PURM
Perspectives on Undergraduate Research & Mentoring

Creating a Supportive Network: The Significance of Non-Faculty Mentors for HURM STEM Undergraduate Researchers

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Introduction

Undergraduate research has been extensively studied and demonstrated to offer numerous benefits to students, particularly those in STEM fields and from historically underrepresented minority (HURM) groups (Kuh, 2008; National Academies of Sciences, Engineering, and Medicine [NASEM], 2017). These benefits include enhanced academic and technical skills, increased confidence and self-efficacy, improved critical thinking and problem-solving abilities, and a greater likelihood of pursuing graduate degrees or careers in research-related fields (Lopatto, 2007; Mastronardi et al., 2021; Seymour et al., 2004; Slovacek et al., 2012). A central component of many undergraduate research experiences (URE) is mentorship (Kassu, 2020). While research mentors play a crucial role in guiding and supporting students in their research endeavors, it is important to acknowledge that they may not always be readily available to address individual student needs, specifically those of HURM students, beyond the scope of research itself (Morales et al., 2017). A lack of diverse faculty leads to many HURM students being mentored by white professors (Bitar et al., 2022). HURM students often require additional support in areas such as career guidance, personal development, and insider advice on navigating the complex landscape of the United States higher education system (Carpi et al., 2017). If students feel that their research mentors are unable to empathize or understand their concerns, the students may hesitate to ask for such additional mentor support. Constraints on research mentors can include both preparation and time. Thus, traditional one-on-one research mentoring may possess inherent limitations that need to be addressed to support the success of HURM students effectively (Johnson, 2015).

Research mentors often lack access to training that would equip them with essential skills in effective mentoring practices (NASEM, 2017). Moreover, they frequently manage multiple responsibilities—such as teaching, meeting tenure requirements, and supervising graduate students—which can reduce the time available for working with undergraduate researchers (Saito, 2013; Sands et al., 1991). To overcome these challenges and improve mentorship outcomes, it is important to acknowledge the valuable role that non-faculty mentors can play in supporting students beyond traditional faculty mentoring relationships. In this context, *faculty mentor* is the assigned primary researcher during the URE, and *non-faculty mentors* encompass individuals who, while not directly engaged in the technical facets of undergraduate research, wield substantial influence in supporting and guiding students throughout their academic journey. It is essential to note that acknowledging these complementary support systems is not an attempt to diminish their pivotal role in ensuring successful research journeys for students. Instead, it underscores the importance and validity of diverse forms of research expertise within a university enterprise. Individuals in these roles are frequently dedicated to the success and well-being of students, employing a DEI-informed

approach to cultivate a supportive and nurturing environment, particularly with HURM students in mind. These contributors may include non-faculty mentors in various roles, such as undergraduate research program directors or coordinators, advisors, and librarians, though this list is not exhaustive. These mentors may share similar identities with the student or come from HURM backgrounds, though this is not always the case. The individuals in a student's extended network can help fill the gaps that the primary faculty mentor cannot.

By examining and contrasting the mentorship experiences of HURM STEM students with faculty and non-faculty mentors, this paper aims to shed light on the distinct dynamics and outcomes associated with these different forms of mentorship and the importance of facilitating students' success beyond their undergraduate research experiences. We argue that mentorship throughout various stages in academic pathways is important, and by modeling how this may show up with students in different contexts, we can further support their unique needs and set them up for personal and professional success.

Literature Review
Even when mentors use effective mentorship practices with undergraduate researchers (Shanahan et al., 2015), additional barriers may still discourage students from seeking exclusive support from their faculty mentors (Mekolichick & Gibbs, 2012). For instance, power dynamics within mentor-mentee relationships can make graduate students hesitant to approach their mentors with non-research-related concerns (Tuma et al., 2021). Although not explicitly discussed in the literature, we hypothesize similar occurrences happen among undergraduate researchers. In recent years, resources like the Equity Minded Mentoring Toolkit (Wofford et al., 2023) have been produced, offering additional support in building mentoring relationships for graduate and undergraduate students.

NASEM (2017) recommended further research to understand students' unique needs and goals. Consequently, there has been an increase in studies specific to mentoring HURM students participating in undergraduate research. The focus of these studies ranges from examining mentoring relationships as a contributor toward HURM undergraduate persistence in STEM (Estepp et al., 2017; Estrada et al., 2018), to examining STEM mentoring frameworks for HURM students (Mondisa et al., 2021). Yet, the vast majority of these publications do not acknowledge the work of non-faculty mentors, and inclusion is usually token references.

