The Benefits and Challenges of a Blended Peer Mentoring Program: Peer Mentors' STEM Beliefs, Interests, Skills, and Behaviors

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Abstract

In the 2018-2019 academic year, a blended peer mentoring program was piloted across two historically black institutions (HBCUs) with the aim to broaden the participation of minority women in science, technology, engineering, and mathematics (STEM). The current multi-site case study undertaken was aimed at exploring how and in what ways peer mentors' participation in the program influenced their beliefs, interests, skills, and behaviors related to STEM, with a specific focus on the mentoring experience. Evidence from the semi-structured interviews, focus groups, and survey demonstrated that the peer mentoring experience had a direct impact on the mentors' self-efficacy, career interest, leadership and professional skills, and intent to persist. Specific peer mentoring program experiences salient to these outcomes included: 1) recognition, 2) functioning as a mentor, 3) developing an other's orientation, 4) engaging in a sisterhood, and 5) developing competencies. Challenges experienced were also noted.

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A disparity exists between the number of men and women who engage in STEM degrees (National Science Foundation [NSF], 2019). Women remain underrepresented in STEM degrees, with women who also identify as an ethnic or racial minority being even less represented (NSF, 2019). Even when women choose to matriculate into STEM degree programs and graduate, relatively few choose to pursue or remain in STEM careers (Fouad, Singh, Cappaert, Chang, & Wan, 2016). Lack of representation of White and minority women in STEM degrees and careers has been attributed to myriad reasons, including family responsibilities, lack of fit between jobs and personal values, and a reportedly hostile climate (Dawson et al., 2015; Fouad et al., 2016). However, research supports that a so-called "confidence gap", resulting from poor self-efficacy, serves as a foundational reason for the disparity in participation in STEM degrees and careers (Hill et al., 2010). For over two decades, researchers have attributed White and minority women's lack of engagement in STEM degree programs (Falk et al., 2017) and matriculation from STEM degrees or careers (Cadaret et al., 2017; Dawson et al., 2015; Falk et al., 2017; Hill et al., 2010, 2015) to poor self-efficacy.

Consequently, growing interest in improving self-efficacy of women to broaden participation has emerged, and engagement in mentoring relationships have been identified as central to the development of self-efficacy and, ultimately, persistence (Carlone & Johnson, 2007; Hill et al., 2010). Participation in mentoring relationships has been cited as an important element in assisting minority women in advancing in White, male dominated fields (Chan, 2018; Pon-Barry et al., 2017). Therefore, the purpose of this study was to examine how and to what extent graduate-level minority women mentors' participation in a blended peer mentoring

experience at two HBCUs influenced their STEM beliefs, interests, skills, and behaviors. For the purpose of this study, mentorship was defined as "a reciprocal, dynamic relationship between mentor (or mentoring team) and mentee that promotes satisfaction and development of both" (McGee & Keller, 2007, p. 316), and peer mentoring was defined as a reciprocal, dynamic relationship that occurs between or among peers, in which one peer is more skilled or experienced than the other. The focus on peer mentoring is especially important as peer mentoring includes both psychosocial (e.g., emotional and psychological support) and task functions (e.g., providing information, setting goals, finding resources) (Terrion & Leonard, 2010).

Conceptual Framework

The current study was grounded in Tinto's (1987; 1993; 2017) Institutional Departure Model. The model supports that personal attributes (e.g., race, gender, culture), family backgrounds (e.g., socioeconomic status, parental education), and previous experiences all directly and indirectly influence students' performance, experience, and STEM degree attainment. Further, students' persistence in a STEM degree is influenced by the degree to which they integrate into the university and into the STEM community, which in turn influences students' institutional and discipline-specific commitment and, thus, their likelihood to earn a STEM degree. While many factors have been found influential in students' integration, formal mentoring experiences have been shown especially important to ethnic and racial minorities and women (Yosso, 2005).

Social Cultural Career Theory (SCCT; Lent et al., 1994) also supports the current study. The premise of SCCT is that students' interest promotes their intention to enroll in STEM courses, pursue STEM degrees, and pursue STEM careers. Interest and intention motivate action,

with success and failures providing specific feedback that influences self-efficacy and performance outcome. Further, self-efficacy and beliefs surrounding the likelihood to achieve a performance outcome influence motivation, goals, and persistence. SCCT is grounded in Bandura's (2006) self-efficacy framework, which proposed four factors that influence self-efficacy: mastery experience or performance accomplishment, vicarious experience, social persuasion, and psychological response. These four factors intersect to form an individual's self-efficacy-- individual's perceptions of being capable of reaching success on certain tasks towards goal completion, supporting persistence, and influencing performance in STEM (Anagnos et al., 2014; Fouad et al., 2016). Self-efficacy has been shown to be especially salient to ethnic and racial minorities and women (Anagnos et al., 2014; Fouad et al., 2011; Ireland et al., 2018; MacPhee et al., 2013).

Methods

In the 2018-2019 academic year, a blended peer mentoring program was piloted across two HBCUs with the aim to broaden the participation of minority women in STEM. Graduate students enrolled in STEM programs across the two participating HBCUs were invited to be peer mentors in a peer mentorship program consisting of both face-to-face and online components—thus, a blended peer mentorship program. Through a rigorous application process, seven mentors were invited to participate in the program. Six mentors participated in this study. The mentors were required to be a woman or racial or ethnic minority in STEM, be enrolled in a STEM degree program, have a cumulative GPA of 3.0 or higher, and provide a letter of recommendation from a STEM faculty member upon request. Upon selection for the program in Summer 2018, the peer mentors were invited to participate in an online, self-paced six-module training program. In Fall 2018, each mentor was assigned two to three undergraduate mentees

enrolled in STEM programs (e.g., engineering, biology, etc.). During the Fall 2018 and Spring 2019 semesters, peer mentors met with individual mentees on a weekly basis. They also frequently met with their mentees in a group. Meetings took place both in person on campus and at local coffee shops as well as online via video conferencing and chat. Phone calls, texts, and online chats between scheduled meetings were also frequent. For each individual and peer mentoring session, mentors kept notes and submitted them to the program's faculty coordinators. At four points during the semester, twice at each HBCU, all the mentors and mentees gathered for a luncheon, where a STEM professional was invited to speak and interact with all the mentors and mentees.

