



“What Are You Doing Here?”: Examining Minoritized Undergraduate Student Experiences in STEM at a Minority Serving Institution

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Accepted: 9 June 2023 / Published online: 10 July 2023
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Abstract

Prior research has demonstrated that women and racial minority undergraduate students experience stereotype threat in unwelcoming STEM classrooms in predominantly White institutions. Drawing from focus group and journal entry data with Latinx and African American undergraduate students ($N = 52$) majoring in a STEM field at an institution that holds both Hispanic Serving Institution (HSI) and AAN-APISI designations in Southern California, we find that Latinx and Black undergraduate students narrate exclusion from faculty and peers in four main ways: (1) exclusionary STEM classroom culture fomented by faculty, (2) study group stereotype threat, (3) nuances in Black student undergraduate experiences, and (4) unaddressed gendered discrimination. We find that Latinx and African American undergraduates enrolled at a minority serving institution highlight that STEM faculty foment stereotype threat in their classroom culture, which trickles down to students and negatively impacts their ability to develop the necessary social capital networks with both faculty and peers to succeed.

Keywords Minoritized · HSI · AANAPISI · Stereotype threat · STEM · Sexism · Social capital

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Introduction

Several studies have explored the retention and attrition of minoritized students (MS)¹ in STEM fields in predominantly White institutions (Flores, 2011; Hurtado et al., 2009; Johnson, 2012; McGee, 2016, 2018). Despite the numerous offerings for both students and faculty to foster minoritized students' (MS) success, US post-secondary institutions are not graduating MS at the same rates as non-MS in STEM (Hurtado et al., 2009; Lord & Camacho, 2013; President's Council of Advisors on Science and Technology, 2012) for a confluence of reasons such as stereotype threat (Johnson, 2012). Recent data by the National Center of Education Statistics (2018) indicate that nearly 60% of bachelor's degrees in STEM were awarded to White students, while only 15% were awarded to Latinx students and nine percent to African American students. MS in STEM often describe that the science environment is not conducive to their engagement in the learning process because of microaggressions and exclusionary behavior by faculty members and peers that are rooted in unfair and debilitating stereotypes (McGee, 2018; Ong, 2005). Faculty play a significant role in the development of positive (or negative) classroom culture, and we seek to understand the factors that Latinx and African Americans enrolled in both a federally designated Hispanic-serving institution (HSI) and Asian American and Native American Pacific Islander (AANAPISI) narrate.

Classroom culture is shown to have a significant impact on minoritized students' success in higher education. Johnson (2012, p. 336), while exploring campus climate and women's persistence, observed that "STEM educational environments often privilege White men, and marginalize women and people of color." This distinctly White and heteromascuine culture creates challenges for those who do not fit those social location markers (Ong, 2005), prompting women and minoritized individuals to navigate stereotypes about their gender or racial/ethnic group. For instance, stereotype threat, perceived through the classroom environment, and defined as the risk of confirming negative stereotypes about an individual's racial, ethnic, gender, or cultural group (Great School Partnership, 2014; Steele & Aronson, 1995), negatively influences the persistence rates of MS in STEM (Beasley & Fischer, 2012). Chang et al., (2011, p. 569), argue that,

Students who belong to groups often targeted with negative intellectual stereotypes not only risk embarrassment and failure but also risk confirming those negative perceptions of the group. This threat of being reduced to negative stereotypes in various situational contexts can lead to increased anxiety, which depresses performance.

The classroom environment is a pervasive issue in STEM culture that postsecondary institutions must intentionally address to ensure that all students, of any racial or ethnic background, can realize their full academic potential.

¹ We classify both Latinx and Black undergraduates as minoritized students (MS) in this manuscript due to their low representation in STEM overall.

