), in their narrative study of two African American women in academia, one faculty and one doctoral student, found similarly that additional same-sex, same-race mentors are

ideal for African American women to succeed against barriers at PWIs. Absent from the literature, however, is research on the mentoring experiences of REM women in HBCU contexts where barriers may differ and desired mentors more prevalent (Gasman & Nguyen, 2014). Literature on STEM peer mentoring, especially in virtual environments, is even more sparse. Gregg et al. (2017) focused on virtual STEM mentoring for college students with disabilities and found effective mentoring on a variety of social media platforms. The researchers found that participants for whom conventional peer mentoring activities would be out of reach reported growth in STEM. In an expanded version of the same study, the researchers found virtual mentoring enhanced the STEM academic outcomes of REM (Gregg et al., 2017). The present study builds on Gregg and colleagues' work to explore the impact of virtual mentoring on REM women and expand research to examine mentoring in the HBCU context. This study also seeks to address additional weaknesses in the mentoring literature by presenting a through description of the peer mentoring experience and the experience of mentees with trained mentors.

Lunsford et al. (2017) reported that poor descriptions of mentoring relationships, including how they are established, structured, and supported, continue to make it difficult to ascertain what is occurring during the mentoring process and to isolate the elements of the relationship to understand the factors influencing mentee outcomes. This was reiterated in the most recent NASEM report (2019). Unfortunately, 'information on primary mentoring program components […] was absent in 75% of studies, making replication difficult', revealing another weakness in the existing literature on mentoring (Gershenfeld, 2014, p. 366); namely, that detailed accounts about the context, roles, and functions for the mentoring relationship are largely missing from the literature. Inconsistencies exist in how mentors are trained to support their mentees, although studies extensively demonstrate the efficacy of trained mentors (Pfund et al., 2016; Sorkness et al., 2015). Moreover, Crisp and Cruz (2009) noted the necessity of future studies that incorporate qualitative findings to expand understanding of non-traditional and underrepresented groups' experiences with mentoring. Even though deficiencies in methodological rigor have persisted in the literature, mentoring programs have proliferated across college campuses at a high rate. If colleges are to fully realize the potential of peer mentoring programs and ensure that they are a worthy investment of time and energy, more rigorous, well-structured research in the area of peer mentorship is necessary (Linn et al., 2015).

Methods

A multi-site case study approach (Yin, 2014) was employed to explore the following research question: If at all, to what extent and how did participating in the virtual Stem Peer Mentoring (VSTEM PM) experience influence peer mentees' STEM beliefs, interests, skills, and behaviors?

In Fall 2018, 20 undergraduate students across two HBCUs were selected to serve as peer mentees. HBCUs were selected based on proximity to the research team (i.e., location) and receipt of XX funding to support the current study. The use of a multi-site case study allowed a larger population from which to draw the participant sample, enabling a more representative sample. Mentees were recruited through distribution of flyers, email announcements, social media, and word of mouth. An incentive was offered to encourage participation (e.g., laptop to facilitate completion of the online components of the program and a nominal stipend). Mentees were chosen through a rigorous application process, requiring that participants be women enrolled in an undergraduate STEM degree program at one of the two participating HBCUs, have a grade point average of 2.8 or above, and provide a letter of recommendation from a

STEM faculty member upon request. Four faculty members who held doctoral degrees in social sciences and/or a STEM field screened applications and selected the participants (i.e., Biology, *n* = 7 [33.3%]; Engineering, *n* = 6 [28.6%]; Math, *n* = 3 [19%]; Pre-med, *n* = 1 [4.8%]; Computer Science, *n* = 2 [9.5%]; Other, *n* = 1 [4.8%]). Participants were between the ages of 18-22. Most (*n* = 16, 80%) of the participants identified themselves as Black. However, participants also identified as Hispanic (*n* = 1), American Indian (*n* = 1), Pacific Islander (*n* = 1), and Mixed (*n* = 1), respectively. Upon selection for the program, each mentee was assigned to a peer mentoring group consisting of one STEM graduate student mentor and two to three other mentees. In light of the research suggesting that racial and ethnic minority women may experience more satisfaction and psychosocial rapport with mentors with whom they share similar value, race, and gender orientations (Blake-Beard et al., 2011; Lee, 1999; Russell et al., 2007), mentees and mentors were matched based on gender, race/ethnicity, and universities. While cross-university peer mentor and mentee interaction occurred, all mentees were assigned mentors from the institutions where they were seeking their degrees as having on-site mentor was deemed valuable due to the importance of heuristic knowledge the mentor could provide to the mentee to successfully navigate the institution attending (Whittaker et al., 2015; Zambrana et al., 2015). Each graduate student mentor participated in a six-week virtual training (Authors, in press); the authors have investigated both the training and mentors' experiences in the program (Authors, in press).