The current study was undertaken to explore how and in what ways peer mentors' participation in the program influenced their beliefs, interests, skills, and behaviors, with a specific focus on the mentoring experience. The mentor training was investigated in a previous inquiry (Rockinson-Szapkiw, Wendt, & Sharpe, in progress). The research questions for the current study included:

- 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 multi-site case study approach was used to investigate these questions as the researchers desired to explore "how" or "why" questions within a real-world context across two cases or institutions (Yin, 2014).

All of the peer mentor participants were minority women between the ages of 22-31 enrolled in a STEM graduate program. Five of the mentors identified their race as Black, and one

mentor identified her race as Hispanic. Table 1 describes the mentors' demographics and case. All six mentors participated in the survey and five mentors participated in the semi-structured interviews and focus groups.

Table 1.

Mentor Demographics

Pseudonym	Race	Age	Gender	Case
Jerrica	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

Data were collected from the mentors via a survey prior to participation in the program as well as in the final week of the program. The survey consisted of open-ended questions related to intent to persist and personal development as well as items to measure STEM self-efficacy (STEM SE), STEM career interest (STEM-CIS; Kier et al., 2014), and mentoring skills (PAMI; Cohen, 2003). Additionally, during the final week of the program, the mentors participated in semi-structured interviews. To further ensure the trustworthiness of the data, the researchers also reviewed the mentors' weekly mentoring notes, which confirmed data collected in the survey and interviews (Creswell, 2013; Yin, 2014).

Descriptive statistics (e.g., *M, SD*) and percentage of change were calculated for the quantitative data collected from the surveys to determine if peer mentors' self-efficacy, and in

turn, mentor's mentorship skill development, STEM career interest and STEM persistence changed from the pre- to post-program assessments.

Coding cycles were then used to analyze the qualitative data (Saldaña, 2013). Analysis within the first cycle was open and inductive (Patton, 2002). Significant words, phrases, and passages were highlighted within the semi-structured interviews and open-ended survey questions. The researchers then used descriptive coding (Creswell, 2013) to label each significant word, theme, and passage, which resulted in 32 codes. Within the second cycle, the codes were aggregated into 15 categories. Then, a deductive pattern coding process (Creswell, 2013) was used to merge the 15 categories into 6 broad themes within and across the two cases.

Results

The mentors believed that participation in the program increased their STEM self-efficacy from pre-training to post-training, which strengthened their mentorship skills and STEM career interest (see Table 2).

Evidence from the interviews and open-ended survey questions demonstrated that the peer mentoring experience had a direct impact on mentors' self-efficacy, career interest, leadership and professional skills, and intent to persist (see Table 3). While only four mentors reported intent to persist in their STEM degree program pre-training, all mentors reported intent to persist post-training. Likewise, only four mentors reported intent to pursue a STEM career pre-training and, post-training, all mentors reported intent to pursue a STEM career.

Table 2.

Descriptive Statistics for Pre- and Post-Surveys

	Pre-Training		Post-Training			
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
STEM-CIS Science	46.00	6.99	47.83	5.56	3.98%	5-55
STEM-CIS Math	40.83	8.33	44.00	10.84	7.76%	5-55
STEM-CIS Engineer	29.83	12.56	36.83	7.05	23.47%	5-55
STEM-CIS Tech	44.17	5.85	46.00	5.48	3.98%	5-55

Note. STEM SE = self-efficacy, STEM-CIS = career interest, and PAMI = mentoring skills, $N = 6$

Table 3.

Open-Ended Survey Questions

	Pre-Training		Post-Training		
Question	Yes	No	Yes	No	Change
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%
Do you intend to graduate from your STEM degree program?	4 (66.7%)	2 (33.3%)	6 (100%)	0 (0%)	50%

Note. $N = 6$

The thematic analysis of the data sources revealed that specific elements of the peer mentoring experience influenced the mentors' beliefs, interests, skills, and behaviors, including the following 5 themes: 1) recognition, 2) functioning as a mentor, 3) developing an other's orientation, 4) engaging in a sisterhood, 5) developing competencies, and 6) challenges.

Significance of the Study

While the benefits of mentoring for mentees is well documented, the evidence to support positive outcomes of the relationship for mentors has been limited. Moreover, the programs, books, and ideas on mentoring in STEM which have emerged, unfortunately, lack empirical research (McGee, 2016) and are primarily focused on mentoring in the research lab (e.g., *Entering Mentoring*) and in face-to-face environments at predominately White institutions. Thus, psychosocial aspects of the relationship have been largely ignored. Further, in general, peer mentoring programs that employ online and blended aspects are only beginning to be developed

and piloted (Leidenfrost et al., 2014; Watts et al., 2015), with most focusing on disciplines external to STEM. This study answers the call for the continuing need to develop interventions to support women's and, in particular, racial and ethnic minority women's participation in STEM, as well as encourage their persistence in STEM degrees and careers (Ireland et al., 2018). Further, this study adds to the current body of literature on the benefits of the peer mentorship experience to mentors.

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