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STEM Stories: Fostering STEM Persistence for Underrepresented Minority Students Attending Predominantly White Institutions

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Abstract

Challenges persist in creating a diverse pipeline of STEM professionals. This study aims to understand the multifaceted experiences and needs of Underrepresented Minority (URM) college students as they navigate STEM environments and career choices. Utilizing social cognitive career theory (SCCT), this qualitative, multi-institutional study explored the varied experiences and barriers that 44 URM STEM students negotiated at two Predominantly White Institutions (PWIs). Implications for practice, research, and policy focus on interventions aimed at increasing persistence and fostering STEM career decision-making.

Keywords

STEM, underrepresented minority students, career exploration, student–faculty relationships, mentoring

Scholarly work on the experiences of underrepresented minoritized science, technology, engineering, and mathematics (STEM) students continues to emerge in higher education, career development, and the student affairs literatures (Burt et al., 2020; Diamond & Stebleton, 2019; Morton, 2020; Rodriguez & Blaney, 2020). From an economic standpoint, the effort to attract and retain minoritized STEM college students only grows in importance given the increasing diversity in the U.S., and the reliance on a technologically based economy (National Science Board, 2015).

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Although incremental progress with regard to these dual issues of recruitment and retention of minoritized STEM students has been made, large disparities and inequities continue to persist in U.S. higher education at various levels (Funk & Parker, 2018). These differences include enrollment and persistence rates of underrepresented minoritized students as compared to White students in STEM fields along a range of factors, including race, ethnicity, SES levels, and gender (Prescod et al., 2020; Rodriguez et al., 2020). For instance, Black, Latinx, and Native American students received 14.7% of the STEM bachelor's degrees awarded, even though these groups represented 29% of the U.S. population (Estrada et al., 2016).

Black and Latinx individuals are underrepresented minoritized students in STEM career fields, making up just 9% and 7% of the overall STEM workforce, respectively (Funk & Parker, 2018). In addition, while women make up half of the broad STEM workforce, they are overrepresented in specific career tracks, primarily healthcare practitioner and technician jobs, while being underrepresented in engineering and technology positions (Flores et al., 2020; Funk & Parker, 2018; Kruger & Nel, 2020). These disparities have led to the creation of programs to support underrepresented students in STEM including Louis Stokes Alliance for Minority Participation, an initiative funded by the National Science Foundation (NSF), which is the site of this study. Subsequently, this qualitative study explores the central research question, "How do URM STEM students negotiate career pathways within predominantly White institutions (PWI)?" The present study includes a thematic analysis of interviews with 44 URM STEM students enrolled at two separate PWIs. For this study, we utilize the NSF grant terminology URM to refer to underrepresented students in STEM, including Students of Color (defined by federal grant STEM stipulations as American Indians/Alaska Natives, Blacks/African Americans, Hispanic/Latinx, Native Hawaiian/Other Pacific Islanders, and other Mixed-Race individuals), low-income and poor individuals, first-generation scholars, and women. We recognize constraints of this terminology, in that does not represent all underrepresented groups in higher education including students with disabilities, queer/trans* students, and Asian students from refugee and immigrant communities, among others.

Theoretical Framework: Social Cognitive Career Theory

Social cognitive career theory (SCCT) serves as the primary theoretical framework for this study. SCCT focuses on the interaction of individual cognitive factors (such as goals, outcome expectations, and self-efficacy) and aspects of the environment and individual characteristics, such as social supports and barriers, gender, and ethnicity (Burga et al., 2020; Flores & O'Brien, 2002). The application of SCCT advances an understanding of how people form career interests, navigate choices related to career pathways, and perceive and pursue goals from diverse cultures and educational levels (Li et al., 2021). Rooted in general social cognitive theory and applied to career theory by Lent et al. (1994), SCCT focuses on the examination of cognitive-person variables and self-efficacy concepts (Bandura, 1986; Lent et al., 2000). SCCT scholars and practitioners emphasize the connection to significant environmental variables (e.g., cultural, socio-economic, and social influences on career pathways and identities), including engagement in STEM disciplines (Byars-Winston & Rogers, 2019; Lent & Brown, 2017). Since the present study aimed to explore social factors, influence of culture, and the role of contextual factors, SCCT proved to be a logical choice for the theoretical framework.

