STEM doctoral mentoring: a call for a conscious, culturally responsive journey

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Abstract

Purpose – The purpose of this research study was to explore U.S. STEM faculty's perceptions of culturally responsive mentoring underrepresented doctoral students in STEM programs. The research question that guided this study was "How do STEM doctoral faculty mentors engage in culturally responsive mentoring?

Design/methodology/approach – A case study research design was used and included findings from an embedded case drawn from a larger ongoing study. Six STEM faculty participants provided in-depth insights into the dynamic nature of the culturally responsive mentoring journey through semi-structured interviews that were analyzed using thematic analysis. The theoretical framework for this research study was grounded in the ideas posited by culturally responsive pedagogy.

Findings – The findings revealed three themes related to the mentoring journeys experienced by the faculty fellows: an academic journey, an intentional journey, and a subliminal journey.

Research limitations/implications – The findings of this research provide significant contribution to the current literature on mentoring and point to the importance of continuous, structured research efforts to increase the quality of mentoring for URM students in doctoral STEM programs.

Practical implications – STEM faculty could benefit from participating in mentor training framed by culturally responsive pedagogy. Future research is needed to explore the mentor training needs of STEM faculty in other environments, including contexts outside the United States.

Originality/value – This study extends understanding of STEM faculty's knowledge, dispositions, and abilities of culturally responsive mentoring and emphasizes the need for ongoing professional development training in this area.

Keywords Culturally responsive mentoring, Underrepresented minority students, STEM doctoral education, STEM faculty

Paper type Research paper

The United States (US) population has become increasingly more diverse; however, its higher education institutions continue to experience racial and ethnic disparities in graduation, educational inequalities and opportunity gaps, especially in science, technology, engineering, and mathematics (STEM) programs (de Brey *et al.*, 2019). This is evidenced by doctoral

student populations in STEM fields that do not reflect the increasing diversity of the United States. For example, in 2012, African Americans received just 5% and Hispanic students only 6% of doctorate degrees in STEM (National Science Foundation [NSF], 2014). However, African Americans made up just over 13% and Hispanics represented about 17% of the US population that year (US Department of Education, 2016). These groups, along with Native Americans, Native Hawaiians, Native Alaskans and Native Pacific Islanders, comprise what the National Science Foundation name underrepresented minorities (URMs). The extant literature suggests diversity, particularly in STEM, may be increased by providing support services such as mentoring.

Mentoring, as a term, has various connotations and is often conflated with advising. Schlosser *et al.* (2011) argued that a fundamental difference between advising and mentoring is that mentoring allows for a broader relationship than advising; the latter may be more focused on professional skill development. They contended that mentoring relationships can bridge into a deeper, more "emotionally bonded relationship" (p. 5). Millet and Nettles (2006) described a mentor as "someone on the faculty to whom students turned for advice, to review a paper, or for general support and encouragement" (p. 98). Similarly, Brunsma *et al.* (2017) agreed that mentoring is an additive, interventive component with graduate education that contributes to grant development, publication and fellowship-seeking opportunities. Lechuga (2011) contended that graduate students' relationship with faculty overall is one of the most important factors for success. In addition, the American Association for the Advancement of Science (2017) highlighted that "inclusive mentoring practices should help students succeed and make all students and early-career professionals feel like they belong and can succeed in STEM classrooms and/or careers" (p. 2). Inclusive mentoring practices are particularly important for minoritized students in STEM disciplines given the underrepresentation of faculty and students of color (Lechuga, 2011).

Brown-Nagin (2016) and Freeman and Kochan (2019) argued that higher education institutions face a mentoring gap. Underrepresented racial minority and low-income students face unique challenges in higher education and have unequal access to mentors who can nurture their talents and support them professionally and emotionally throughout their educational journey. With this in mind, the purpose of this research study was to explore the perceptions of US STEM faculty on culturally responsive mentoring of doctoral students in STEM programs. The research question that guided this study was "How do STEM doctoral faculty mentors engage in culturally responsive mentoring?" This paper describes the theoretical framework, literature on mentoring within the STEM field, methodology and findings. It concludes by identifying the implications of the study.

