

Inclusive and Culturally Relevant Mentorship for Underrepresented Minoritized Adolescents in STEM

I. Objectives

In STEM education and workplace settings, mentoring has become an important means of increasing the persistence and success of underrepresented minoritized (URM) individuals, including women, Native/Black/Latine Americans, and low-socioeconomic status (SES) students (e.g., McGee, 2021; Stoeger et al., 2013; Yong et al., 2023). For URM individuals, STEM mentorship must be inclusive and culturally relevant to be effective (National Academy of Sciences, Engineering, and Medicine [NASEM], 2019; Packard, 2015). To date, however, most current studies on STEM mentorship tend to focus on the dimensions of instrumental and psychosocial support (Eby et al., 2013; Hernandez, 2019). Little theoretical and empirical work exists for understanding and analyzing inclusive and culturally relevant mentorship (ICRM) in STEM. This study fills in this critical gap by investigating ICRM practices for URM mentees in STEM education setting.

II. Theoretical Framework and Relevant Literature

This study brings together cross-disciplinary perspectives of inclusion, culturally relevant education (CRE), mentorship, and practice architectures to conceptualize and identify important ICRM practices. Shore et al. (2011) defined inclusion as “the degree to which individuals experience treatment from the group that satisfies their need for belongingness and uniqueness” (p. 1265). The concept of uniqueness was further elaborated by Jansen et al. (2014) as authenticity, referring to “the extent to which a group member perceived that he or she is allowed and encouraged by the group to remain true to oneself” (p. 372). Building upon the framework of Gay’s (2002, 2010) culturally responsive teaching and Ladson-Billings’s (1994, 2014) culturally relevant pedagogy, CRE includes four tenets: (a) connecting students’ cultural references to academic skills and concepts, (b) engaging students in critical reflection, (c) facilitating students’ cultural competence, and (d) developing students’ sociopolitical consciousness (Aronson & Laughter, 2016). Taken together, ICRM practices of mentors should promote belonging, identity, and cultural competence in STEM among URM mentees.

The theory of practice architectures (PA; Kemmis & Grootenboer, 2008; Mahon et al., 2017) suggests that education practice, in our case ICRM, comprises doings (vis-à-vis activities, resources, and settings), sayings (vis-à-vis beliefs, language, and stereotypes), and relatings (vis-à-vis leadership, communication, and power dynamics), all of which work to shape one another and achieve a given goal (Kemmis et al., 2014). Abundant studies have documented that effective mentorships provide both instrumental and psychosocial support through various sayings, doings, and relatings (Eby et al., 2013; NASEM, 2019). Despite a longstanding recognition in the field that (cross-)cultural factors play a critical role in the process and outcomes of mentorship in STEM (Estrada et al., 2019; McGee, 2018; Sánchez et al., 2014),

little research to date has examined mentorship practices that can be inclusive and culturally relevant—in terms of doings, sayings, and relatings—for URM mentees in STEM, which is the major aim of this study.

III. Methods

Study Context: This study used data collected from a multi-week STEM summer program (hereafter SSP) offered through multiple colleges in the Southwestern US. SSP's mission is to prepare middle and high school URM students for success in advanced STEM studies and careers (Authors, 2019, 2022, 2024). Two prior SSP studies found that participants generally reported higher level of perceived STEM inclusion at SSP, compared with their STEM classes in school (Authors, 2020), and that their near-peer mentors (college students at each SSP) at the program play a crucial role in socializing them into the program and helping them learn STEM subjects (Authors, 2024).

Study Participants: Eighteen near-peer mentors for URM adolescents from four SSP sites were recruited for this study in summer 2023. Mentor selection was based on recommendations from SSP directors at each site. The mentors represented a diverse array of gender, race, ethnicity, and socioeconomic status. Table 1 presents demographic characteristics of the 18 mentor participants.

Data Collection: We conducted semi-structured interviews to gain insight into the ICRM practices of mentors at SSP. The interview protocol, approved by the IRB at [institution name blinded for submission], was centered on ICRM practices. These interviews were carried out in person by a team of five researchers and typically lasted around 60 minutes. Participants were compensated \$50 for their time. The interviews were recorded and transcribed.

Data Analysis: We utilized a two-step coding process for data analysis using NVIVO 12. Initially, we derived *a-priori* codes based on the definition of practices by Mahon et al. (2017), which includes doings, sayings, and relatings, and followed a collaborative coding approach as described by Saldaña (2016). This iterative coding continued until saturation (Corbin & Strauss, 2015), facilitating the construction of a codebook that identified ICRM practices used by SSP mentors. Subsequently, a second coding process was conducted using this codebook, the analysis of which included discussions, refutations, and comparisons among the researchers to enhance the study's validity. After the second coding round, we applied an inductive coding approach to identify themes (Saldaña, 2016), allowing for a deeper understanding of the types of ICRM practices that STEM mentors implement with their URM mentees at SSP.

IV. Findings

We identified four preliminary themes in the mentors' experiences that demonstrate their ICRM practices through doings, sayings, and relatings that can enhance STEM belonging, identity, and cultural competence of their URM mentees.