SCCT's recognition of the role of the environment in shaping career development remains consistent with the rich body of previous research on URM students in STEM (Lent et al., 2018; Rottinghaus et al., 2018; Sheu et al., 2018). For example, the theory incorporates background contextual influences (e.g., student inputs and belonging) and self-efficacy as significant aspects of student development and college success. Numerous contextual factors (e.g., systemic oppression,

racism, discrimination, and social injustice, among others) that influence choice behavior are especially relevant for historically marginalized social identity groups (Hurtado & Carter, 1997; Maestas et al., 2007; Strayhorn, 2019). Furthermore, SCCT's focus on agency and self-determination in connection with choice actions and performance domains connects to the experiences of URM students in STEM; this served as another reason for our choice of SCCT as an overarching theoretical framework (Dutta et al., 2015; Sheu & Bordon, 2017). Dutta et al. (2015) found that SCCT was a useful tool for understanding minoritized students' experiences with disabilities in STEM education contexts.

In SCCT, individuals are seen as being affected by their environments of origin rather than defined by these environments (Burga et al., 2020; Lent et al., 2000). SCCT acknowledges the habitus of the institutional ecology while emphasizing the agency and currency of the individual (Lent et al., 2018). This approach is consistent with the findings of Hernandez et al. (2013), who found that mindset and goal setting influenced favorable academic performance and persistence in STEM even after controlling for background characteristics and prior achievement.

Literature Review

The Chilly Climate and Leaks in Pipeline Approaches. Research suggests that the *chilly* culture of STEM fields coupled with persistent negative campus climate experiences of underrepresented students contributes to a *leaky* STEM career pipeline (Fouad & Santana, 2017; Griffin, 2017). The chilly climate perspective proposes that gender and racial inequalities in STEM careers can be at least partially attributed to women and URM individuals feeling discriminated against, and incompatible with the prevailing White, masculine culture of STEM (Simon et al., 2017). The inability of academia and scientific institutions to recruit and retain underrepresented minority STEM students has been described as leaks in the scientific pipeline (Hernandez et al., 2013). Extensive research on the leaky pipeline in STEM career participation and persistence demonstrates that "fewer women and racial–ethnic minorities are preparing for, entering, or remaining in STEM careers at each progressive step" (Fouad & Santana, 2017, p. 33).

Leaks occur at critical junctures of the STEM socialization process in academia and the workplace, including a void of mentoring, lack of access to research opportunities, and lapses in enrollment (Burt et al., 2020; McGee, 2016). These incongruences in school and career progression are frequently attributed to family and community responsibilities, and to the challenges of navigating PWIs that feature socialization and support models that are not designed for URM students (Fouad & Santana, 2017). In a qualitative study, 31 post-graduate URM engineers were interviewed. Of the 10 participants who had abandoned their STEM career trajectories, they reflected specifically on the chilly climate, lack of support, and the leaky pipeline in STEM (Buse et al., 2013). For the engineers who opted out of engineering careers, they reported feeling forced out of the profession, cited challenges navigating the workplace, and described their life goals of having children and caring for family as incompatible with their workplace cultures. Such findings underscore the importance of identifying and dismantling the causes of the leaky, chilly STEM culture experienced by URM students.

Student–Faculty Interactions and the Role of Mentoring

Many marginalized students may identify as first-generation status, low-income, and/or from immigrant or refugee communities (Jehangir et al., 2015). As such, they are already negotiating new experiences in higher education spaces that do not readily value the capital students bring from their communities (Whitley et al., 2018; Yosso 2005). Furthermore, negative interactions with faculty and staff leads to non-persistence in STEM degree programs, as does a lack of

supportive communities on campus (Crisp et al., 2017; Hurtado & Carter, 1997). Conversely, faculty members who serve as role models for underrepresented STEM students can positively influence students that can lead to increased retention and persistence (Cole & Griffin, 2013). The intersection of being a minority in STEM (e.g., race/ethnicity) with other underrepresented identities like first-generation and social class suggests additional layers of challenges, but also underscores the need for the academy to find intentional ways to translate their navigational and aspirational capital of URM students into their college experiences (Yosso, 2005). Yet, more work and exploration merits scholarly attention with a strong emphasis on qualitative, asset-based approaches.