Theoretical framework
A central theoretical influence in this study was culturally relevant pedagogy introduced by Ladson-Billings (1995) and culturally responsive pedagogy introduced by Gay (2002). Culturally relevant pedagogy seeks to engage students in learning by connecting students' prior knowledge and cultural experiences, recognizing their various voices and empowering them to reach their full potential. Ladson-Billings (1995) highlighted the importance of teachers "empowering students intellectually, socially, emotionally, and politically by using cultural referents to impart knowledge, skills, and attitudes" (p. 18). Gay (2002) added that it is essential to build a cultural diversity knowledge base about students' heritage, use strategies that validate students' diverse cultures, be caring, empathetic educators and incorporate effective, cross-cultural communication skills when fostering culturally responsive environments. Culturally relevant pedagogy focuses on cultural, social, intellectual and emotional aspects of learning in social contexts. This approach guided the research study because it underlines the social nature of learning and development in the mentoring process.

Thus, culturally responsive mentoring can be viewed as validating the contributions of racially minoritized students' cultural histories, identities, experiences and worldviews and evaluating one's prejudices, biases and attitudes. To be most effective, mentoring should be culturally responsive. In the following section, we review literature related to STEM mentoring, mentoring URM students and cross-cultural mentoring.

Literature review

Mentoring in STEM graduate education has been described as "guiding and supporting students' career aspirations and sense of belonging on campus" (Crisp *et al.*, 2017, p. 12). Shanahan *et al.* (2015) also described 10 salient practices in mentoring STEM students. These practices include strategic pre-planning in order to be responsive to students' needs, setting clear expectations, teaching research skills, offering emotional support, providing sufficient time for mentees, promoting independence in the research process, helping students network in their discipline, facilitating peer mentoring and offering opportunities to share findings and accomplishments. For the purpose of this study, mentoring is understood as a journey that the mentor and mentee take together and is defined as:

> a process whereby one guides, leads, supports, teaches, and challenges other individuals to facilitate their personal, educational, and professional growth and development through mutual respect and trust. An understanding of cultural and gender differences is critical to the success of the mentoring process. Mentoring is viewed not only as a relationship between two individuals, but as a process. Mentoring is the all- inclusive description of everything that is done to support the protégé's orientation and professional development. It includes creating the relationship, ensuring emotional safety, and providing the cultural norms needed for risk-taking for the sake of learning and achieving the desired result of accelerated professional growth. (Wright-Harp *et al.*, 2008, p. 8)

Research confirms the benefits of mentoring in STEM programs. For example, Thiry *et al.* (2011) researched four universities where mentees reported that effective mentoring improved their confidence and skills in conducting research. Mentoring is especially valuable for racially and culturally diverse students. For example, many URM students experience feelings of isolation and lack of access to mentors, which may result in lower persistence and satisfaction rates in doctoral programs (Ellis, 2000; Girves *et al.*, 2005). Racially minoritized doctoral students, particularly, may feel isolated when embarking on an educational journey. Byars-Winston *et al.* (2015) found URMs in STEM reported it was crucial to have mentors that look like them, and Blake-Beard *et al.* (2011) argued that similarly, especially in STEM fields, mentors reflect mentees in terms of race and gender in order to foster positive mentoring relationships. When mentors and mentees do not share similar characteristics, such as race, gender and class, they may experience clashes during their mentoring journey. Unfortunately, few STEM faculty are members of underrepresented racial groups, which forces URM students to engage in cross-cultural mentorships that are fraught with difficulties. Johnson-Bailey and Cervero (2004) argued that cross-cultural mentoring relationships can be challenged in many ways, including experiencing trust issues, covert racism, power struggles, paternalism and marginalization.

Research has established that effective cross-cultural mentoring relationships impact minority student success in higher education and further career endeavors (Davidson and Foster-Johnson, 2001; Estrada *et al.*, 2018; Felder, 2010; Freeman and Kochan, 2019). For example, Davidson and Foster-Johnson (2001) asserted that formal mentoring relationships are important to advance the success of graduate URM students because mentoring can improve socialization and integration in the department, strengthen professional and social networking, improve graduate student research skills and prepare them for the future workforce. Eby (2008) claimed that mentoring women of color in STEM can help with socialization and career development.