During the 2018-2019 academic year, peer mentees individually met with their mentors four times per month and with their triads or collective groups on the alternate weeks, engaging in twice-monthly meetings. Meetings took place both in person on- and off-campus as well as online via video conferencing and discussion forums; phone calls, texts, and chats between scheduled meetings were also frequent. On average, mentors and mentees met 50% online and 50% via a distance medium. Meeting length varied.

Within the first several meetings, peer mentees engaged in an activity about aligning expectations with their peer mentors. They also collaboratively created a peer mentoring agreement, and mentees set three goals documented on an individualized development plan. Subsequent meetings then focused on the individual mentee's goals, which were personal, professional, and academic in nature. Meeting requirements and some activities were structured through the program (*url*). Throughout the relationship, mentees were provided professional socialization; academic and career support; and psychosocial, personal, and emotional support. During meetings, mentors guided the mentees through problem-solving activities to solve professional and personal problems, provided professional socialization through case study discussions focused on discipline specific norms and skills, assisted with job and internship searches, provided feedback on professional products (e.g. conference presentations), and used active listening and empathic confrontation to assist with barriers mentees faced. For each individual and group mentoring session, mentors kept notes and submitted them to the program's faculty coordinators. At five points during the semester, twice at one participating HBCU and three times at the other participating HBCU, all the mentors and mentees gathered for a luncheon, where a STEM professional, a REM woman working in STEM, was invited to speak and interact with all program mentors and mentees.

Data Collection and Analysis

Data were collected from the mentees via semi-structured interviews. Mentors and mentees also participated in focus group interviews. Interview questions asked pertained to how the peer mentoring experience influenced the mentees' self-efficacy, STEM career interest, and

STEM skills, knowledge, and behaviors. Interviews were conducted via video conference sessions, were recorded, and were transcribed. Observations were also completed of online discussion forums that the mentors and mentees used for the program as well as the mentors' weekly meeting notes (Yin, 2014).

Qualitative data were analyzed using coding cycles (Saldaña, 2013). Within the first cycle, coding was open and inductive (Patton, 2002). Significant words and phrases were highlighted within the data. Using descriptive coding (Miles et al., 2014), these significant words and phrases were labeled and coded within and across the two cases. Within the second cycle, these codes were aggregated into 15 categories. Through a deductive pattern coding process (Miles et al., 2014), 15 categories were merged into 4 broad themes within and across the two cases.

Results

Findings

Findings illuminated benefits of the program. From the data, four themes emerged including a) The Salient Condition: A Virtual Sisterhood, b) The Salient Program Elements and Sisterhood Experiences, c) The Salient Mechanisms that Motivated Outcomes, and d) Positive STEM Outcomes (see Figure 1).