Systemic Structures that Inhibit Persistence

Structural systems of dominance and subjugation related to students' marginalized social identities (e.g., gender, class, race, ethnicity, immigration status, among others) play a significant influence on the STEM participation and persistence of URM students (Carlone & Johnson, 2007). While URM students cultivate capital and agency to overcome discrimination (Yosso, 2005), encountering prejudice within institutional environments can cause students to doubt their sense of belonging and aptitude for STEM majors and careers. Carlone and Johnson (2007) referred to this STEM-specific form of imposter phenomenon as a diminished science identity. Furthermore, Chang et al. (2014) found that even for students who were highly identified within their discipline, experiences of racial exclusion and oppression increased the likelihood that they would depart from STEM fields. Unwelcoming and hostile STEM environments are prevalent in predominantly White academic institutions and career fields (Dortch & Patel, 2017; Lee & Ferrare, 2019). This makes understanding the processes of science identity development and career ideation of underrepresented minority students an urgent priority for increasing both the recruitment and retention of minoritized students in STEM. Griffin (2019) asserted, "We cannot move the needle and increase diversity in science without addressing the systemic challenges minority students face on their paths into and through higher education" (p. 1). This statement underscores the importance of understanding the experiences of URM students as they navigate STEM fields within the context of predominantly White academic institutions including policies, practices in labs, and classrooms.

Method

Participants and Institutions

This study was conducted at two different academic institutions, which both have North Star STEM Alliance programs. Funded by the NSF, the North Star Stem Alliance is a consortium of 14 Midwest colleges, universities, and community organizations with the goal of increasing the number of URM students receiving bachelor degrees in STEM fields in Minnesota. Our study included two institutions located in a large urban setting less than one mile apart from one another in the upper Midwest region of the U.S. The first institution is a large, public research institution that serves approximately 50,000 undergraduate and graduate students. On average, 24% of the 31,500 undergraduates at this large institution are URM students. We refer to this first institution as Midwest State University (MSU). The second institution is a small, private liberal arts institution that serves approximately 3400 undergraduate and graduate students. At the time of this study, URM students represented approximately 40% of the population at the smaller, private institution. We refer to this second institution as Private Liberal College (PLC). Student participants were recruited through targeted email and newsletter outreach to the North Star STEM community at

MSU and PLC. To indicate an interest in participating, students voluntarily signed up using an online form and included their demographic information.

Forty-four URM students were interviewed for this study. Students needed to meet several criteria to be included in the study. First, students were required to be an enrolled student at MSU or PLC, and hold connections with their respective North Star STEM Alliance programs. Second, students needed to have experience with undergraduate research, internships, or conference presentations, as these activities are identified as integral to the STEM student experience. Third, participants were required to be advanced undergraduate students as indicated by junior or senior status; several advanced sophomores were accepted due to extensive experiences with STEM curriculum and programming. Lastly, students needed to identify as an underrepresented minority (URM). Multi-racial students were considered for inclusion as long as one of their identified race/ethnicities met the NSF definitions. Among the 44 participants, 24 identify as African American/Black, 12 identify as Latinx/Chicanx/Hispanic; eight identify as Multi-racial. In terms of gender, 32 identify as women and nine identify as men. In addition to race/ethnicity and gender demographics, 13 participants identify as immigrants to the U.S., 21 speak a language other than English in their home, 24 participants are the first in their families to attend college, and 26 participants are considered to be low-income based on Pell Grant eligibility.

Interviews

Students at both MSU and PLC participated in a 60-minute semi-structured interview focused on their experiences within the STEM field. Using SCCT as the guiding framework, interview questions focused on factors, and interactions that shaped the students' experiences. Examples of questions included the following: "How important is participation in STEM activities to your identity?" "What experiences and types of interactions with faculty have been most helpful to you?" "Given the challenges of the STEM field, what is it about you that keeps you in this field of study?" The interviews took place on students' respective campuses, were conducted in private rooms, and were audio recorded. Additionally, students were given a gift card for their participation. The interviews were transcribed professionally, and the data were organized through Dedoose software. While quantitative-focused research on student persistence is extensive, this narrative data provides a multidimensional context to how URM students navigate STEM fields and how systemic barriers at PWIs affects their academic and career trajectories from a qualitative perspective.