How students seek guidance from mentors outside their research group remains largely unexplored. However, studies have shown that HURM graduate students tend to seek faculty mentors from similar demographic groups (Thomas et al., 2007), and it is hypothesized that this pattern extends to HURM undergraduate researchers (Chamely-Wiik et al., 2020). In fact, Chamely-Wiik et al. (2020) found that at a public university in the southeastern United States, where the majority of faculty members were male, white, and tenured, there were higher percentages of HURM faculty mentoring undergraduate research students than there were HURM faculty in the institution overall. However, faculty hiring has not kept up with the demand, even as universities have pledged to support increased faculty diversity (Matias et al., 2022). Overburdening HURM faculty, in turn, may lead to more attrition of HURM mentors as service is not as highly valued when compared to research output (Deanna et al., 2022).

Mentoring Models
Many undergraduate research experiences are built with a traditional one-to-one mentoring relationship. These relationships, also known as protégé or apprenticeship models, have one experienced faculty researcher paired with a student researcher. This model, while ubiquitous, also has serious drawbacks due to the limitations of a single individual. The protégé model within the

undergraduate research experience is designed as a type of instrumental mentoring. *Instrumental mentoring* is where the relationship is problem or goal-focused (Darling et al., 2006; Flaxman et al., 1988). The mentor for students participating in an undergraduate research experience is usually the researcher in charge of the assigned project, with the implication that the relationship is built on the cooperation of the project. However, many HURM STEM students have additional needs that go beyond instrumental mentoring relationships. *Psychosocial mentoring* focuses on "altering, adapting, and growing the personal qualities of the mentee" (Longmire-Avital, 2020). While, in theory, the faculty mentor can fulfill both types of mentoring needs, many barriers can prevent this from happening.

In contrast to a one-to-one model, the *constellation model* acknowledges the benefits of having a larger support network for undergraduate researchers and sets these relationships from the start of the research program. Defined by Higgins and Thomas (2001), the constellation mentoring model is "the set of relationships an individual has with people who take an active interest in and action to advance the individual's career by assisting with his or her personal and professional development" (p. 224). The constellation model has been successfully implemented in non-STEM settings (Vandermaas-Peeler et al., 2023) and STEM undergraduate research programs (Hall et al., 2021). Mentors and mentees alike found value in the non-traditional group mentoring dynamics. Like the constellation model, Kobulnicky and Dale's (2016) *community mentoring model* opens up mentoring relationships to include other research faculty, postdocs, graduate students, and peers to create a "constellation" of relationships that are "research-based 'best practices' to STEM UREs" (p. 18). When implemented in STEM undergraduate research programs, the constellations or communities are built around departments or research teams and require the buy-in of the entire group. Students gain the experience of working on a research team while receiving support from multiple members of the project.

The constellation and community mentoring models fit into the *multi-mentoring structure*, where the group is comprised of at least three people (Nicholson et al., 2017). By not relying on a single individual, students can approach mentors that are most compatible or suited to a specific concern. However, a common limitation of these models is that not all STEM departments work in teams or are collaborative enough to create a multi-mentoring network for undergraduate researchers, so there is still a need for additional mentors. While valuable within the research context, these multi-mentoring models do not specifically include or acknowledge the work of non-faculty mentors in the formal research experience. In their analysis of multi-mentor network programs, Deanna et al. (2022) noted the importance of non-faculty and contingent faculty in "mentoring and provision of DEI services in academia" (p. 5). Nicholson et al. (2017) emphasized how multi-mentoring can strengthen undergraduate research programs by utilizing non-faculty and sharing mentoring responsibilities. Recognizing the limitations of how different multi-mentoring models are currently applied in STEM URE and understanding the diverse needs of HURM students, it is crucial to foster an inclusive mentorship ecosystem that goes beyond the research realm.