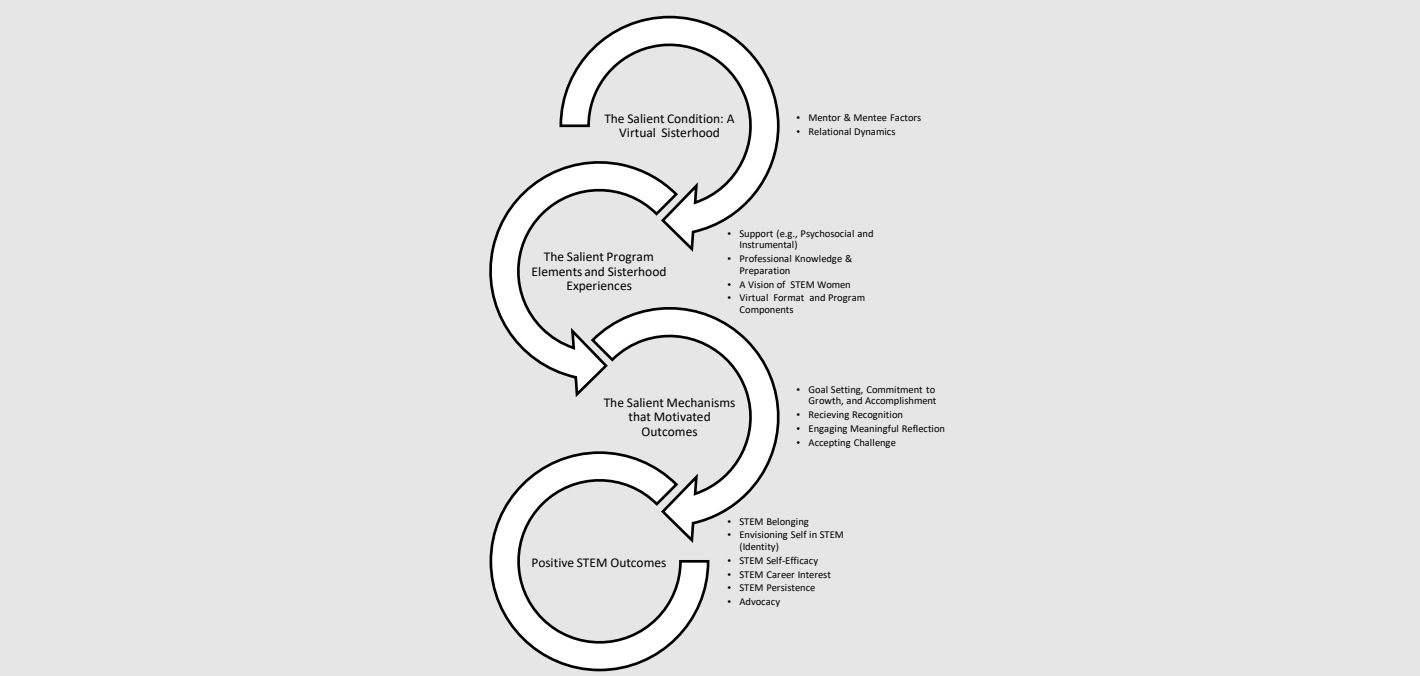

Figure 1. *Model of findings.*

The Salient Condition: A Virtual Sisterhood

Over 60% of the mentees, in their interviews, used the term 'sisterhood' to describe the relationships formed within and between each collective mentoring group in which they participated. One mentee described, 'My experience in the peer-mentoring program was purely positive and uplifting. I formed a sisterhood, and the women that I was partnered with were like-minded…. We had each other's backs and knew we were going through the same things .... The sisterhood…. was not just about feeling encouraged and belonging. It was also about caring about each other too much to see each other stay stuck or not accomplish something.' The sisterhood provided the contextual foundation that facilitated the outcomes experienced within

the program. The mentees suggested that individual mentee and mentor factors and relational dynamics were essential in their feeling of safety and formation of trust that were needed for the building and maintenance of their 'sisterhood.'

Mentor Factors. All of the mentees perceived their mentors as trustworthy, authentic, accepting, non-judgmental, and caring much akin to what Rogers (1959) identified as unconditional positive regard. Mentees expressed being acknowledged and valued by their mentors, which facilitated trust and safety. One mentee noted that her mentor was 'very understanding and caring, always lending a listening ear, creating a safe space.' Although many mentees noted the importance of time in developing trust and ultimately their 'sisterhood,' several stated that the formal nature of the program still enabled the organic development of relationships.

Throughout the individual interviews, many mentees also attributed the development and maintenance of safety, trust, and, ultimately, the sisterhood to their mentor's various relational, psychosocial, and instrumental competencies, including actively listening, sincerely praising, providing education, providing information and instruction, modeling, facilitating and encouraging deliberate action, and assisting with competencies necessary for problem-solving. These competencies were also observed in the mentor's notes and online forum. In a focus group, one mentee reflected on her mentor's creation of a safe and inclusive environment while competently challenging her,

> I think they influenced it positively. I think one thing that I've learned through this entire process is how to persist and find out how to be happy and satisfied as a woman, a woman of color, in my career…. It wasn't really until I talked to my mentor that I decided to commit myself to my chosen career. She asked good questions to help me evaluate, praised me for my accomplishments, even a simple A in a course, and helped me network and become part of a club. There was a warm welcome into the community. She guided me too, and she always made me feel safe even when she was challenging me. I really needed that. She really pushed me to take action and was there to teach me and challenge me. She saw me for me and recognized me.