Data Analysis and Trustworthiness

The team for this study included the two faculty principal researchers and a team of graduate students. In this analysis of narratives—which is rooted in social, cultural, historical, and economic contexts—our objective was to gain a greater understanding of the experience of URM STEM students from their perspectives (Clandinin & Connelly, 2000; Polkinghorne, 1995). Polkinghorne discussed using *narrative cognition* to gain a better understanding of individual action; it is a collaborative process between researcher and participant. Using this analysis of narrative approach, the research team initially reviewed interview transcripts individually, and then met to compare and analyze the data over the course of several phases (Denzin & Lincoln, 2013; Merriam & Tisdale, 2016). Inductive codes based on emerging thematic categories were identified and discussed (Bogdan & Biklen, 2007; Creswell & Poth, 2018).

We used initial codes and moved to process coding using gerund-based, action verbs words (Saldaña, 2009). A codebook was developed and each research team member used the codebook to analyze the interview data. From there, the thematic analysis process involved three separate

phases. In phase one, the team engaged in a process of meaning making by individually deriving emergent categories for eight randomly selected interview transcripts. Using these emergent categories against one transcript, we engaged in cross-checking the developed codes with the other participant interview data, which resulted in themes. To ensure trustworthiness, this process continued in phases until there was a saturation of categories and the team saw no more emerging categories and resulted in nine final themes.

Research Team and Positionality

The research team included both graduate students and faculty. The graduate students included students who identified as first-generation college students and Students of Color, including a first-generation Indigenous, multiethnic scholar. The principal investigators include two faculty members, one who identifies as a Woman of Color and the other as a White man. All researchers are deeply committed to supporting URM students. The team met initially to discuss their own experiences and expectations prior to entering the interview phase of the study.

Findings

The analysis process yielded nine themes. For this paper, we will focus on three themes that closely tied to career development and how URM students negotiated career pathways within a PWI. The three themes include the following: navigating the ecology of a PWI, examining the nature and quality of faculty interactions, and influencing career decision-making.

Navigating the Ecology of a Predominantly White Institution

This theme encompasses the intersections of URM identities that affect experiences of students in STEM. These identities include being a Student of Color, being the first in their family to go to college, being low-income, as well as immigrant and refugee narratives. The first sub theme addressed recognition of inequitable systems and spaces. Yamina, a Black, immigrant, low-income student, shared the "cultural shock for both the students and for me too, 'cause I have never experienced this before and I've never had all-White dominant class and have to prove myself constantly." Her comments also indicate that being one of few minoritized students, she was pressured to demonstrate her right to be there. This feeling of being alone was further revealed by other students like Faizah, a Black, immigrant, low-income student who shared how she was perceived by White peers:

> I also stick out like a sore thumb, since it's a pretty White college. I forget that, people see me differently, because I'm Black. I'm used to it. They were like, "Oh, so what are you?" "Are you Kenyan? Are you Arab?" They were circling around it. I just told them straight up what I am. And I'm Somali. And I told them about my culture. I told them you can just ask me about it, instead of being awkward about it.

Faizah's experience speaks to the existence of an ecology or structure of STEM spaces that is equipped to engage White students with other White students, but does not prepare them, or faculty, to engage relationally with URM students. This further positions URM students as anomalies, or worse, interlopers, in an environment that questions their qualifications. Fawzia, a Black, low-income, first-generation, and immigrant student explored this realization of the inherent questions about both her commitment and her qualifications while at dinner with a group of peers. She shared:

> I think the breaking point was at dinner with some students and one student made the comment that we never have enough Black people in the program. And that student just felt like if Black people weren't lazy, then they would be successful... she just felt like we aren't working hard! Her excuse was I used to work at a store in high school while I was going to school. I think it was just seeing how the other students didn't find that shocking. So hearing that was a huge wall that I just had to put up.