Theme 1: Actively Engaging with *Each* URM Mentee

Our first theme explores the efforts of mentors to actively establish individual connections with *each* URM mentee to foster a sense of acceptance and belonging at the SSP. Mentors primarily achieved this through reaching out and engaging in friendly and inquisitive verbal communication. For example, Roman mentioned asking questions like *“How are you doing? How’s your day been? How are you feeling right now? Are you struggling in class?”* in a casual manner. Mentors also noted using physical gestures and body language to enhance a sense of welcoming in the STEM space among their URM mentees. As expressed by Claudia: *“I’ll high-five or open the door for them. I’ll be nice to them... I also think of body language. I try not to stand like this (closed off) around anyone. I always try to be very open. I try to talk to them. I gesture a lot with my hands.”*

Many mentors emphasized that they would ensure *every* mentee, regardless of their demographic and cultural backgrounds, feels welcome and seen. Brianna, for instance, shared that: *“I treat them all equally”. In the mornings, I give out cereal, I go up to everybody, ‘hey, there’s breakfast, are you hungry?’ Even the kids who don’t get any [I tell them], ‘oh, there’s food if you need anything’. I feel like that’s my way of making sure they feel welcome. I’m always trying to look out for all of them.”*

Theme 2: Facilitating Peer Relationships among *All* URM Mentees

The second theme demonstrates how mentors foster mentee-mentee connections that can enhance a sense of belonging in the SSP by cultivating a collective learning culture. This was achieved by emphasizing group dynamics and promoting the idea that *every* URM mentee, including “shy” students, is valuable and indispensable to classroom learning and group project success. Several mentors elaborated on forming groups to bring together students from diverse backgrounds who might have yet to naturally gravitate toward working with each other. For example, Alex mentioned, *“I did have a few quiet students, and I deliberately tried to mix up their groups just so they would be exposed to talking with students that they otherwise wouldn’t interact with.”*

Mentors also fostered friendships among URM mentees by encouraging them to reach out to and engage with more peers. For instance, Emily expressed her approach to encouraging peer interaction: *“I like to be like, ‘Oh, did you see this group? They have a really cool idea. You should go talk to them about it.”* Emphasizing promoting supportive peer relationships among URM mentees, Aiden suggested using games to “create camaraderie,” and Brianna explained her efforts to *“try to make them feel more at ease so they can engage more and make new friends.”*

Theme 3: Recognizing and Validating STEM Abilities of *Each* URM Mentee

The third theme addresses how mentors utilize language to motivate and support their URM mentees, regardless of their STEM experience and background. By using affirming language and

providing positive feedback, mentors help their URM mentees recognize their capabilities and sense of belonging in STEM. For instance, Mateo recounted a scenario in which he encouraged a reserved student during preparation for a group project presentation: *“I [asked] them what they think, and when they would give their comment, I said, ‘Cool. You can add that to your presentation because it helps in X, Y, and Z’. I explained to them as to why their statement was correct, and then they would be the ones to state that during their presentation.”*

When mentees expressed their struggles with STEM, their mentors provided both practical support and positive feedback. Emilio, for example, would intervene with assistance when a mentee expressed doubt, and would later celebrate their success with humor: *“If they started like, ‘Oh, I don’t know if I can do this,’ [I] would help them. At the end, I’m like, ‘See, I told you, you could do it,’ and then try to make them laugh. Just helping them see that transition or that growth, I think that’s what helps them feel more a part of the program.”*

Theme 4: Promoting Positive Cultural Narratives in STEM for URM Mentees

Our fourth theme illustrates how mentors challenge their mentees’ perceptions of who belongs in STEM and promote positive cultural narratives in STEM for URM mentees. When working with female mentees, Emily emphasized the importance of reminding them, *“You can do it.”* Jose highlighted the prevalent misconception that STEM is only for boys and recounted instances where male peers claimed to be smarter than female peers. Challenging this notion, Jose would question such statements by saying, *“why are y’all talking like that? It’s not even true.”*

Mentors who are URM in STEM college majors also used their stories to challenge the biased concept of a “STEM person.” Elias discussed when some URM mentees felt they *“were not cut out”* for STEM, they would share their experience of overcoming challenges to assure URM mentees they belong in STEM: *“I didn’t really come from a very pleasant upbringing and where I am right now, sometimes I also felt like I don’t belong here, but I’m here, you’re here. Obviously, you did something right to get here. So you belong here.”*

Similarly, Anthony encouraged URM mentees to embrace their unique social and cultural identities. He said, *“I told them in any field, it’s always good to be yourself because that gives a lot of character. It makes you just more unique and it makes you stand out much more instead of being a generic person. I tell them, ‘Look at me as an example. I have really rough hair and I might not pass as a STEM student, but then when you get to know me, it’s like, ‘oh, this guy’s a STEM student, I wouldn’t have known.’”*

V. Significance of Study

This study contributes to the literature on mentorship and STEM inclusion in several ways. Our study uncovers four major ICRM practices for URM mentees in promoting their belonging, identity, and cultural competence in STEM. To effectively support URM mentees in STEM, a mentor should actively engage with each of their URM mentee individually, help their URM

mentees develop peer relationships, recognize and validate STEM abilities of their URM mentees, and promote positive cultural narratives in STEM for their URM mentees. This set of findings can be used for developing measurement tools that can capture various dimensions of ICRM practices in STEM and link them to STEM outcomes of URM individuals in large scale quantitative studies (Hernandez, 2019). Our results are also of importance for those professionals and practitioners who seek to improve their own practices or to train other mentors to effectively support URM individuals in STEM education and workplace settings (NASEM, 2019).

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Table 1. Demographic characteristics of mentor sample (N=18)

	Count	Percentage
Gender		
Male	12	67%
Female	6	33%
Race/Ethnicity		
Hispanic/Latinx	15	83%
White, non-Hispanic	2	11%
Asian, non-Hispanic	1	6%
Parental Education		
Master's degree or higher	3	17%
Bachelor's degree	8	44%
Associate's degree	0	0%
High School Diploma	4	22%
Less than High School	2	11%
Did not respond	1	6%