Despite "growing evidence that mentoring programs may be an effective means to diversify the science, technology, engineering, and mathematics pipeline and workforce" (Crisp *et al.*, 2017, p. 9), the substantial benefits mentoring offers, especially for underrepresented minoritized students, and the prevalence of cross-cultural STEM doctoral mentorships, Hund *et al.* (2018) asserted that mentoring is not a principal goal of STEM faculty members, departments and institutions, and further, most scientists receive "little to no training and often lack essential skills for accomplishing this goal" (p. 9974). To date, little research has focused on exploring culturally responsive mentoring relationships (Byars-Winston *et al.*, 2015; Charleston *et al.*, 2014). This study fills a void in the literature, illustrating faculty's experiences and perceptions of mentoring and how those experiences and perceptions reflect the principles of culturally responsive mentoring.

Methodology

A qualitative research method was used to uncover and understand "how people interpret their experiences, how they construct their worlds, and what meaning they attribute to their experiences" (Merriam, 2016, p. 5). The case study methodology employed, specifically, a multiple embedded case study design. "A case study is an in-depth exploration from multiple perspectives of the complexity and uniqueness of a particular project, policy, institution, program or system in a real-life context" (Simons, 2009, p. 21). Table 1 illustrates the study design. Within this design, each case represents a different university: two predominately White institutions (PWISs) and one historically Black college and university. Each case had four embedded cases: faculty fellows, department leadership, doctoral students and URM doctoral students. Accordingly, this research design allowed for investigating the complexity and nuance of mentoring relationships to provide a richer understanding of how participants viewed the importance and promotion of culturally responsive mentoring. The findings presented in this article are drawn from the larger ongoing multiple embedded case study and report the findings of one of the embedded cases, the first cohort of faculty fellows at a PWIS, indicated as Institution A in the table.

Data collection

Data collection included individual, semi-structured interviews conducted by two members of the research team. Qualitative interviews seek "the customization of each conversation through individualizing follow-up questions and probes for specifics within each interview" (Ravitch and Carl, 2016, p. 146). Qualitative interviews also have a few characteristics that are key to this research. These are (1) relational, (2) contextual/contextualized, (3) non-evaluative, (4) person-centered, (5) temporal, (6) partial, (7) subjective and (8) non-neutral (Ravitch and Carl, 2016). This means that the interviews in this study emphasized establishing positive relationships; involved delving into participants' macro-sociopolitical contexts; focused on understanding participants' feelings, views and perceptions instead of judging or evaluating; centered on participants' needs in order to create a safe environment; and included "snapshots of a moment in time" (Ravitch and Carl, 2016, p. 149) in which participants shared

Case I Institution A	Case II Institution B	Case III Institution C	
(1) Department leadership	(1) Department leadership	(1) Department leadership	
(2) Graduate program directors	(2) Graduate program directors	(2) Graduate program directors	**Table 1.**
(3) Faculty fellows	(3) Faculty fellows	(3) Faculty fellows	Embedded case study
(4) Doctoral students	(4) Doctoral students	(4) Doctoral students	design

impactful memories and experiences and embraced understanding of the participants' and researcher's subjectivities such as their "bias, assumptions, and politics" (Ravitch and Carl, 2016, p. 149). The goal of the individual interviews in this study was to gain insights into life experiences and perspectives of STEM doctoral mentors. Six interviews ($n = 6$) were conducted. Each participant participated in one interview with an average duration of 60 min. Interviews were audio-recorded. Memo writing occurred and aimed to capture nonverbal reactions during the interview, offering more insights into the analysis (Ravitch and Carl, 2016).

Participants and setting

Participants named as faculty fellows in a mentorship training program funded by the NSF facilitated at a large PWIS in the southeastern part of the United States were recruited for this study. Faculty fellows applied to participate in the program, received a stipend and attended monthly and semi-annual workshops. Six faculty fellows representing different STEM departments agreed to participate. The six participating departments represented life sciences, physical sciences and mathematical sciences. To preserve anonymity, the specific departments are not named. There were four males and two females, none identified as URMs and all but one identified as White. The following are the participants' pseudonyms: Alexandra, Connor, Michael, Stephanie, Thomas and William. Table 2 provides information on participant demographics.