Fawzia's comments both reflect the isolation that many UMR students feel and illustrate how these students' presence and choices are critiqued and questioned without an understanding of their financial or familial contexts. Linda, a Latinx, first-generation, low-income, and immigrant student raised questions about how she can come to belong in a place where she knows so little about the context:

> In the very beginning I was really scared of not finding a place, a community, people that are going through something similar. People in my engineering classes, they were all like, "Oh yeah, both my parents are engineers. Or like, my grandma was an engineer. And it's like, my grandma doesn't know how to read." Those people have had guidance on it their whole life, even if they haven't noticed. Which is always really terrifying...but I didn't feel jealous, I just felt out of place.

Each of the voices above reflect the daily challenges of overt and covert racism and classism that is inherent to the structure of higher education. These experiences speak to the impact of racism and classism on students' sense of belonging in STEM fields based on implicit and explicit messages and expectations of the ecology of PWIs. First-generation UMR students also discussed how enclaves of support can work to challenge this chilly climate and help them forge a path forward. Several students elaborated on the necessity of sites of support both internal and external to their college. Faizah noted that:

> I think it's really necessary to have that support because...you can get lost in the blur of things if you don't have that anchor, that community, people like you. So having a program that can provide you with that kind of support…I think really is central and I recognize that.

Elena, a Latinx, low-income student, extended this idea to regional and national organizations like the Society of Hispanic Engineers (SHPE) that create spaces of representations and reinforce that first-generation, UMR students can have a place in science. She shared:

> I don't have this inside advice or inside look into what a scientist's life is like, so I'm not really sure what I'm doing counts as real science. But I think especially with SHPE, meeting a lot of other people who are in the same type of situation, it kind of made me think like, "Oh, we can still be in science. We don't have to have parents and grandparents who are engineers to – in order to get into it".

Elena's comment demonstrates that negotiating the challenges of PWI context relies on the extent to which institutional agents (programs, faculty, and staff) create or impede opportunities that build these career pathways.

Examining the Nature and Quality of Faculty Interactions

A second theme that emerged from the student data analysis captures the variance in quality of faculty interaction that UMR students experience in classrooms, office hours, and lab settings. Their reflections highlight the types of interactions that they have encountered, including the extent to which the relational engagement is present or absent in mentoring relationships.

Participants articulated how the ecology of the PWI was operationalized in relationships with faculty who are the gatekeepers to their learning, the field of study, and pathways to graduate school and internships. Ava, a Latinx, low-income, first-generation student underscored the absence of representation in STEM. She noted:

> Just being in this institution, none of my professors look like me. They're all White males. I've taken a class outside of my major where it's like Women of Color and it just makes sense. Sometimes my science classes are a drag because I just don't feel like I connect with the professor at all.

While one could argue that content can be learned from any good instructor, Linda reflects on how implicit bias and faculty affinity for what makes them most comfortable can exclude UMR students from engagement. She shared:

> Like, this class right now, my professor is from a little town in Wisconsin and a lot of the students are from farm towns. They all have land and he's talking about this land. He's always calling on everybody who is from around here, but he knows I'm not, so he never calls on me. Ever.

Linda's experience demonstrates how some faculty may unconsciously favor some students over others based on familiarity or shared traits; this implicit bias can disadvantage marginalized students and perpetuate isolation for UMR students. Students were hungry for faculty interactions that gave them permission to share their stories, but also to ask questions about the material or steps toward careers in the field. Tyler, a bi-racial student, described a faculty relationship that affected his engagement and sense of belonging in his field. He shared:

> There are a couple professors where it feels different, like they really know me, and they care. It's not all formal like that, you know, they're really chill with me, I'm chill with them, and we talk about life things. We make jokes. There's more of a friendly, amicable relationship versus a very formal like student knows nothing, subordinate, teacher knows everything, superior kind of thing.

Tyler's comments underscore how relational versus transactional hierarchical encounters influence his ability to see himself as someone who has something to offer in the academic space. Omari, a Black male student who is first-generation, described what that might look like as a newcomer to a project:

> I would much rather have someone that is more supportive of my learning. I'm going to make mistakes along the way, but just actually being there to support me, and just kind of be like, "Okay, this is not how you do it. Let me show you."