Counterspaces
While not a mentoring model, the concept of *counterspaces* provides an additional frame for viewing our extended network model. Ong et al. (2018), drawing on Solórzano and his colleagues (Solórzano et al., 2000; Solórzano & Villalpando, 1998), define counterspaces as "academic and social safe spaces that allow underrepresented students to: promote their own learning wherein their experiences are validated and viewed as critical knowledge; vent frustrations by sharing stories of isolation, microaggressions, and/or overt discrimination; and challenge deficit notions of people of color (and other marginalized groups) and establish and maintain a positive collegiate racial climate for themselves" (p. 209). Counterspaces not only encompass the physical settings for the identified interactions but can also be "conceptual and ideological, such as in mentoring and peer-to-peer

relationships" (Ong et al, 2018, p. 219). Mentor relationships, student organizations, and professional spaces can be counterspaces. While not all counterspace interactions are mentoring relationships, some extended network mentoring relationships can be uniquely positioned at the margins, thus becoming a counterspace. For some HURM students, mentors outside their formal faculty mentor can be a counterspace. Counterspaces also acknowledge the importance of both instrumental and psychosocial mentoring, as many counterspaces are specific to marginalized identities in STEM.

Positionality

We, the authors, are both women of color who were first-generation college students and who have personally witnessed the transformative impact of undergraduate research experiences and mentorship. Our personal and professional lives have been influenced by the invaluable support of mentors, and seeing ourselves represented in our mentors has motivated us to persist at our predominantly white institution. Moreover, in our professional roles, we have had the privilege of serving as mentors to students from similar backgrounds, allowing us to navigate and address the challenges they face continuously. Our backgrounds and experiences inevitably influence how we approach our relationships with colleagues and students and how we convey these relationships in our vignettes. However, we believe that our positionality not only gives us insight when mentoring HURM students but also strengthens our assertion regarding the importance of an extended network to HURM students participating in undergraduate research experiences.

Vignettes

The following vignettes are pulled from our encounters with students, anecdotes shared by campus colleagues, and conversations we have had with research faculty. All the vignettes use pseudonyms but are based on actual experiences of students involved in undergraduate research. The varied experiences demonstrate that individual students have different needs and need different levels of support to succeed in their programs. We start with the ideal apprentice-model mentoring relationship to underscore why these relationships are rare and, unfortunately, cannot be the reality for many HURM students. The remaining vignettes demonstrate how informal relationships in the extended network model can help fill the gaps when the formal faculty mentor cannot.

Ideal Undergraduate Research Experience with Single HURM Faculty Mentor

Elena is a first-generation college student who is majoring in biology at a large R1 institution. She is excited to participate in the undergraduate research program offered by the university, but she is nervous about being one of the few students of color in the program. Elena is paired with a mentor, Dr. Garcia, who is a tenured professor from a HURM background in the biology department.

At their first meeting, Elena feels relieved that Dr. Garcia is welcoming and supportive. She shares her concerns about being an underrepresented student in the program, and Dr. Garcia listens attentively and reassures Elena that her experiences and perspectives are valuable. Elena feels encouraged to continue with the program.

As the program progresses, Elena finds that she is learning about research and developing a close relationship with Dr. Garcia. They have regular meetings to discuss Elena's research progress, but they also talk about her future goals and aspirations. Dr. Garcia shares her own experiences as a scientist from an underrepresented group and provides guidance on navigating academic spaces.

Common Undergraduate Research Experience with non-HURM Faculty Mentor

Camila is a first-generation college student and a member of a traditionally underrepresented group in a STEM field of study at a large R1 institution. She is excited to participate in a university-wide

undergraduate research program and is assigned a mentor, Dr. Andrews, who is a pre-tenure, white faculty member.

Initially, Camila was thrilled to have Dr. Andrews as her faculty mentor. However, as the term progressed, she found it increasingly difficult to get in touch with Dr. Andrews. Dr. Andrews was busy with the tenure process, serving on a faculty search committee, and teaching two courses. Camila felt like she was often left on her own with little guidance. When Camila finally managed to meet with Dr. Andrews, the meetings were often rushed and unproductive. Camila felt like her research project was not progressing as it should, and she was losing confidence in herself and her abilities. She was able to make some progress on her research project, but she often felt like she was working in isolation without the support of a dedicated mentor.

Despite the challenges, Camila persevered and tried to seek out help from other resources, such as the undergraduate research program coordinator, other faculty members, and the professional staff she had met during the undergraduate research program workshops. She felt she needed a space to talk about things she did not feel comfortable asking her faculty mentor because she was concerned about being judged or not taken seriously. Each of these unique relationships afforded the different support that gave her the tools and resources she needed to continue her research project.

Experience with Undergraduate Research Program Coordinator
Aaliyah is a student from a HURM group who was selected to participate in her university's undergraduate research program. She was thrilled to have been given the opportunity but also felt intimidated by the rigorous expectations that came with it. Aaliyah's faculty mentor was kind and knowledgeable, but she felt hesitant to ask certain questions or express her concerns for fear of appearing incompetent.

