

# **The Missing Pieces of Nurturing Students' Needs in Doctoral STEM Mentoring Relationships**

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## **Abstract**

*Mentoring is crucial for academic success in higher education, especially for women and minority students in STEM doctoral programs. The purpose of this paper was to examine mentoring relationships involving diverse doctoral students studying in the STEM programs at the university in the southeastern part of the United States. Data collection methods included focus groups with twenty-five students and individual interviews with nine underrepresented minority students studying at various STEM programs. Data was analyzed using an inductive process. The findings reveal a few missing pieces to effective mentoring that are connected with feelings of lack of personal, social, and cultural inclusion in mentoring relationships. These findings call for transformation of mentoring in graduate STEM education.*

## **1. Introduction**

Many universities across the United States have witnessed disparities in diversity in doctoral student populations in STEM programs. The National Science Foundation [17] reports that women and minorities are underrepresented in achieving doctoral STEM related degrees. Many scholars emphasize the importance of support networks of mentors, who can contribute in reducing the diversity gap in graduate programs [1] [7] [11] [18]. A body of research illustrates that minority students face racism, discrimination, and microaggressions at the graduate school, and especially in the STEM programs. The women and minority students may face social, cultural, and intellectual isolation and neglect in their departments [22]. Also, both the faculty and student population does not resemble the increasing diversity of the United States population [9]. In the view of such complex issues, this qualitative research study engaged twenty-five doctoral students in critical dialogue and reflection on their feelings about their mentoring relationships.

## **2. Literature Review**

Many scholars engaged in defining and exploring effective mentoring relationships. For the purpose of this study, mentoring is seen as an essential part of graduate student success. Mentoring can be defined as “a relationship between two individuals whereby the more experienced person is committed to providing developmental support to

the other, less experienced person” [2]. The benefits of mentoring include better academic performance [3] [16], persistence [23], social integration [12] [24], and increased career advancement [5] [15]. “There is growing evidence that mentoring programs may be an effective means to diversify the science, technology, engineering, and math (STEM) pipeline and workforce” [2].

Some scholars also discuss the dynamics of culture affecting mentoring relationships, especially power and prejudice that may lead to dysfunctional mentoring relationships between White male mentors and minority and female mentees [4] [18]. Also, some scholars voiced their concerns about effectiveness of mentoring in doctoral STEM programs as faculty in this field do not receive proper training [10] [11].

Some studies focused on defining what is a good mentor. For example, Hund et al. [11] found that effective mentors in STEM doctoral programs are considered as patient, honest, communicative, empathetic, respectful, and good listeners. Some studies also looked at successful and failed mentor relationships, and report that ineffective mentors are characterized as possessing limited communication skills, commitment, and experience [21]. In this study, when we asked the participants about their mentoring relationships and mentors, they used more negative descriptors. Therefore, this study makes a significant contribution to the literature on mentoring relationships by revealing the missing pieces of effective mentoring in STEM graduate programs at a university in the southeastern region of the United States.

### **3. Theoretical Framework**

This study draws on critical theory that “examines the current structure of society, in which dominant socioeconomic groups exploit and oppress subordinate groups” [6]. This research aimed at encouraging critical dialogue and reflection and “uncovering social structures, discourses, ideologies, and epistemologies that prop up both the status quo and a variety of forms of privilege” [13]. Thus, drawing on Freire [8] researchers engaged participants in open conversations on their mentoring relationships in order to elicit critical thinking, invite sharing experiences, and promote humility, hope, and mutual trust [8]. Drawing on critical theory, this study focused on understanding the social, historical, and contextual conditions of mentoring relationships in higher education.

### **4. Methodology**

A qualitative research method is used to uncover and understand “how people interpret their experiences, how they construct their world views, and what meaning they attribute to their experiences” [13]. The findings presented in this study are drawn from a larger ongoing study, a multiple embedded case study that includes various voices, such as faculty, students, and department leaders across three institutions. This article reports the findings of one of the embedded cases, the first cohort of doctoral students at Institution A.

“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” [19]. Accordingly, this research design allows for investigating complexity and nuances of mentoring relationships. The research question that guided this study is as follows: How do STEM doctoral students feel about their mentoring relationships?