The mentors' responsibility, accountability, access, engagement, and reliability were also pivotal to the building and maintaining of trust, safety, and the sisterhood.

Responsibility and Reciprocal Relationship. Mentees recognized that they, too, needed to invest in the relationship. While the peer mentoring relationship was not absent of power dynamics, most of the mentees discussed the notion of shared responsibility and stewardship. Mentees saw the peer mentoring relationship as reciprocal in nature and responsibilities in the relationship shared. Throughout the mentor notes, there was evidence that the mentors encouraged the mentees to take action toward their goals and documentation of the active steps mentees took to achieve their goals.

One mentee reflected in an interview, 'I feel that it is an empowerment, it is an inspiration, it is accountability. … …her accountability to us, to me as a mentee… but accountability and responsibility to myself, too.'

Mutual growth and learning were also ideas exposed by several mentees. Mentees noted that the peer mentoring relationship enabled 'reciprocal interaction' and 'mutual learning.' One mentee recalled, 'my courageous action inspired my mentor…that made me see the importance of my investment in this [the relationship].'

Other Relational Dynamics. Finally, the concept of match and fit was also a subject of discourse and verified as salient to the sisterhood. Mentees identified a 'good fit' or match with

mentors who shared gender characteristics, race and ethnic backgrounds, values, and degree areas. Lack of match was sometimes considered evidence of the mentor's low capacity to provide instrumental (e.g., academic, career) and psychosocial support and information needed. One mentee noted that having a mentor who was engaged in the same STEM field as her would have been helpful, believing that the mentor would 'be more knowledgeable and help me to find things that I would need in my field'. Shared demographic characteristics and degree areas were described as engendering trust development and facilitating community building, aligning with similar existing research (Chan, 2018; Ireland et al., 2018). Shared values and an understanding of cultural and racial dynamics, however, emerged as the most salient theme regarding the match. Racial, gender, and cultural topics were most prevalently discussed in online forums and documented as salient topics of meetings in mentors meeting notes. Mentor meeting notes often documented addressing concerns related to unique experiences such as gender discrimination and racial and ethnic opportunities faced by the mentees.

The Salient Program Elements and Experiences

Mentees also suggested psychosocial and instrumental support, professional knowledge and preparation, and vision of STEM women as vital elements of the outcomes gained through the program.

Support. Support was identified as instrumental in mentees' growth and development in the program. Mentees cited instances of psychosocial and instrumental support, very similar to the well-documented support of mentors (Kram, 1985). As discussed in the interviews and documented in the forums and mentor notes, instrumental support was inclusive of providing information, providing professional advancement opportunities, assisting with locating and gaining internship or job placements, and connecting mentees to professional networks. One mentee noted that her mentor, 'always welcomed me to come in and shadow her' in her internship while another mentee stated that her mentor 'provided information and knowledge' to succeed academically and well as vocationally, helping her develop her resume and research potential internship opportunities that she needed to graduate. Another mentee shared how her mentor pointed her to helpful others and utilized her professional network, **'**If I made a comment or something about school, then she would ask me, have I tried talking to this person or that person… She would make suggestions.'

Moreover, mentors provided support for assessing, choosing, and persisting in academic and career pathways by assisting mentees in assessing their strengths, weaknesses, interests, and capabilities through critical reflection; exploration of career options via career assessments; developing, reviewing, and keeping mentees accountable for goals and progress toward goals; and empathically challenging ideas and behaviors; constructing plans of action; and persisting through challenges. One mentee recalled her mentor sharing, 'it's great to highlight a list of goals, but you need to break those up and have microgoals. And don't look down on yourself if you don't accomplish them. She said, just move on the next day.'

Psychosocial support included empathizing, active listening, building confidence, and encouraging. One mentee recounted an instance where her fear and lack of efficacy was inhibiting her from studying for and taking a discipline specific competency exam. She noted that her mentor's belief in her and active commitment to help her succeed through accountability and action provided the support she needed to progress toward her academic and vocational goals.

> I didn't study…. So, my mentor helped me set goals to start studying…. She'd always ask, 'How's it going?' and then say, 'I believe you can do this.' So, throughout the week,

> I would come to my room and I would do my own studying on my own time. I definitely began to feel more prepared for my test. I definitely needed to continue to study and believe I could pass. Having a mentor ask me about it and encourage me in it boosted my confidence…. She committed to keeping me accountable for studying and even helped me develop the study plan. A lot of people don't pass, so studying was imperative for me. I would say it [the mentoring relationship] definitely helped me be more confident, study, and pass.