Analysis

All interviews were transcribed, and jotted memos from the interviews were expanded. Each of the four members of the research team inductively analyzed all data using the four stages of thematic analysis proposed by Bryman (2008) and described by Ravitch and Carl (2016). Data interpretation consisted of reading all the data sets, and then searching for relevant words and phrases, which were labeled by codes. The codes were organized into meaningful categories. The research team reread the data and took notes, determining interconnection between the categories in relation to the research question and developing thematic clusters that provided insight into the faculty fellows' mentoring relationships. The research team met regularly to develop the findings. This method was used to analyze data to discover the central themes across the interview transcripts. Data investigation in this case study followed a cyclical process that proceeded from more general to more specific analysis and conclusions (Ravitch and Carl, 2016).

Ethical considerations

This research followed an ethical protocol, including gathering voluntary informed consent forms from participants and using pseudonyms to refer to participants. Before the consent form was sent, the researcher provided participants with details of the nature and purpose of the research. Participation in the study was anonymous and voluntary. Participants could

Participant's pseudonym	Gender	Race
Alexandra	Female	White
Connor	Male	Asian
Michael	Male	White
Stephanie	Female	White
Thomas	Male	White
William	Male	White

Table 2.
Participants' demographic information

withdraw from the study at any time. The data collected were confidential. The interview transcripts were stored in a password-protected Google Drive folder. According to Shenton (2004), measures to ensure credibility of a study include providing a rich, detailed description of the study's context and data collection procedure, ensuring all researchers review the data analysis, and maintaining the researchers' journals to record personal reflections on data collection.

Findings
This study illuminates the sociocultural experiences of mentors and their journeys while mentoring in STEM doctoral programs. The findings revealed three themes: an academic journey, an intentional journey and a subliminal journey.

Theme: mentors' focus on the academic journey
The first theme to emerge from data analysis revealed that all the faculty fellows tended to view mentoring as academic support. During the interviews, faculty frequently discussed the importance of supporting students academically on their educational journey. For instance, the majority described their mentor role as providing guidance students need to complete the doctoral program. Two faculty fellows stated that they understood mentoring as only guiding students through the program without focusing on other aspects of mentoring. For instance, Connor stated, "As a mentor it's a little bit easier because again you're guiding them down a scientific path. You do not necessarily have to explore other things in their life that can be more challenging."

For others, this guidance also included meeting with students regularly to keep them on track and to offer personal support to improve matriculation in the program. While faculty fellows seemed to see mentoring as the act of supporting students academically to be productive students, Michael also showed recognition of thinking about students' stress levels in guiding them to complete the work effectively. For example, Michael shared,

> I always tell them that they should be very stressed out, Ph.D. students, in particular, but that stress should come from work. If there's other things in their life they gotta let me know because otherwise I just think they're not being productive when really there's some crisis. Right? So basically, it's how to communicate and then how to get the work done.

In general, faculty fellows emphasized the role of research during the mentoring journey. They articulated that mentors' focal responsibility was assisting students with research and encouraging them to publish and work in the labs. For instance, Thomas commented that, during his mentoring journey, he worked toward helping students become independent researchers. He commented, "I think an important step of mentoring is moving them beyond that and to be able to do more, generate knowledge and obtain new knowledge independently."

The STEM doctoral faculty in this study also discussed the importance of supporting students financially via funding opportunities and providing appropriate resources when they mentored students. Providing funding was a fundamental aspect of mentoring in STEM as faculty fellows felt obliged to make sure students had enough money to conduct research in the program. Faculty recognized the significance of sufficient funding. For instance, Thomas said,

> Well, I think probably one of the key ones is financial stability. I think it's important that students are well supported, whether that be research funds, or their stipend, whether that comes from an RA [research assistant], a fellowship that you help them obtain or they obtain, or TA-ships [teaching assistantship] and whatever supplemental resources can be provided for that.

The majority of faculty fellows also saw mentoring as a venue for mentees to network in academia, whether with students and professors in the program or outside the campus at conferences or other social events. For example, William described how he engaged in networking: "So making networking connections, providing the person with tangible letters of recommendation, so helping them to be seen by the outside world, and in the appropriate light [were important responsibilities of a mentor]."

Ultimately, STEM faculty conceptualized mentoring as an academic journey involving funding, networking and academic guidance to move students through the graduate program. While some recognized the role of personal support in this process, most did not.

