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The Role of Emotional Intelligence in Faculty Advisor-Graduate Student Mentoring Relationships in Engineering

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Denise R. Simmons, Ph.D., PE, F.ASEE, PMP, LEED-AP, is a pioneering leader in civil engineering education and workforce development, currently serving as a tenured, full professor in the Department of Civil and Coastal Engineering at the University of Florida. With over three decades of experience in both academia and industry, Dr. Simmons has continually integrated theoretical research and practical application, demonstrating a commitment to evolving engineering competence in its most holistic sense.

Dr. Simmons's recent research efforts have expanded to include a nuanced exploration of communication within engineering education, specifically focusing on developing agentic communicators. Her studies delve into the complex dynamics of communication within research labs, examining how graduate students experience communication mis-cues and identifying strategies to help both students and their advisors navigate and overcome these challenges. She also investigates how faculty approach their communication with graduate students, the concerns they encounter, and the guidance they provide to cultivate stronger, more effective communicators.

Recognizing that effective communication is foundational to leadership and mentorship, Dr. Simmons emphasizes the role of oral communication in building agency. Her work uncovers how mastering oral communication can empower individuals to assert their ideas confidently and navigate professional interactions more effectively. This focus on agency around communication aligns seamlessly with her broader mission to equip engineers not just with technical skills but with the leadership, mentorship, and communication competencies essential for driving innovation and fostering inclusive growth in the field.

Her groundbreaking contributions to engineering education, supported by nearly $8 million in federal funding and over 100 refereed publications, continue to redefine the standards of excellence in the profession.

Dr. Simmons's dedication to empowering underrepresented groups and guiding minority-serving institutions earned her the esteemed honor of Fellow Member in the American Society for Engineering Education in 2023, solidifying her legacy as a transformative figure in both the academic and professional engineering communities.

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The Role of Emotional Intelligence in Faculty Advisor-Graduate Student Mentoring Relationships in Engineering

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Abstract:
This full paper explores the critical role of emotional intelligence in engineering faculty advisor-Ph.D. student mentoring relationships and the role emotional intelligence plays in navigating mentoring relationships. Emotional intelligence is the ability to recognize, understand, and manage one's own emotions, as well as to perceive, interpret, and influence the emotions of others. In the context of mentoring relationships, emotional intelligence enables mentors to effectively navigate complex interpersonal dynamics, foster trust, and provide tailored support that addresses both the academic and emotional needs of their mentees, ultimately enhancing the transfer of social capital and demystifying hidden curriculum in academic environments. Building upon an early-stage, exploratory NSF-funded study aimed at improving support for Black Ph.D. engineering students, the authors first used a participatory research design in the form of a collaborative autoethnography to understand their own mentoring relationships in engineering. From the cycles of coding that included *a priori*, frequency, and magnitude coding, an emerging theme emotional intelligence of mentor-mentee relationships was found. A follow-up study was then conducted on seven Black faculty mentors in engineering to explore how their mentoring relationships and strategies used may be similar compared to the author's mentoring relationships. In the focus group, it was identified that emotional intelligence in the form of psychosocial support and emotional awareness was enacted by the Black faculty advisors with their Black Ph.D. students. The paper concludes with recommendations for implementing these types of mentoring practices, lessons learned from the research process, and implications for graduate education across disciplines and in addressing the hidden curriculum that surrounds the academic experience.
Keywords*: Mentoring Relationships, Emotional Intelligence, Hidden Curriculum, Graduate Student Development, Engineering Education*

1. Introduction:

The landscape of engineering education is undergoing a significant transformation, moving beyond the traditional focus on technical expertise to recognize the critical importance of interpersonal dynamics in mentoring relationships [1]. At the heart of this evolution lies the growing recognition that successful mentoring in engineering education requires emotional intelligence, particularly when supporting underserved doctoral students [1]. Emotional intelligence is a psychological competency that plays a crucial role in helping mentors and mentees navigate the complex hidden curriculum and social capital exchanges that characterize academic environments [2].