In this second theme, URM students' comments regarding faculty interactions demonstrate how the ecology of the PWI permeates into classrooms and relationships. They also include examples of how faculty can challenge the constraints the UMR students experience by thinking more intentionally about how they orient students to their field, and demonstrating their willingness to engage in relational building that supports students within and beyond their classroom. Descriptions of faculty interactions with students, coupled with the ecology of the PWI, are seen in the third theme where students discussed career decision-making in science.

Influencing Career Decision-Making

The third theme, influencing career decision-making, demonstrates how students' trajectory in STEM fields is driven by their interest, curiosity and altruism and how the environment can shape

their perceptions of their own strengths and areas for development. This theme demonstrates that influences (educational, familial, financial) impact persistence in pursuing science. Students' experiences in research and internships also reflect how their opportunities to explore STEM were shaped by both happenstance and intentional planning to arrive at current goals. While the motivation of social mobility and financial security is important, students also had an understanding that their paths may not always be linear and that taking advantage of opportunities even as a process of elimination was important. The difference was whether ambiguity was shaped by their own choices versus the impact or decision of institutional agents such as lab advisors and academic support staff.

Baati, a Black, male, first-generation, low-income, and immigrant student, felt that pathways were chosen for them by advisors or institutional agents who may have not helped with process, direction, interest and goals with the intentionality they needed. Baati shared:

> There's no straight path, which is also why I was struggling sophomore year because this was the path that I always thought I was supposed to take, and now it doesn't seem so clear anymore. It doesn't feel like the path that was for me. It was just a path that we were all kind of shoved in.

Baati's comments also reflect potential guilt and concern about familial support if an initial path is abandoned. It is here that faculty mentors and internship advisors played a critical role in demonstrating how one can stay the course in STEM, even if that involves choosing a different path than originally intended.

Chase, an Indigenous, bi-racial, low-income, and first-generation student, shared the impact of their decision to veer from the vision of medical school to an alternate route:

> This research experience was based in Sioux Falls at the research center, but it was working with tribal populations in South Dakota and I grew up there! I took that chance... I had an amazing mentor and incredible faculty members that were so open to answering my questions and helping me figure out what I wanted to do and how I can make the most of this internship experience.

In addition to the positive mentoring, Faizah noted that it matters how students are oriented to their internship experiences or even the process they might engage in at their institutions to seek out new opportunities. She noted that sometimes research and internships can be framed in ways that seem unreachable.

> It feels really high up where you can't get to it. So bringing it down and making it more reachable helped me pursue that experience which happened to be pretty much the most life-changing experience that I've had in terms of deciding what kind of career I want to have and where I want to be.

Finally, given that many UMR students are also first in their family to go to college and also low-income, they may experience what researchers have called the burden of privilege (Jehangir et al., 2015). This includes pressure to lift their family and community as they pursue financially stable careers. Increasingly, though, students with access to programmatic and institutional support see that their career trajectory does not need to be an either/or choice, but rather, they can blend their passion and their desire for upward mobility and altruistic goals. Victoria, another Latinx, immigrant student who is first-generation and low-income, reflected on how her interests could coalesce with her passion for marginalized communities. She shared:

> I have started thinking about grad school or down the line, more degrees. Which is another thing that I never thought I would do. I'm really interested in agriculture, how we can use it as a tool to combat

> climate change and how we can use it to empower communities, especially those who have been marginalized.

URM students' comments reflect that despite challenges of environment, finances and imposter phenomenon, there is a commitment for STEM often rooted in early development. Students also demonstrate a nuanced understanding and ability to embrace ambiguity as part of the career process, especially if there are individuals to guide them through the uncertain future path. Baati, an African immigrant student, spoke about this commitment to the journey:

> What I'm doing right now, is making paths for the future. ...just laying the foundation for where I'm going to stand tomorrow. So doing the research while I'm in undergrad here, it's just like any investment to see myself in grad school.