Theme: a critical need for intentional journey

The second theme that emerged from the data analysis revealed mentoring in doctoral STEM programs lacked intentionality. Broughton *et al.* (2019) suggested that intentionality in mentoring practices includes purposeful and systematic engagement, particularly in areas of cultural competency and awareness. Mentoring practices that extend beyond advising are more a reflection of the department and institutional beliefs and actions in terms of commitment to direct engagement of empirical research, collaborative scholarly work and a more enhanced academic community (Cobb *et al.*, 2018). In this study, intentionality is framed in the following two ways: intentional cultural awareness and training.

Faculty fellows indicated a lack of systematic efforts to focus, prepare, structure and support mentoring, demonstrating awareness of the gaps within mentoring processes in graduate programs. For instance, faculty fellows expressed an awareness of the lack of representation between mentors and mentees. Three faculty fellows stated that URM students did not have many mentors that shared similar backgrounds and experiences. Thomas explained, "There were going to be all these people [URMs] that do not have any mentors to identify with." Data analysis also revealed faculty fellows recognized an overall lack of cultural awareness by STEM faculty. They were cognizant that some mentors may not have a deep understanding of their mentees' backgrounds due to cultural differences. Thus, mentors may overlook careful and thoughtful examination of mentees' needs, resulting in the inability to provide an enriching experience. For instance, Thomas explained,

> I think one of the hurdles is there's some things that just are not known. And, maybe, not necessarily conflicts, but there may be hurdles that arise because of cultural differences that are not recognized by a mentor in the mentee for example, or a department for example, that might isolate a mentee or the mentee might isolate the department because of some cultural things.

In addition to a deficiency in engaging in deliberate reflection on how cultural differences may affect mentees during mentoring relationships, the majority of faculty fellows reported that they received limited training on effective mentoring and thus did not gain crucial knowledge on how to mentor students, particularly racially and culturally diverse students successfully. They were aware of the lack of intentional preparation for their role as mentor and explained they had learned how to be successful mentors through their own experience of mentoring. For instance, Alexandra explained, "Yeah, it's totally individual. There's no discreet program for preparing faculty. I guess it's just more informal conversations with people."

Thomas stated that faculty did not receive mentoring training that equipped them with the knowledge and skills to work with students of various identities. The limited training experience indicated that he did not feel confident in working with racially and culturally diverse students. Thomas saw personal differences as one of the biggest challenges in mentoring relationships, commenting, "I think the other big one is personality differences. Sometimes they're not necessarily good or bad, but in that we don't receive a lot of training in those aspects."

While discussing the lack of training on effective mentoring, Connor explained that the faculty in the department would not necessarily want to attend a training program. He indicated faculty's resistance in deliberately improving their mentoring skills because such training might expose their mediocre jobs as mentors. He explained,

> The thing is that I feel the overwhelming majority of faculty would resist being told they had to receive mentorship training; particularly I think the resistance would go up exponentially with how poor of a mentor the faculty member really is.

While discussing the need for more training, three faculty fellows explained that they had limited funding support in their departments. They saw limitations in funding and coordination between the graduate school and the department, which inhibited the stability of funding students. For instance, Thomas mentioned, "Yeah, I think there could be better coordination with . . . the graduate school. I think there could be more. There's no cushion like if funding doesn't come through."

Ultimately, data revealed that the faculty fellows were aware of the gaps in their knowledge and resources that impacted their ability to offer effective mentoring in general. This recognition points to the importance of taking a more intentional journey that would forge more beneficial mentoring experiences. Data analysis indicated that the faculty fellows had little guidance and support in being effective mentors, much less culturally responsive ones.

Theme: mentoring as a subliminal journey
The third theme that emerged from data analysis suggests subliminal priming of presumptions, implicit biases, toward historically racially minoritized students. STEM doctoral mentors subliminally function from deficit and color-blind perspectives of URM students. A deficit perspective was evidenced in how some of the faculty fellows viewed URM students as ill-prepared for the graduate work. They did not trust the URM doctoral student capabilities in the graduate program. For instance, William expressed,

> They're coming in with a more diverse background than the students we've typically admitted to our program, which is good, but it's a challenge for the instructional faculty in the first-year core courses, because the students are at all different levels of preparedness.