Professional Knowledge and Preparation. Most mentees purported experiences at their HBCUs were similar to what has been previously documented in the literature (Borum & Walker, 2012). A few commented that the nurturing and supportive HBCU environment has contributed to their success as REM women in STEM. Throughout their programs, they received support, found a sense of community, were supplied with resources, and interacted with faculty who were of the same gender and racial backgrounds. The experience within their HBCU STEM program, they perceived, had not prepared them for the cultural, societal, and personal barriers they would likely face when they stepped outside of their safe environment. One mentee acknowledged this during her individual interview,

> My experience interacting with my mentor and other mentees opened my eyes to some of the things that they're going through that I may not have experienced as a STEM major here at [HBCU]. Because one thing specifically was a question that my mentor asked us one time was, 'Do you struggle being a female in the STEM field?' I've never struggled as being a female in the STEM field because, at least for math majors, there are more females than males. So, I haven't really experienced any kind of bias or any professors trying to downplay me trying to reach my goals. Everyone's always tried to help me along the way. I have been supported and it did not occur to me that I would face struggles as a Black woman.

Some mentees reflected on their mentor's self-disclosure as impactful and insightful to a women's experience in STEM,

> When she comes back [from her job] and tells me her struggles…it gives me the opportunity to develop those skills to navigate this area. Sharing her journey and her personal experiences helped me learn more about what being a woman in STEM is going to be like.

Several mentees found their experiences at the STEM luncheon salient to illuminating their understanding of the disparity in the number of REM women who engage in STEM compared to the number of White men (NSF, 2019). Learning about the disparities and barriers in STEM resulted in most of the mentees solidifying their commitment to their chosen STEM field and finding ways to encourage more women in STEM. One mentee provided this example,

> She [luncheon speaker] had statistics on how many people actually get a mathematics degree or get a master's degree in that, even doctoral degree. Seeing those stats just made me want to do what I'm doing more, I guess, to actually get out there and be a part of that statistic and to maybe even influence other people to become math majors…to change students' perspectives on math…. that did encourage me to pursue, to continue to pursue my major.

Vision of STEM Women. The program also provided mentees with numerous opportunities to interact with REM women who were STEM graduate students and professionals, including their mentors and individuals who attended and spoke at the STEM luncheons. Seeing and building a relationship with these role models assisted the mentees in envisioning themselves

as women, women of color, and mothers who could have satisfying STEM careers. Often, interacting with these role models inspired pursuit of advanced degrees and involvement in advocacy for REM women in STEM. The interactions also assisted many mentees in seeing that the traditional STEM career trajectory is not the only career pathway. One mentee explained,

> Two luncheons--the one where the president's wife from the university came and the one we had someone from [public university] come and speak. They were both women in STEM who persevered against the odds. So, they are living examples of what success in STEM looks like, and the possibility of routes that we can take. We don't have to just do it one way, doesn't have to be quick, but it can be done.

Moreover, many of the mentees were determined to pursue degrees in STEM because of their own inherent interest in doing so or enjoyment of learning. Altruism and the desire to serve others was also a key motivation. Unfortunately, as some pursued their degrees they began to wonder if their values and the career options available could be reconciled. They expressed concerns about finding a career pathway that aligned with what they valued most and would enable them to 'serve others' or 'interact and be with others', especially in male-centric fields.

Program Components and Format. The use of digital platforms increased the flexibility of the program and the accessibility of mentors to their mentees. Virtual mediums such as videoconferencing, social media, and chat were used for approximately 50% of the meetings. The virtual peer mentoring approach mitigated some of the barriers (e.g., time, locations) to peer mentoring that existed for them as REM women, which coincides with previous literature recommending e-mentoring for this population (Gregg et al., 2017). However, most mentees at some point during their interview noted that, while they did not have the time, they preferred and would have liked to meet face-to-face more frequently (e.g., 'We met off campus which was convenient and helpful…something I would change was just to incorporate more [F2F] campus meetings.').

Mechanisms that Motivated Outcomes

Engaging and participating in the various program elements (or the 'sisterhood') enabled the mentees to experience the following, which became mechanisms for change a) Goal Setting, Growth Commitment, and Accomplishment; b) Receiving Recognition; c) Engaging in Meaningful Reflection; and d) Accepting Challenge.