Overall, these three findings reflect the challenges faced by many URM STEM students, but also the navigational capital that URM students possess. The themes inform potential implications for career educators and other institutional agents in higher education ranging from faculty and staff to career practitioners.

Discussion

This study explores the experiences of URM and mostly first-generation college students who are pursuing undergraduate degrees in STEM disciplines at two PWIs. The central research question focuses on how URM students negotiate career pathways in a PWI with a focus on their experiences, including their interactions with faculty members, advisers, and institutional agents on campus. Applying SCCT as a framework to understand the data, the findings of this qualitative study are distinctive in that they highlight the individual stories of current students in STEM majors who have participated in some type of research experience and interacted with faculty and staff (e.g., work in a laboratory, research internship, and volunteer opportunity). While much of the research on STEM experiences focuses on survey-based inquiry, this study focuses on qualitative processes to gain a better understanding of marginalized students' lived experiences. The themes outlined are unique; yet they overlap and intersect.

As viewed through the SCCT theoretical framework, these narratives suggest that students' personal inputs (e.g., gender, race, ethnicity, first-generation status, among others) intersect with environmental influences to help shape choice actions and choice goals as they relate to the pursuit of goals in the STEM disciplines (Lent et al., 1994). These personal inputs often intersect with proximal environmental influences that end up creating barriers, such as racism and sexism, and lack of support for some URM students (Conkel-Ziebell et al., 2019). These findings can also be understood by addressing the contextual situations that many URM students confront, including being first-generation and/or low-income students. As addressed in the findings, students confront the challenges of being a Student of Color in a PWI; they have to negotiate the system or ecology of the environment constantly (Burt et al., 2018). This ongoing challenge often presents itself as overt and covert racism and discrimination for URM students. Many of the students were able to name it directly; others referred to these challenges. The discrimination (e.g., racial and gender) came from a multitude of sources, including peers but also faculty members, lab supervisors and other institutional agents. These interactions include experience with both implicit and explicit bias in academic settings and push students to name ways in which classism and racism influence their experiences in predominantly White STEM fields (McGee, 2020).

Although participants discussed evolving into their identities as STEM students, many of them described what is known as *imposter phenomenon*, a feeling of not belonging or being unworthy.

Similarly, students did not use the words *hidden curriculum,* referring to the unspoken or implicit academic, social, and cultural messages and expectations that are communicated to students in higher education (Margolis, 2001); yet their stories reflected this experience of not being familiar with the nuances and language of the academy. For example, Faizah's reference to working while in school is typical for many UMR students who may also be the first in their family to go to college and are also low-income. Being first-generation in the academy is akin to negotiating a new country without a guidebook, and feeds into an imposter phenomenon with which many UMR students already grapple.

Many students discussed how specific experiences shaped their educational and career trajectories. Although some of these experiences might have been negative, others described the role that faculty members played in creating and fostering these learning opportunities. For instance, Chase's experience with a mentor in his internship who shaped his experience illustrates how faculty interaction can positively impact career decision-making and pathways for students. Based on what is known about the SCCT model as it applied to STEM contexts for marginalized students, the role of external factors were relevant and reinforced the impact of family, community, and related influencers. For example, many URM students discussed the burden of giving back to their families, especially those students who were first in their families to attend college (Fouad & Santana, 2017). It was not uncommon for students to talk about wanting to work with marginalized communities and areas of science so that they could give back to their families and larger communities as a way of returning their good fortune.

Implications

The findings of this study inform implications and strategies for career development leaders and student affairs professionals could implement for career development practice, policy, and research. Often, these initiatives could be implemented at the institutional and departmental levels.

Practice

There are numerous opportunities to develop additional career education training programs for faculty, instructors, and staff. Utilizing SCCT as a guidepost, much of this training could focus on anti-racism messaging and, more broadly, on mentorship and supervisory guidance (Kendi, 2019). Training modules should include examples of how faculty can challenge the constraints the UMR students experience by thinking more intentionally about how they orient students to their field. This includes their willingness to engage in relational building that would support students within and beyond their classroom and ability to actively unpack the hidden curriculum in their field to avoid perpetuating imposter phenomenon for URM students. Descriptions of faculty interactions with students coupled with the ecology of the PWI were highlighted, particularly in the third theme on influencing career decision-making.