Other faculty indicated that they could not relate to URM students' backgrounds, perhaps revealing their implicit bias toward working with URM mentees. Alexandra expressed her concern with working with one of her mentees who is a URM student:

> I'm not sure that I actually truly understand the society that he comes from and what unique circumstances he brings to table. I'm not sure that I truly understand his unique circumstances. I try, but I'm not sure that I truly do.

Michael echoed this:

> I don't feel uncomfortable mentoring them or trying to help them find jobs and so on, but if something were to come up that I felt that I didn't have experience or training [with], there's this worry that you're not relating or helping them or being as aware as you could be or should be.

Comments from two faculty fellows displayed a color-blind approach. These faculty fellows said they did not see race when discussing mentoring White versus URM students. This indicates they were unaware of the unique experiences and needs of URM students and did not take an active role in learning about their unique challenges in graduate STEM programs. For instance, one of Connor's answers indicated his color-blind approach to mentoring. He stated,

> I recognize that most people want the same things and deep down inside, there's only one race. The rest of it's just visual. The way that I mentor a URM student is the same way that I would mentor any

other student unless that student tells me that they're missing something, or I can somehow sense that there's a problem. One of us in the relationship would have to either admit that there was a problem or recognize the problem in another.

These findings hint at a lack of culturally responsive mentoring in STEM doctoral programs. The lack of intercultural understanding and implicit bias may be the cause. Overall, the data implied that participants strived for understanding their students and helping them reach their goals, but did not evaluate mentoring practices more critically. Therefore, the faculty fellows took a subliminal journey in their mentoring relationships that deprived them of deeply connecting with their racially and culturally diverse mentees and examining their own dispositions.

Discussion

This study provides valuable insights into how mentoring is perceived and promoted in higher education and calls for change in mentoring in STEM fields. This research adds to the growing body of mentoring literature that describes successful mentoring as going beyond academic support. The academic journey theme points to the need to reimagine mentoring in STEM doctoral programs as more than a student–advisor relationship (Schlosser *et al.*, 2011). The findings revealed that mentors assisted graduate students in thriving academically by offering support in research, funding and staying on track during the program but routinely failed to offer support in other areas. STEM doctoral students need mentors who care about their social and emotional well-being and who improve their sense of belonging in academia (Roberts *et al.*, 2008).

Another key finding in this study, intentional journey, highlights the significance of intentionality in mentoring relationships. Thus, intentional efforts, such as training in culturally responsive mentoring, should be forged across the whole department to nurture successful mentoring relationships. This finding adds to the existing body of literature that calls for institutional accountability, commitment and collaboration to provide support and training (Hund *et al.*, 2018; Scott and Miller, 2017), particularly for mentors of URM students (Brown-Nagin, 2016; Gardner, 2010). Institutional accountability can occur by creating conditions wherein faculty trend away from "reproduc[ing] status quo and militat[ing] against social, cultural, and intellectual diversity" (Scott and Miller, 2017, p. 150).

The third theme, subliminal journey, raises awareness about critical issues in mentoring journeys in doctoral STEM programs: implicit bias and racism. This research reveals the complexities of cross-racial mentoring dynamics as the majority of participants in this study were White. The relationships fostered with their mentees pointed to a lack of understanding of URM students' cultural differences, which may have influenced their mentoring experiences. Mentors may subliminally mask or obscure attitudes about racially minoritized doctoral students as well as choose not to see or understand minoritized concerns or issues, suggesting a lack of conscious awareness of micro insults or bias experienced by mentees (Gandhi, 2016).

The lack of diversity in the professoriate is most apparent in terms of the structural barriers it presents in mentoring a diverse class of students. Supporting research explains the mentoring gap in higher education, where mentoring relationships are fraught with power struggles, unconscious bias and misunderstandings (Freeman and Kochan, 2019; Johnson-Bailey and Cervero, 2004; Tillman, 2001). Faculty who have limited mentoring experiences with marginalized groups need information about how to "facilitate or confirm negative or affirming assumptions" (Wyatt *et al.*, 2019, p. 1) within the academy. They need to be aware of how problematic it is to construct the student identity of URM students as less prepared and to ignore their needs (McCoy *et al.*, 2015). Findings presented in this study affirm research that suggests a visible neglect of URM students in mentoring relationships

([Byars-Winston *et al.*, 2015](); [Charleston *et al.*, 2014]()), confirming the critical need for mentors who are culturally responsive and able to analyze the interplay of power, oppression and privilege in mentoring relationships and academic experiences ([Felder and Barker, 2013](); [Freeman and Kochan, 2019](); [House *et al.*, 2018](); [O'Meara *et al.*, 2013]()).