The goal of the focus groups and individual interviews in this study was to gain insights into experiences and perspectives of STEM doctoral students. Each focus group lasted about 60 to 90 minutes and were conducted with the doctoral students at large from various STEM departments. Twenty-five students volunteered to be part of four focus groups. Also, nine underrepresented minority students agreed to semi-structured interviews that lasted between 45 to 90 minutes. The consent forms were collected before the data collection process. The consent forms explained the purpose of the study and confidentiality measures. The conversations in the focus groups and

individual interviews were audio recorded and transcribed. Memo writing occurred as well and was aimed to capture nonverbal reactions during the interview and offered more insights into the analysis [18].

## **5. Analysis**

Data from the focus groups and interviews was analyzed using an inductive process, namely constant comparative method [9]. The analysis started by looking for raw words, then codes and leading to the development of common themes, keeping in mind the research question. Drawing on Ravitch and Carl [19], the analysis process involved identifying words and phrases and organizing them into meaningful categories and then into thematic clusters. Data investigation followed a cyclical process that proceeded from more general to more specific analysis and conclusions [19].

## **6. Findings**

The findings from both the focus groups and individual interviews revealed the doctoral students' feelings and perceptions of ineffective mentoring in their doctoral STEM program. Some of the missing pieces of nurturing their needs were connected with feelings of lack of emotional, social, and cultural inclusion in their mentoring relationships.

### **6.1. Undermined**

A lot of students mentioned in the focus groups that they felt like they were being undermined. For example, they often said the mentors used them for their research purposes and asked them to deliver their work without engaging in the mutually benefiting research process. One of the male participants in the focused group explained:

“So, I think that gets to what other people are saying about some sort of getting the mentor's time for something that doesn't necessarily benefit them directly, but instead benefits their mentee. Maybe that's where the difference is between an advisor who could really be ... A lot of people I feel like have advisors who are just sort of bosses who are running a lab. And then the mentorship is subordinate to that, or separate.”

### **6.2. Neglected**

Many students mentioned that they were neglected by their mentors. For example, some mentors resorted to advising more than mentoring, where they provided academic guidance but did not engage in building stronger socio-emotional mentoring relationships. For example, one female student discussed in the focus groups how her mentor omits to attend to all her needs, and she hoped for him to have a more holistic approach in his mentoring.

“But I would not say that she's mentored me on that holistic level as I've been thinking about. I am not sure if that is my fault in my ... I wouldn't say necessarily reluctance, but the fact that I haven't been as maybe honest or vulnerable with where I am going forward. But in terms of advising, she's been great helping me move forward in the program. It's absolutely wonderful. When it comes down the mentor and thinking about it this way, I would say that I don't have a mentor at this point.”

### **6.3. Ambiguous**

Some students discussed that mentoring lacks deliberate caring relations. Students experience tensions and challenges because their mentors show little concern for them. They simply check on them but do not build genuine, intentional mentoring relationships, and that leaves the students confused about the mentoring process. One student explained in the focus group that the mentor did not communicate with him enough during their mentoring process, and he was unclear about what needed to be done.

“Really affects the quality of whatever kind of relationship that you're in. And so you were just saying, if stuff is ambiguous in a meeting, after the meeting it's going to be a 100 times, and it's not going to be good. And so you can't have a run in your office, check in, have a 30 second conversation, and leave, and call that a mentorship. It has to be intentional.”

### **6.4. Unrelatable**

In addition, underrepresented minority students voiced their concerns. Many of them admitted that their mentors cannot relate to their backgrounds and needs. They feel like their mentors do not understand where they come from. For instance, one Black male mentioned during the focus group that he feels that his mentor is oblivious to certain challenges he experiences in the department.

“I am black, and we can't necessarily relate on those things. If I have certain issues, I can't necessarily go to him, and him understand ... I can go to him and tell him like "Oh my gosh, this happened." And he would listen, but that doesn't necessarily mean that you can respond in a way of knowing because you went through the same things yourself.”

### **6.5. Biased**

Some underrepresented minority students also made comments about their feelings of being referred to as incompetent in their programs. Their mentors or faculty seem to be biased and hold deficit views on diverse students and perceive them as less qualified than their White peers. For example, one Black student mentioned that mentors might have stereotypical understanding of underrepresented minority students, and their language suggests belittlement. He also highlighted that he faces challenges in voicing said concerns.