Luckily, Aaliyah had a great relationship with the undergraduate research program coordinator, Dr. Carter, who shared the same HURM identity as Aaliyah. During their meetings, Dr. Carter intently listened as Aaliyah shared her fears and doubts about the research process. Dr. Carter provided Aaliyah with the emotional support and personal interest that she needed to balance the rigorous expectations of the program.

Dr. Carter set clear and well-scaffolded expectations for Aaliyah and the other undergraduate researchers in the program. She emphasized the importance of building a community among the groups of undergraduate researchers and mentors, including graduate students, postdoctoral fellows, and other research team members. Dr. Carter also dedicated time to one-on-one planning meetings where Camila could discuss her goals and get ideas about what steps she could take next. Additionally, Dr. Carter supported Aaliyah's professional development by connecting her with other potential mentors on campus who could give Aaliyah the chance to further develop her network. Aaliyah appreciated Dr. Carter's strategic pre-planning, which prepared her to respond to various needs throughout the research process. Thanks to Dr. Carter's support and guidance, Aaliyah successfully completed her research project and gained valuable experience in her field.

Overall, Aaliyah's experience in the undergraduate research program was positive. She feels that the mentorship she received from Dr. Carter and the support from her additional mentors was instrumental in her success. She plans to continue pursuing research and hopes to become a mentor to other underrepresented students in the future.

Experience with Librarian
José was a HURM STEM student who had just started undergraduate research at a prestigious predominantly white R1 institution. He was passionate about his research project but had trouble

finding the appropriate research articles and data to support his work. Although José had a faculty mentor, he felt hesitant to ask for help when it came to finding resources because he did not want to seem unprepared or incompetent. He had heard about the science librarian and decided to visit the library.

José was amazed by how helpful and welcoming the science librarian was. The science librarian, a woman of color who had similar undergraduate STEM experiences, empathized with José's hesitations in asking his faculty mentor for help. He was introduced to the library's online resources and was shown how to navigate databases to find relevant research articles and data. The science librarian also taught him how to use citation management tools to help him organize and cite his sources effectively. Through his conversations with the science librarian, José learned that there were many resources available to him that he was not aware of, such as interlibrary loan and open-access journals, which meant he did not have to pay to access resources needed to advance his research. He also learned about upcoming workshops and events that could help him improve his research and writing skills, which would be essential for his research project and upper-level courses.

José appreciated the guidance he received from the science librarian and felt more confident in his ability to conduct research. He knew he had a valuable resource to turn to when he needed help finding the appropriate resources for his work. He continued to use the library resources he had been introduced to and met regularly with the science librarian not only for the remainder of his undergraduate research experience but for the remainder of his undergraduate career.

Experience with Student Club Advisor

As a HURM STEM student at a predominantly white R1 institution, Maribel felt isolated and at times overwhelmed by the demands of her undergraduate research project. While her faculty mentor was knowledgeable and supportive in many ways, Maribel found it difficult to discuss certain aspects of her experience with them, such as the microaggressions she faced on campus or the unique challenges she faced as a first-generation college student.

Thankfully, Maribel had also become involved with the Society for the Advancement of Chicanos and Native Americans in Science (SACNAS) chapter on campus, which was led by an advisor who was also a first-generation college graduate and understood some of the issues Maribel was facing. In meetings with the SACNAS chapter advisor, Maribel felt comfortable sharing her frustrations and discussing strategies for navigating the university's resources and social dynamics.

The SACNAS chapter also provided Maribel with opportunities to connect with other HURM students in STEM and build a supportive community on campus. Through attending events, workshops, and the National SACNAS conference, Maribel learned more about career opportunities and the experiences of other HURM STEM students, which gave her a sense of belonging and encouragement to pursue her goals.

While Maribel valued the support of her faculty mentor, she recognized that the SACNAS chapter provided a unique space for her to discuss issues related to her identity and find a sense of community that she might not have otherwise found on campus. The combination of support from both her faculty mentor and the SACNAS chapter allowed Maribel to navigate the challenges of her undergraduate research project with greater confidence and resilience.