What cultural and social factors do underrepresented and minoritized students enrolled at an Asian American and Native American Pacific Islander (AANAPISI) and Hispanic-serving institution (HSI) believe need to be considered in the classroom to improve student persistence in STEM majors? We build on this robust scholarship by placing a critical eye on how majoring in STEM at an institution that holds both designations matters (Brooms, 2022; Garcia, 2019; Pirtle et al., 2021; Serrano, 2020; Shultz et al., 2022). García (2019) notes that several institutions of higher education have obtained HSI status for enrolling Latinx students but do not necessarily serve their unique educational needs. Brooms, (2022) and Pirtle et al., (2021), on the other hand, demonstrate that Black undergraduate students enrolled in HSIs experience gendered anti-blackness and contend with anti-Black institutional embeddedness, respectively. Moreover, Nguyen et al., (2021) note that AANAPISI institutions must disaggregate their data to better inform campus practices and aid Asian heritage groups like Cambodians, Laotians, and Hmong students who have the lowest bachelor degree attainment rates (American Community Survey, 2015).

Current Study

To examine how undergraduate minoritized students narrate or explain the social and cultural factors that impact their academic performance in a minority serving institution, we broke down our overarching research question into three sub questions:

1. How do MS describe the STEM classroom cultures created by faculty?
2. How do MS and non-MS undergraduate students interact with one another in their programs?
3. How are MS students' experiences shaped by attending a campus that is both an HSI and an AANAPISI? And how, if at all, do their experiences vary by gender?

Literature Review

STEM Classroom Culture

The STEM fields are not culturally neutral forums, even though there is a presumption that they are (Flores & Bañuelos, 2021; Ong, 2005). While STEM fields are presumed to have no distinguishable organizational culture or identity, several studies have emerged that describe the overall climate of STEM classrooms as “chilly” and unwelcoming for women and people of color (Allen-Ramdial & Campbell, 2014; Bailey et al., 2020; Beasley & Fischer, 2012; Chang et al., 2011; Johnson, 2012; Lee et al., 2020; Lee & McCabe, 2021; Newman, 2011; Ong, 2005; Rendón et al., 2019). This is especially the case in science and engineering fields that have a distinctly affluent, White, and hetero-masculine culture (Lord & Camacho, 2013), where studies have shown that men take up more classroom sonic space than women (Bailey et al., 2020; Lee & McCabe, 2021). Moreover, Ong (2005, p. 598) notes that “to claim membership in science women of

color must maintain the appearance of belonging to a culture of no culture.” This comes with personal costs, such as compromising one’s identity by concealing cultural differences in an attempt to fit into the presumed mold of a scientist.

Classroom culture is also shown to have a significant impact on minoritized students’ success in higher education. While classroom environments may seem culturally or racially neutral, studies have shown that students do not experience them in the same ways (Beasley & Fischer, 2012; Chang et al., 2011; Flores, 2011; Johnson, 2012; Lee et al., 2020; Rendón et al., 2019). For example, stereotype threat and stereotype lift, “felt” through the classroom environment, could result in students of color confirming (or attempting to confirm) larger hegemonic stereotypes about their racial groups’ social status. Among these hegemonic racialized views are that Asians and Whites, especially White men, are “good in STEM,” but Latinxs and African American students, and women, in particular, are not (McGee, 2018; Twine, 2022). McGee, (2018) shows that both Asian and Black students endured stereotypes that created challenges to their mental and physical well-being, whether they were stereotyped as high or low achieving. Students themselves often conclude that White boys are exceptionally more intelligent than girls due to the subtle interactional behaviors they observe between teachers and students (Musto, 2019). Students are also racialized in relation to one another by educators in majority-minority educational settings, which often results in a concomitant racialization process of Asian valorization and Latino inferiority (Cheng, 2014; Ochoa, 2013). These racialized biases and the facing of negative stereotypes about one’s social group can create a psychological barrier known as stereotype threat (Steele & Aronson, 1995), where unease about them can negatively affect overall course performance. These implicit biases exhibited by educators—whether consciously or subconsciously—become embedded in classrooms and are not always visible to all members of society.