Goal Setting, Growth Commitment, and Accomplishment. Several mentees noted appreciation for their mentor assisting them in articulating goals, seeking resources, constructing plans of action, and envisioning accomplishment. The mentor's notes demonstrated that all mentees in the program set goals, experienced growth, and accomplished at least one goal. One mentee identified goal setting and planning as the most beneficial component of the program, 'What was most beneficial was like sitting down and, and basically mapping what I wanted to do in my major'. Another mentee noted, 'When I met with my mentor, our main topic of discussion was my goals. After leaving the meeting with her, I would always come back to my room or go to the library or go back to an academic building and just work on my goals'.

Receiving Recognition. Mentees noted that their participation afforded them the confidence and opportunity to receive recognition; recognition was often seen in the online forum with mentors writing, "Way to go, girl! You are representing well, and I know your presentation will go great." And " Don't minimize what you did. Your award is a great accomplishment. Let's celebrate." One mentee shared, 'I got the highest award, I got like three awards in the class…. I even won a prize…. I got the most awards out of the entire class and

enterprise. That really keeps me going, my mentor really believed that I could do this. That keeps me going right now.'

Another mentee reflected that the recognition of accomplishment from her mentor really encouraged her 'to continue to go on no matter what life may throw at me', demonstrating an agency of action in which she could intentionally resist and undermine 'structural constraints resulting from a subordinate location in the matrix of oppression' (Johnson, Brown, Carlone, & Cuevas, 2011, p. 343).

Engaging in Meaningful Reflection. Mentees discussed the benefit of engaging in reflective action, and mentors often documented in their notes that they used the reflective journal questions from their mentor training to challenge their mentees to reflect. One mentee shared, 'She would ask these great questions that caused me to critically reflect'. Purposeful engagement in meaningful reflection gave one mentee the opportunity to author her own identity as a woman of color and a professional, aligning with previous research (Johnson et al., 2011), while also serving as a mitigating protective factor in ensuring alignment of personal goals, strategy, and needs,

> It's been an eye opener for me as a scholar and as a woman and as a human being. And what I mean by that is, it's broadened my horizon and allowed me to step outside of my comfort zone and working towards my goal and being very advantageous about it, like really honing in on what my needs are. And not stretching myself so thin that I forget my objective and my goal.

Accepting Challenge. Finally, mentees accepted challenge, which further enhanced their ability to engage in opportunities and actions that motivated change. One mentee shared how, within the mentoring relationship, both she and her mentor encouraged one another to meet and overcome challenges head on, 'Sometimes even they [the mentor] get discouraged, and it's just like, 'No, we are going to do this''. She went further by explaining how, previously, she was discouraged and considered quitting. When encountering current challenges, she was encouraged to push forward,

> Because it's almost like going through the process all over again. I'm gonna hit some classes, they're going to be hard, and it's like, 'Oh, do I want to do this? [consider quitting] You're not going to do this [quit]. You went through this process already. Keep on moving.

Another mentee shared how the mentoring relationship helped her become more determined to accept challenge and refuse defeat,

> But it's just the fact that the support with this program, it has pushed me over the top. I really get the feeling sometimes that people look at me. When they see me they face up, because they are like 'this girl is relentless, she is not going to stop until she gets an intern[ship].

Positive STEM Outcomes

The mechanisms for change assisted the mentees in envisioning themselves as REM women in STEM building self- efficacy, and encouraging STEM interest, which, in turn, solidified their commitment to persist. Being part of a sisterhood and interacting with STEM professionals resulted in a sense of belonging in STEM as well as normalized their experiences. The mentees made comments in interviews and in the online forums such as, 'We're all going through the same things, we're all trying to do our best and get our degree, and it motivated us all and myself to push harder,' 'Having women that were like-minded going through the same experiences ….we are all going through the same things,' 'I realized it's not just me….other

females are having issues juggling school and life as well…now I am more determined to continue, 'and 'I know if possible.' Moreover, learning about the historical underrepresentation of REM women in STEM positions resulted in many of the mentees experiencing increased determination to take the road less traveled and blaze trails for others in order to broaden participation in STEM. This reflects the consensus that broadening participation of REM in STEM is most effectively addressed by providing support and encouragement for REM already interested in STEM (Johnson et al., 2011)—that is, facilitating continued interest and opportunities for advancement and accomplishment among those already engaging in STEM degrees and careers.