Reflection

Limited faculty representation within postsecondary educational institutions poses a significant challenge to mentoring and supporting HURM students in undergraduate research (Bitar et al.,

2022; Matias et al., 2022). However, as demonstrated by our vignettes, a potential solution lies in utilizing the expertise of non-faculty mentors, specifically mentors from HURM groups or individuals who share identities or backgrounds with the student (e.g., first generation college student, gender identity, low income, etc.). By understanding these mentoring dynamics more deeply, we can develop effective strategies to support students throughout their research experiences (Davis et al., 2020).

The student experiences in our vignettes highlight the importance of having supportive mentors who are available and responsive to the needs of HURM students. Even with the best intentions, mentors may not be able to provide the support and guidance that students need to succeed in their undergraduate research experience (Brownell & Tanner, 2012; Dolan & Johnson, 2010). However, fostering a supportive mentorship environment that prioritizes the needs of HURM students is crucial for ensuring their success in undergraduate research experiences.

Our interactions with students shed light on how they navigate their undergraduate research experiences. This paper emphasizes the value of non-faculty mentors beyond the research environment and how students may seek advice on non-research and research-related issues. Non-faculty mentors may bridge the gaps for students lacking a strong faculty mentor and enhance the support they receive when they do have one. For HURMs participating in undergraduate research, ample support is crucial (Nicholson et al., 2017). Recognizing the significance of non-faculty mentors alongside faculty mentors is crucial; this does not diminish the role of faculty mentors but rather acknowledges that the mentoring process for undergraduate research requires a collective effort. While this paper is hypothetical in nature, incorporating future qualitative research studies focused on understanding the extensive networks of HURM students and their diverse mentors would enrich the study. Additionally, a limitation of our paper is that the scenarios mentioned earlier are not universally applicable.

We want all mentors to understand the significance of cultivating relationships with HURM students and how they can contribute to their undergraduate research experiences. We acknowledge that specific HURM students may require additional culturally relevant support to ensure their success (National Academies of Sciences, Engineering, and Medicine [NASEM], 2019). However, a persistent challenge lies in providing students with access to culturally relevant mentors and maximizing the benefits of these relationships. As demonstrated in our vignettes, this need can be filled by non-faculty mentors. Thus, as mentors, we intend to create a harmonious support system that sets students, and particularly HURM students, up for success, enabling them to thrive beyond their undergraduate research experience. At the same time, we understand that individual mentors cannot fulfill every student's needs. With this understanding, it is crucial to communicate with students about the roles and responsibilities of the mentor and be aware of how to intentionally introduce or transition them to relevant mentors or resources that can better support the student's unique needs. Transparent communication fosters trust and creates an opportunity for students to seek assistance in the future, should they need it. Each student may have a distinct relationship with their mentor, making it necessary to tailor approaches and support to individual needs for their success.

Additionally, addressing the limited diversity among faculty mentors in higher education is crucial, and efforts to hire diverse faculty must be prioritized (Bitar et al., 2022). In this context, Harris et al. (2023) proposed ways in which universities can intentionally redress hiring inequalities by utilizing a co-hiring policy to recruit diverse faculty in STEM. They highlighted actionable steps universities can take to achieve this objective (Harris et al., 2023). By embracing a co-hiring approach, universities can actively tackle the underrepresentation of HURM groups in STEM academia while promoting diversity and inclusion. This proactive strategy has the potential to bring about meaningful change and foster an environment that embraces the contributions of individuals from diverse backgrounds.

Conclusion

While our paper is limited to vignettes from one R1 institution, we are encouraged by conversations with colleagues outside of our institution that have conveyed similar experiences and relationships. Our vignettes showcase the value of an informal extended network model. While many of these relationships and interactions are not long-lasting, there is still benefit to the undergraduate researcher. Undergraduate research programs and mentors can work to build programs that include an emphasis on creating an extended network mentor relationships outside of the research context for students to get a wider connection to additional non-faculty mentors. This not only leads to more resources for the student but also models the importance of collaboration.

Undergraduate research has demonstrated the potential to provide students with the skills, knowledge, and confidence necessary to succeed academically and professionally (Lopatto, 2007; Osborn et al., 2009; Thiry et al., 2011). As undergraduate research mentors, we are passionate about breaking down systemic barriers preventing students from accessing these opportunities. We believe it is crucial to prioritize equity and inclusion in all aspects of undergraduate research, from program design and recruitment to mentorship and professional development. We are deeply committed to creating a culture of inclusivity, mentorship, and excellence that fosters the growth and success of all students, particularly those from HURM backgrounds. We believe that by providing students with access to research experiences, mentoring, and professional development opportunities, we can help to build a more equitable and just society.

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