“He's made numerous comments to me about not being smart enough to be here, that was based on stereotypes. And then there's the idea of, well if I voice my opinion when something like this happens to whoever says it to me, then instead of the person who said it getting reprimanded or getting in trouble, it's gonna be me for expressing how I felt.”

### **6.6. Unresponsive**

In addition to experiencing biased attitudes, some underrepresented minority students expressed that they attempted to talk to their mentors about their experiences and challenges in the doctoral STEM programs and even reached out for help to resolve some issues, but they were unresponsive to their requests. For example, one Black male described his mentor as an unsupportive who did not take action in helping him resolve an issue he experienced with discrimination in the department.

Then he was like, "Well you know, you can't help ignorant people." And I was like, "Yes, I'm aware of that. I've been told that my whole life." I said, "I wasn't telling that to you so you can kinda put a bandaid over it, I'm making you aware of the situation and that I felt uncomfortable. And I know you have ties with the people who run this, this happened to me before, so maybe you could reach out to them and they could put out a whatever about making sure that you're respectful of all walks of life.”

Something to that nature, I mean ... He didn't take it that far, it's more of like, "I'm sorry. These things unfortunately happen." So that's when I needed you to like, be an ally. I needed you to use your power.

### **6.7. Isolated**

Data analysis also revealed that many underrepresented minorities who participated in this study experienced social and cultural isolation in the doctoral departments. They mentioned that they have faculty who do not look like them and study with students who are overwhelmingly White males. For example, one Black female shared her concerns during the individual interview. She said she felt alone in the program because she is a Black female.

I don't see a lot of people here that I identify with and understand where I'm coming from so I don't feel super comfortable. make me feel excluded. I think always being looked at as someone who doesn't belong or that's how I feel. I feel like everyone looks at my differently than everyone else.

### **6.8. Prejudiced**

Female students also voiced many concerns about experiencing prejudiced behavior. They were frank about the hostile attitudes they experienced from some of their faculty and mentors. For example, one female student expressed her feelings of experiencing sexism in the program.

“And, she's accusing this faculty member of just blatant sexism. And, if you look at his lab, this committee member, it's all white males. I've heard it from them too, this person treats them like crap. “

## **7. Discussion**

Many scholars have argued for improving mentoring in STEM programs [7] [21] [22]. This study adds to the body of research by emphasizing the criticality of listening to students' voices in order to understand how to improve mentoring in higher education. The voiced concerns relate to lack of social, cultural, and emotional caring in mentoring relationships. Students explained they felt undermined, neglected, and misunderstood. The findings also point to the importance of listening to the underrepresented minority and female students as they face additional challenges in finishing doctoral programs. They mentioned that their mentors did not relate to their unique needs and did not understand their backgrounds. Even though they tried to listen, they did not take action to change a toxic environment in their graduate program. Female students also talked about experiencing prejudice that contributed to feelings of frustration and alienation. That finding supports research that focuses on mentoring training that specifically address the needs of women and underrepresented minority students [4] [7] [18]. This study confirmed that underrepresented minority and female students experience discrimination and prejudice at higher institutions [23]. These findings add to the existing body of literature by highlighting the criticality of transforming mentoring relationships in STEM program in order to create more inclusive learning environment.

## **8. Conclusions**

This study is significant because it aids in providing a more nuanced understanding of how doctoral students feel about their mentoring relationships in the STEM academic environment. Participants in this study used a lot of negative descriptors about the mentoring experiences, and that information can be used for improving professional development for current and future mentors in STEM fields. This research study is important because the findings serve as a premise for mentor training to enhance mentoring quality and improve the learning environments of underrepresented minority and female students in graduate STEM programs. However, there are several limitations in this study, including the sample size, participant bias, researcher bias, as well as duration and location of the study. The limited number of participants in this research study (25) may present a limitation in terms of transferability. The research also recognizes that the participants and researchers may bring various perspectives, experiences, and possible biases into the study. We documented our reflections in researcher journals throughout the study and provided participants with a safe space for critical dialogue and reflection. In addition, focus group and interview data was collected from participants studying in one state in the southeastern United States. Therefore, findings may not be generalizable to STEM education in the whole country due to regional differences and state policies governing STEM programs.

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