Discussion

In the present study, the experiences of undergraduate REM women mentees supported engagement in virtual STEM peer mentoring as it was beneficial to developing a sense of belonging, enhancing interest in STEM, encouraging STEM identity, building STEM self-efficacy, and ultimately, promoting STEM persistence. The current study provides a rich picture of how and why peer mentoring is perceived as effective by mentees in STEM programs at HBCUs. The sisterhood provided the contextual foundation that facilitated the outcomes experienced within the VSTEM PM program. The participating mentees suggested that individual mentee and mentor factors and relational dynamics were essential in their feeling of safety and formation of trust that were needed for the building and, ultimately, the maintenance of their 'sisterhood.' The mentors' characteristics and competencies, the mentees' active participation, and the relational dynamics, especially the reciprocal nature of the relationship, fit, and match, facilitated the creation of the sisterhood. Specific program elements and experiences within the sisterhood enabled the mentees to experience the mechanisms (i.e., goal setting, growth, and accomplishment; recognition; meaningful reflection; and challenge) that ultimately generated the mentoring outcomes of increased belonging in STEM; STEM identity development and integration; and improved self-efficacy; which, in turn, solidified their STEM career interest and commitment to persist in their STEM degrees, even to seek advanced STEM degrees.

This research also illuminates the forms of social support within peer mentoring relationships that bolster REM women's career, academic, and psychosocial development in male-dominated fields such as STEM. Research to date has not yet produced a clear understanding of the types of support that are most needed and most effective for women and women of color in STEM (Dutta 2018; Mullet et al., 2017). This study fills a gap in mentoring literature that has existed for the past three decades and yields important insight regarding the characteristics of a successful mentoring relationships from the mentees' perspectives, leading to the development of a model for a VSTEM PM program among racial and ethnic minority STEM students attending HBCUs. The design and results of the study also extend the peer mentoring literature by working from a strong, established definition (NASEM, 2019) and theoretical grounding (Crisp & Cruz, 2009; Gershenfeld, 2014). The methodological rigor of this study also makes it a valuable addition to the existing peer mentoring literature.

Findings also provide many implications for STEM peer mentoring programs. Melton et al. (2018) argued that HBCUs and other minority-serving institutions make ideal settings for peer mentoring programs. HBCUs differ from PWIs because HBCUs employ strategies and a culture that cultivates belonging--stereotyping and discrimination in the classroom and in STEM labs are often minimized (Gasman & Nguyen, 2014). This contributes to the success of REM women's success in STEM (Perna et al., 2009). However, for some, this supportive environment

minimizes the acknowledgment of societal and personal barriers they will likely face as they enter the STEM workforce. The VSTEM PM thus played a pivotal role in not only enhancing perceptions of belonging, but preparing mentees with the knowledge and skills for the challenges they will likely face as REM women as they leave the safe haven of the HBCU and enter their respective STEM fields.

The use of a virtual program also allowed the mentees to experience the positive outcomes of a mentoring relationship that several mentees noted would have been inaccessible otherwise. However, consistent with the literature was the mentee's preference for the face-to-face meetings, even when recognized as logistically impossible. Many racial and ethnic groups, such as African Americans, place high emphasis on high touch 'communal values... which includes…community' (Remy et al., 2018, pp. 153-154). In consideration of these values, researchers have suggested that online programs need to offer opportunities for collaborative group context both with online and face-to-face meetings when possible to address the needs and values of diverse populations, especially African American students (Rovai & Gallien, 2005). While values are not monolithic within an entire race or ethnicity, consideration of such values can be valuable when educators and administrators seek to provide effective experiences for certain populations (Gallien & Peterson, 2004; Hale, 2001). Evidence from this study suggest that mentees value face-to-face interactions that enable community; thus suggesting that peer mentoring programs are designed around opportunities for both virtual interaction for the sake of convenience and accessibility as well as designed to ensure that individuals who are in geographical proximity to each other, whenever possible, can meet face-to face (Flannery, 1995).

In sum, the findings from this study contribute greatly to the body of knowledge and will serve as a foundational model on which future VSTEM PM relationships can be built and fostered among other HBCUs, with the potential to broaden participation in STEM.

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