As Tekerek's emphasizes, emotional intelligence is defined as the ability to identify and manage one's own emotions and the emotions of others, including three critical skills: (1) *emotional awareness*, (2) *emotional harnessing* for thinking and problem-solving, and (3) effective *emotional management* [3]. Recent research shows that engineering students need more than advanced technical skills to succeed in their field, with emotional intelligence significantly relating to cognitive capability and having marked effects on high scholastic achievement [4], [5]. In STEM mentoring relationships specifically, emotional intelligence serves as a critical bridge between technical expertise and interpersonal effectiveness, enabling mentors and mentees to build the trust and understanding necessary for navigating complex research challenges [6]. These studies suggest that integrating emotional intelligence into engineering education can be crucial for mentoring and developing well-rounded professionals that navigate both the technical and interpersonal aspects of their roles.

1.1 Emotional Intelligence in Mentoring Relationships

Emotional intelligence provides mentors and mentees with the tools to effectively manage and navigate the complex emotional landscape of their relationships [7]. This capability encompasses the ability to recognize, understand, and manage emotions in oneself and others, making it a crucial component of successful mentoring in engineering education [8], [9], [51]. Faculty advisors with high emotional intelligence demonstrate several key capabilities that enhance the mentoring relationship, including the ability to recognize signs of stress or struggle in their students and the ability to adapt their mentoring approaches according to the unique needs of their mentees.

Emotionally intelligent mentors are better equipped to establish boundaries, manage expectations, and create sustainable mentoring relationships that benefit both parties [10]. This is particularly important in engineering education, where traditional emphasis on technical competency may overshadow the importance of emotional and social development [11].

Moreover, emotional intelligence plays a crucial role in helping mentors guide students through the various challenges of doctoral education. Mentors who exhibit high emotional intelligence are more successful in helping students build professional networks, navigate institutional politics, and develop the soft skills necessary for career success [12], [13]. Furthermore, these mentors are better positioned to support students from diverse backgrounds, as they can recognize and respond to cultural differences and individual needs more effectively.

Emotional intelligence becomes particularly significant when helping mentees navigate hidden curriculum in doctoral programs [14]. The unwritten set of expectations and norms can significantly impact student success, yet often remains unclear to many students, particularly those from underserved populations [15]. Mentors who possess emotional intelligence are better equipped to recognize when students struggle with these unspoken expectations and can provide explicit guidance and support in navigating these challenges [16], [17].

In engineering, less attention is paid to the socioemotional aspects of mentoring [18], including emotional intelligence. Despite its importance, there remains a significant gap in our understanding of how emotional intelligence functions within engineering mentoring relationships [19] and how it may vary by race or cultural differences.

The current study addresses this gap by comparing and contrasting emotional intelligence between a multi-ethnic, multi-cultural group and the experiences of Black faculty mentors mentoring Black Ph.D. engineering students. The racial and cultural similarities and/or differences may shed new insights across mentoring relationships in engineering.

1.2 Cross-Country Cultural Mentoring and Emotional Intelligence in Higher Education

Much of the developments found around emotional intelligence have centered around the practice of teaching in different contexts and cross-country populations [20]-[23]. For example,

emotional intelligence has been shown to help mediate and antecede resilience and improve stress among international students [20]-[23]. Educators are responsible for creating an emotionally literate learning environment so that teachers and students can develop intercultural competencies and socioemotional caregiving practices [20]. Amongst cross-country groups, culturally responsive teaching practices along with socioemotional learning have shown to improve the overall experience and well-being of international students [21].

Recently, a cross-cultural mentoring model has been proposed as an important framework for students whose social capital and educational opportunities are limited [24]. This model has been suggested to be particularly effective for non-traditional and international students although little is known about its full operation and benefits. Furthermore, little is known about the connections between emotional intelligence and mentoring- a research gap that was just recently acknowledged in the higher education literature [23].

1.3 Intra-Racial Mentoring and Emotional Intelligence in Higher Education

Studies [25] have shown that matching mentors by gender or race makes no difference in whether the mentoring relationship is effective. Instead, research suggests that understanding systemic issues of Whiteness [26] blinds the way that mentors understand issues of a mentee and 'bootstrapping' approaches are used where all groups are aggregated as a single group with universal norms while ignoring the "ongoing processes of discrimination" that operate [27].