Faculty assume multiple roles and responsibilities and may be unaware of the environmental conditions and personal inputs (per SCCT) of their students. Innovative support structures that consider these factors need further development at the institutional and departmental levels. These support systems can be relational, programmatic, and structural and attend to how UMR students are oriented to the hidden curriculum of their disciplines and fields in ways that also honor their ways of knowing. The role that faculty play in the classroom, labs and other learning contexts and as representatives of their field should not be undermined; faculty need to actively pursue these professional development opportunities and their institutions can actively support these efforts via departmental initiatives and funding.

An additional practical implication relates to the role of peer culture in STEM learning environments. Students talked about how this context can be supportive; yet negative interactions with peers can lead to isolation and marginalization. Using SCCT as a framework, departmental leaders can create programs that intentionally develop and foster more collaborative cultures and relationships among all students. These programs might integrate peer learning models and concepts from SCCT such as vicarious learning, social persuasion, and choice behavior ideas within an anti-racist framework. Specifically, naming and recognizing how systemic barriers have limited participation and engagement of students in STEM would be a way to signal how the program or unit situates their commitment to URM STEM students and models what they expect of all students. This type of positionality puts the onus of success of URM on the institution, and raises questions about how the program, unit, or discipline reflects on their own historical context. While understanding historical antecedents to access and success of URM students in education is not part of the curriculum in science fields, engaging the student body with this context in first-year seminars and departmental orientations can collectively take a stance on anti-racism as an ethic of the program. Finally, the contributions of this study may be useful to career educators across university contexts to help provide a better understanding of the assets, capital, barriers, and needs of URM STEM students from an assets-based perspective (Rincón & Rodriguez, 2021; Yosso, 2005).

Policy

Evidence from this study also supports the need to advance policy that re-shapes climate as well as environmental factors that shape the URM STEM experience. The focus here could emphasize climate assessment and transformation of these spaces. SCCT integrates the impact of environmental factors on choice behavior and pathway discernment. Additionally, support programs that aim to enhance URM student success and persistence should be embedded into long-range budgets at institutions. Often, short-term programs with a retention focus exist on grant or soft money, and subsequently these programs fail to continue after the grant ends or when the institution enters a challenging fiscal period. The findings of this study suggest that students benefit from experiences where they have a chance to engage in meaningful interactions over time with faculty and staff around STEM-focused learning opportunities (e.g., directed research, internships, and lab work).

Research

This study focused on the experiences of URM students who were engaging in research opportunities during their undergraduate years. It would be useful for future researchers to engage in longitudinal research that follows students beyond their graduation. While this study focused on URM student experiences, it would be important to examine the experiences of faculty and supervisors to learn more about the mentoring relationship from their perspective. In particular, if some of the faculty members themselves identified as URM and/or first-generation students, this inquiry would merit further attention to learn more about the mentoring relationship (Krieger-Cohen & Johnson, 2020). Since the URM student definition was bounded by the program guidelines, it would be more engaging to explore the experiences of other marginalized student groups beyond this definition; this includes certain immigrant college students (e.g., Asian and Asian American student populations, among others).

Limitations of the study exist. We were only able to interview each student once, capturing their experience at one point in time. Second, we had hoped to get more students from the second

institution, (private PWI), but we were somewhat limited by the smaller sample size of URM potential students associated with this program.

Conclusion

This study focused on the experiences of URM students pursuing STEM majors at two PWIs. Applying SCCT as a theoretical model and drawing on rich narratives of students, we found that personal inputs, environmental barriers, supports, and contextual factors shaped students' experiences. Most notably, URM students often experienced challenges as they traversed the ecology of the PWI, frequently encountering microaggressions and other affronts. Students with supportive faculty and mentors experienced more interactions that were positive, and they had STEM opportunities that were more engaging and fulfilling. These exchanges influenced pathways and STEM engagement during college. Moving forward, career development practitioners and educators play vital roles in supporting URM students as they co-navigate together the systems and structures of the academy and, most importantly, the opportunities that lie ahead for students in STEM careers.

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