In essence, this research study indicates that mentoring is a complex social activity that requires responsivity to issues of culture. Culturally responsive mentoring as a journey happens in social contexts and involves the affirmation of students' backgrounds and views. This is particularly significant for URM students who often are involved in cross-cultural mentorships. Mentors need to engage in an examination of their dispositions in order to help URM students thrive in their doctoral programs. The findings suggest that culturally responsive mentoring was not a journey regularly traveled by those faculty fellows who participated in this study. This research suggests that culturally responsive mentoring should involve more conscious reflection and dialogue on the journey that mentors and mentees take together throughout the doctoral program.

Implications for higher education

This study offers two implications for mentoring and leadership in diverse educational contexts. One of the implications of this study is a more intentional development of formal mentoring training focused on culturally responsive mentoring in graduate STEM programs. Such training should engage faculty in analyzing their own cultural heritage and how it can impact their work with URM students. Thus, such training should offer a safe space for challenging faculty's belief systems and critically reflecting on their biases, privilege and dispositions. Such efforts should be systematic and inclusive, meaning faculty, staff and leadership should be mandated to participate and held accountable for implementing best practices for culturally responsive mentoring.

Second, this study provides meaningful information about understanding doctoral mentoring in STEM, thus adding to the theorization around mentoring. Mentoring can be integrated as a successful retention strategy to complement an academic support plan. This form of intentional support requires clarity about the purpose and function of mentoring separate from advising and the expected types of interactions and outcomes. Adding to the growing chorus of literature advocating for more holistic mentoring approaches, this study extends a need for a mentoring practice that emphasizes more than academic support and includes emotional support and intercultural understanding in mentoring relationships. The findings of this research provide significant contribution to the current literature on mentoring and point to the importance of continuous, structured research efforts to increase the quality of mentoring for URM students in doctoral STEM programs.

Implications for further research

Further research is necessary to deepen the understanding of the experiences, practices and challenges of effective culturally responsive mentoring in STEM doctoral programs. This article provides much needed empirical data on STEM doctoral mentoring practices and relationships. It would be beneficial to conduct longitudinal research to gain a deeper understanding of how these faculty fellows' practice and understanding of mentoring change as a result of participating in a mentorship training program. Since data collection included one interview with each faculty fellow, it could be extended to follow-up interviews with participants. It would also be valuable to include students' and administrators' voices and to compare them with the faculty fellows' mentoring practices. In this way, representing diverse voices will enhance understanding of the complex dynamics of mentoring in graduate STEM programs. Other avenues of research could include conducting this study in other parts of the

USA and in a non-US context to determine ways the findings are transferable to STEM doctoral mentoring in diverse geographic locations.

Limitations

There are several limitations in this study, including the sample size, participant bias, researcher bias and duration and location of the study. As is true of most qualitative research studies, the research is not generalizable due to the small number of participants and that the study took place in one institution located in the southeastern United States. The researchers also recognize that the participants and researchers may bring various perspectives, experiences and biases into the study. To counterbalance this, the researchers documented their reflections in a journal throughout the study and provided participants with a safe space for dialogue and reflection.

Conclusion

This study explored the experiences and perceptions of STEM doctoral faculty serving as faculty fellows in a mentorship training program. Framed by culturally responsive pedagogy, this research revealed three themes relating to the mentoring journeys experienced by the faculty fellows. First, STEM doctoral mentoring tends to be understood as an academic journey deprived of social and emotional support. Second, there is a critical need to see mentoring of STEM doctoral students as an intentional journey that involves deliberate efforts in developing relevant skills, knowledge and dispositions. Third, data exposed hidden biases and dispositions held by mentors about URM students that may affect the quality of mentoring relationships, suggesting a subliminal journey. These findings pinpoint a critical need for STEM faculty to become more conscious, culturally responsive mentors. Thus, this research calls for the transformation of mentoring in STEM fields.

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