Limited work has been conducted in studying the experience of Black faculty mentors with Black Ph.D. students in the fields of STEM (i.e., engineering). A recent study found that faculty of color apply more diverse strategies such as emotional awareness and cultural competence to mitigate the negative effects of marginalization and racism [28]. Emotional intelligence is a skill reported amongst intra-racial mentors and is denoted by an ability to build supportive communities and networks that help mentees navigate promotion and tenure processes while maintaining their authenticity and commitment to students [29]. Emotionally intelligent mentoring from Black faculty can help mitigate the effects of stereotype threat, microaggressions, and impostor phenomena that disproportionately affect students of color [30]. The ability of Black faculty mentors to understand and manage emotions, both their own and their mentees', while building authentic supportive relationships is critical for increasing the retention and success of underrepresented students in STEM fields [30].

For all studies, while emotional intelligence was seen important in different scenarios impacting students and mentees, it is still unclear how it may be similar or different when cross-country cultural mentoring or intra-racial mentoring is applied, from an emotional intelligence standpoint. This exploratory study aims to begin to shed light into the role that emotional intelligence plays in mentoring relationships in engineering.

2 Methods:

This study employs a rigorous methodological approach to examine the emotional intelligence in graduate student-faculty mentoring relationships, both from a cross-cultural and intra-racial standpoint, in engineering. The methodology was carefully designed to capture the nuanced experiences and perspectives of faculty advisors and/or graduate students while maintaining scientific rigor and ethical considerations. The methodology presented is mindful of all the complexities of mentoring relationships and connected constructs, particularly in understanding how emotional intelligence manifests in these relationships.

2.1 Research Design

The research design selected for this study follows a participatory research approach [31], [32]. The first study on cross-country cultural mentoring was conducted using a collaborative autoethnography between a faculty advisor and their graduate students (the first three authors).

The second study was conducted as a focus group with seven Black faculty mentors speaking about their experiences mentoring Black Ph.D. students in engineering. A parallel study exploring the experiences of these Black Ph.D. mentees is underway and will be presented in a future publication.

2.2 Research Quality

The validation process incorporated multiple rounds of evidence gathering, informed by Hall et al.'s perspectives on multidisciplinary approaches to understanding complex social relationships [33]. This included peer debriefing sessions, member-checking, and thorough documentation of the research process. The data analysis phase employed systematic coding and theme development, with all team members participating to ensure multiple perspectives were considered [34].

2.3 Positionality

The authors bring diverse perspectives and experiences to understanding mentoring relationships in academia. The first author, a second-generation South-Asian graduate engineering student, draws insights from extensive industry mentoring experience while having limited academic mentoring background, focusing on bridging theoretical and practical knowledge gaps. The second author, a first-generation Latiné faculty advisor, approaches mentoring through her journey from mentee to mentor, shaped by navigating higher education's hidden curriculum and developing awareness of necessary cognitive and social capital. The third author, is a U.S. born Latina woman with multiple industrial experiences and first-generation mentoring experiences. The fourth author is a Korean, international student with science and engineering education experience. The fifth author is a U.S. born, Black American woman and first-generation college graduate and faculty advisor with an approach grounded in active listening, understanding, and supporting marginalized students through systemic challenges. The sixth author, is a U.S. born, Black American woman faculty advisor, brings perspective as both mentor and alumna of large, predominantly White universities, particularly understanding how social capital and mentoring networks can help students navigate institutional challenges. This diverse group of authors collectively brings important insights into the complex dynamics of mentoring relationships, particularly regarding hidden curriculum and the specific challenges faced by underrepresented groups in academia.

2.4 Research Philosophy, Paradigm, and Interpretive Framework

The research acknowledges that emotional intelligence is socially constructed through interactions between mentors and mentees. This philosophical stance recognizes that understanding these psychological competencies requires attention to both individual experiences and the broader social context in which mentoring relationships occur [35], [36].

The research adopts an interpretive paradigm where all members of the inquiry group are considered co-researchers, contributing to the research questions and identifying relevant insights [32]. The paradigmatic approach particularly suits the study of emotional intelligence, as it acknowledges the subjective nature of these experiences while maintaining systematic investigation methods.

The interpretive framework employed is constructivist in Mirel's sense, viewing knowledge-making occurring during interactions between people, practices, and artifacts [37]. This framework aligns with Espino and Zambrana's findings on the importance of understanding how mentoring modalities are perceived and experienced by different groups [38]. The constructivist approach facilitates exploration of how mentoring practices are shaped by individual interpretations, institutional contexts, and broader social structures.

2.5 Research Question

The study explores the various factors that shape interactions between faculty advisors and graduate students during their mentoring relationships in engineering education. Drawing from prior research on educational relationships [21],[33],[52] and mentoring in engineering education [32], this investigation examines both the visible and hidden elements that influence mentoring dynamics for cross-country and intra-racial groups in engineering. The participatory design of this study enables the exploration of these influences from dual perspectives, while providing a balanced understanding of how different factors affect their mentoring engagement [53] and outcomes, from the standpoint of emotional intelligence.

***RQ1**: What factors influence a [Ph.D. student/faculty advisor] as they engage in mentoring relationship?*

2.6 Data Collection and Analysis

The research process involved a systematic approach to ensure reliability and validity. Following Guba and Lincoln's guidelines for naturalistic inquiry, data was continually verified, research focus was maintained, and the fit of data with conceptual analysis was constantly monitored [39], [40]. These verification strategies helped shape and direct the research during its development, while maintaining responsiveness to emerging themes related to emotional intelligence in mentoring relationships.

The reliability and validity process involved several key activities: peer debriefing, continual discussions for member-checking, memoing, documentation of research steps, and inclusion of advisory board members for accountability checking. These activities ensured methodological coherence, sampling sufficiency, concurrent data collection and analysis, theoretical foundation building, and conceptual understanding development. Additional reliability and validity measures were implemented using components of the Q3 framework [41], specifically focusing on procedural reliability, theoretical validation, ethical validation, and communicative validation as discussed in other publications [42], [43].

For the first study, the three primary author/participants, including one faculty advisor and two graduate students, engaged in multiple cycles of coding to analyze emotional intelligence in mentoring relationships:

First Cycle of Coding: Following the development of the interview questions focusing on emotional intelligence, the participants embarked on inductive coding cycles [44]. *A priori* coding was present throughout all cycles. Each researcher independently coded data subsets using the initially defined codebook, allowing individual interpretations of how emotional intelligence manifested in their mentoring experiences. Through collaborative discussions, they developed an initial codebook that included detailed descriptions of emotional intelligence elements in mentoring relationships.

Intermediate Cycle of Coding: The team defined categories based on participants' responses regarding emotional intelligence in mentoring relationships. This process enabled themes to emerge directly from participants' experiences and perspectives. After establishing categories, the team conducted frequency counts for each category, providing insights into the prevalence of various aspects of emotional intelligence. Additional perspectives were gathered from two graduate students and five faculty members who served as external reviewers.

Second Cycle of Coding: The team employed magnitude coding to assess the strength or intensity of empathic and emotionally intelligent responses within specific categories. This evaluation helped understand the relative importance of different aspects of emotional intelligence in mentoring relationships. The comprehensive coding process incorporated both frequency and magnitude analyses, helping identify themes that were not only frequently mentioned but also carried significant emotional weight for participants.

Microsoft Teams and its transcription functionality facilitated the coding process, enabling efficient transcription and analysis of interview data related to emotional intelligence in mentoring relationships. The comprehensive approach to data analysis, combining inductive category formation, frequency counts, and magnitude coding, enabled the research team to develop a nuanced understanding of how emotional intelligence functioned in mentoring. This systematic analysis approach helped identify patterns in how emotional intelligence manifested in mentoring relationships. The multiple coding cycles ensured thorough examination of these psychological competencies while maintaining research rigor and validity.

For the second study, seven Black faculty mentors in engineering participated in a focus group speaking about the experiences of mentoring Black Ph.D. students in engineering and/or computer science. Talking points of the focus group included successful strategies for mentoring same race students, challenges experienced and roles they play in these mentoring relationships. The second author served as a moderator for the focus group. To minimize bias [29], strategies such as indirect questioning, group discussions in a roundtable manner, options to provide responses online and privately and guarantees for confidentiality were used as described in [48]. The focus group duration was 90 minutes in length.

3 Results & Discussion

One salient theme apparent in the study was that emotional intelligence was mediated by different forms of awareness besides emotional awareness. We did not find differences between cross-cultural and intra-racial mentoring relationships but rather more similarities around three domains: systemic awareness, self-regulation, and cultural awareness.

Theme 1: A system's approach to emotional intelligence

In this study, regardless of country of origin, national or international status, race, gender, or student or faculty roles, all groups agreed that an awareness of the systems and resources present can deter or support mentoring relationships. Systemic awareness involves a recognition and understanding of the interconnections and dynamics of a system. This type of awareness requires a person's ability to see the bigger picture and understand how different systems and elements operate to influence each other. A system's approach to emotional intelligence [45] allows mentors and mentees to see how the changes of an organization can have an impact on the emotional landscape of a mentor/mentee while emotional intelligence serves to support and guide mentors and mentees through transitions.

> *"There are no available institutional resources for phd students to handle challenges that may arise during a research mentoring relationship besides just sitting down and having a conversation (or multiple conversations) with your advisor. However, I am aware that each semester phd students are renewed under their respective grant and that advisors have to fill out an evaluation form. I think that this evaluation would serve as a good talking point about what was done well during the past semester versus what needs improvement. I am not sure if that evaluation form is seen as a resource by advisors but it can definitely be used as one."* *Graduate Student*

> *"Yes, I do make sure I am a role model for all students, but I dont want them to move as I do. This is because there are times when may not speak up for certain issues (as a Black pre-tenure faculty member) and I have to choose my battles. However, I want my students to know that they can speak up and have a voice"*
> *Faculty Advisor*

"…as a Black student there are cultural and social situations that arise in professional settings that students should be aware of and better understand […] including potential bias or societal stereotypes…." *Faculty Advisor*

Theme 2: Self-regulation for emotionally intelligent communications

Self-regulation refers to the ability to control or redirect disruptive emotions and impulses and adapt to changing circumstances [46]. Self-regulation plays an important role in emotional intelligence of mentoring relationships as it allows for more effective emotionally centered communications to occur between a mentor and a mentee, form better relationships, and build trust [46].

"I look at my advisor as a guide that will help me through the PhD process. A mentoring relationship does involve trusting that your advisor has the knowledge and capacity to train you so that you can make it to graduation. Additionally, as a person it is reassuring when your advisor is understanding, supportive, and empathic towards you and any challenges that you might encounter. Some weeks are better than others and personal life things can get in the way of academic progress, so I think it is important to establish good communication and openness so that if anything does happen the student does not feel like they have to struggle or push themselves past their limits in an unhealthy way."

Graduate Student

"It just so happened when I was recruiting my second Ph.D. student who ended up being my first PhD graduate, she had just come from a very difficult mentoring relationship with her previous advisor. And so, I think both of us were very hurt. Both of us were very scared and confused. We weren't sure if this new mentoring relationship we were forming hurt us more. We discussed what mentoring meant to us and decided to work on a paper together…"

Faculty Advisor

" …regular meetings that can go long to talk about personal issues…"

Faculty Advisor

Theme 3: Cultural awareness for emotionally intelligent adaptability

Cultural awareness is important for understanding and respecting cultural differences between students and faculty. It allows both the mentor and the mentee to appreciate and respect the perspectives and emotions of people who come from different countries of origins, languages, and cultural backgrounds [47]. Emotionally intelligent adaptability allows both the mentor and mentee to adjust their behaviors, communication styles, and different cultural contexts to effectively interact and relationship-build [47].

"In the American context, perhaps a mentor may mean something more transactional and more situated on helping a mentee achieve an educational or professional goal whereas the personal goal is not focused on. Because of these cultural differences, I think a Ph.D. advisor and their student may need to discuss what personal or professional boundaries they do not wish to discuss since everyone's line is different."

Faculty Advisor

"Cultural activities in [hometown]…and social activities […] with no academic focus…normalizing counseling and well-being strategies" *Faculty Advisor*

"…acknowledge community needs and supports (financial and otherwise)…offer strategies to navigate job decisions and challenges…" *Faculty Advisor*

4 Recommendations and Implications

The findings from this study highlight three important aspects of emotional intelligence in mentoring relationships within engineering education: systemic awareness, self-regulation, and cultural awareness. These aspects can offer valuable insights for enhancing mentoring practices and addressing the hidden curriculum that shapes graduate students' academic and professional experiences [1], [10], [15]. By considering how emotional intelligence features in mentoring frameworks, engineering programs may be better positioned to support both faculty advisors and graduate students in navigating the complexities of academic life, especially for students from underserved and underrepresented backgrounds.

First, systemic awareness emerged as a crucial theme in mentoring relationships, emphasizing the importance of understanding how institutional structures influence the dynamics of mentoring. For instance, one graduate student noted that institutional evaluation forms could serve as valuable discussion tools between mentors and mentees to reflect on progress and areas for improvement. Similarly, a faculty advisor highlighted the importance of helping students find their voice in academic settings, even when mentors themselves must be mindful of navigating institutional power dynamics. By recognizing these systemic factors, engineering programs may benefit from developing mentoring frameworks that include structured feedback points to address both academic and emotional needs [37]. To further support students' progress and well-being, emotional intelligence considerations could be embedded in existing evaluation processes [40] or introduced through graduate curricula and orientation sessions [35], [36]. Moreover, practical workshops and case studies on emotional intelligence as part of faculty professional development could enhance mentors' ability to provide both academic guidance and psychosocial support, thereby creating a more equitable and supportive mentoring environment.

Second, self-regulation plays an important role in promoting emotionally intelligent communication between mentors and mentees. Participants in the study highlighted how self-regulation helps build trust and create emotionally safe environments. For instance, one graduate student described their advisor as a supportive guide who acknowledged personal challenges and offered understanding during difficult times. Another faculty advisor shared a story of rebuilding trust with a mentee after both had experienced previous challenging mentoring relationships, illustrating how self-regulation can help navigate emotionally complex situations. To promote emotional intelligence in mentoring, faculty advisors can benefit from engaging in self-regulation to identify ways to adapt their practices to better meet mentees' needs. Graduate students, likewise, can enhance their emotional intelligence by practicing self-awareness, being open to feedback, and maintaining clear and honest communication with their mentors [49].

Finally, cultural awareness was also identified as a significant factor in mentoring relationships. Participants emphasized the importance of recognizing cultural differences to build meaningful, supportive relationships. One faculty advisor noted that some mentoring relationships may be seen as primarily transactional in certain cultural contexts, while others value a more personal connection. Given the diverse student populations in engineering programs, recognizing the influence of cultural differences on students' academic experiences

and professional goals could help foster more effective mentoring relationships [50]. Supporting faculty advisors in understanding and respecting these differences may create more culturally responsive and supportive mentoring environments. These initiatives may promote mutual understanding by helping both mentors and mentees develop cultural competence, ultimately enhancing the mentoring experience for all parties involved.

5 Limitations

Several limitations should be considered when interpreting the findings of this study. The study's reliance on collaborative autoethnography, while providing rich insights, may limit the generalizability of findings to broader contexts. The small sample size, though appropriate for the methodological approach, may not capture the full range of experiences in engineering mentoring relationships.

The study was conducted within a specific institutional context and engineering discipline, which may not reflect the diversity of mentoring experiences across different universities and engineering fields. Cultural and institutional variations in how emotional intelligence are understood and expressed may not be fully captured in this study. The self-selected nature of participants may have resulted in perspectives from individuals who are already more attuned to the importance of emotional aspects in mentoring relationships.

The study captures perspectives at a specific point in time and may not fully reflect how emotional intelligence in mentoring relationships develop and change over the course of long-term mentoring relationships. The reliance on self-reported data through interviews and written responses may be subject to social desirability bias, particularly given the sensitive nature of discussing emotional competencies in academic settings.

Future research should address these limitations by expanding to larger, more diverse samples across multiple institutions and conducting longitudinal studies to examine how emotional competencies develop over time. Research should include comparative analyses across different engineering disciplines and investigate the impact of cultural differences on expression of emotional intelligence in mentoring. Additionally, studies should focus on developing and validating measurement tools for assessing emotional competencies in mentoring relationships and examining the effectiveness of interventions designed to enhance emotional intelligence in mentoring relationships.

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