Pedagogy Conducive to Minoritized Student Learning in STEM

In line with classroom culture, MS undergraduate students also report a preference for STEM courses with hands-on approaches and content that connects to their communities as opposed to didactic pedagogy (Rainey et al., 2019; Rendón et al., 2019). MS students perceive that professors who employ active learning strategies and embed their cultural knowledge in the course content genuinely care more about them (Rainey et al., 2019; Rendón et al., 2019; Shultz et al., 2022; Valenzuela, 1999). For instance, some Latina teachers incorporate Latinx cultural resources into their pedagogy to connect with co-ethnics, and Black teachers in the US South actively attempted to racially uplift Black students (Fairclough, 2007; Flores, 2017; Ladson-Billings, 2009) in both predominantly White and majority-minority environments. This is also contingent on institutional context, as García, (2019) notes that designated Hispanic-serving institutions have different definitions of what it means to serve minoritized students, with some taking proactive measures such as hiring more faculty of color or incorporating Latino cultural elements, such as Spanish content, in efforts to improve their microclimates (Serrano, 2020; Shultz et al., 2022). However, much less is known about minoritized students enrolled in an

institution of higher education that holds two federal designations, how Black students experience STEM in these institutions, and the extent that they deem faculty in these organizations as supporting them (Brooms, 2022; Pirtle et al., 2021; Serrano, 2020).

Theoretical Framework

Social capital theory (Bourdieu, 1986), which describes the importance of social capital networks such as institutional agents (Bañuelos & Flores, 2021; Stanton-Salazar, 2011), is crucial to student success in higher education. Institutional agents are defined as non-familial individuals who can use their high-status positions, capital, or personal networks to provide low-status students with support that helps them reach the higher echelons of the educational hierarchy. This is important, as previous research on the experience of minoritized undergraduate STEM students note environmental factors of influence such as faculty-student and peer-to-peer interactions as a significant contributor to attrition (Chang et al., 2011; Hurtado et al., 2009).

College faculty have been shown to have a direct influence on competence, performance, and recognition, which together strengthen and foster the science identity of minoritized students (Carlone & Johnson, 2007). The challenge, however, is that science identity is built upon whether students perceive faculty to genuinely care about them and their interests. For example, Valenzuela, (1999) finds that schools operate as a subtractive process for Latinx students that divest them of their important cultural assets. Latinx students also report that they feel educators do not “care” about them or their backgrounds, making it difficult for them to develop social capital networks with important institutional agents that can aid them in their higher education journeys. Rios, (2011) and López, (2002) find that both Black and Latinx students are negatively stereotyped in schools with boys of color being punished and disciplined at much greater rates by teachers. Conversely, Asian students are valorized and academically profiled as successful by educators (Cheng, 2014; Flores, 2017; Ochoa, 2013) or are attributed with stereotype promise (Lee & Zhou, 2014)—the promise of being viewed through a positive stereotype thereby enhancing their overall performance in education or eliciting feelings of failure when they feel they underperform (McGee, 2018).

Moreover, previous research has found that Black and Latina women in STEM are further marginalized by faculty and men peers (even same-race men peers) due to their race, class, gender, and the intersections of the aforementioned identities (Dortch & Patel, 2017; Lord & Camacho, 2013; McGee, 2016; Rodriguez & Blaney, 2020). This makes it difficult for them to develop important relationships with mentors and peers as Rodriguez and Blaney, (2020) found that Latinas in STEM experienced skepticism and had their ideas and suggestions frequently challenged by their men peers, even when they were right. Other studies have shown that high-achieving Black students in STEM are burdened with a dichotomy of being either a “genius” or a “cheater,” resulting in Black students being wrongfully accused of cheating (McGee, 2016; McGee, 2018). This lack of support from faculty and peers inhibits women and minoritized students’ ability to develop social capital networks with non-MS groups that could help them improve their social mobility.

Methodology

There is a tendency, in pervasive research, to homogenize African American and Latinx student experiences by placing them under one pan-ethnic or racial label (Oboler, 1995; Pattillo-McCoy, 1999) which often fails to recognize the nuances associated with systemic inequity. To combat over-generalization, we sought to understand the daily lived experiences of undergraduate students in STEM, at a granular level, and how demographic intersections (i.e., race/ethnicity, gender, socio-economic status, and immigrant generational level) operate in concert to illuminate diverse realities in academic environments, especially in institutions that are majority-minority in their undergraduate student population.

The institution where we carried out this research is federally recognized as both an HSI and an Asian American and Native American Pacific Islander–serving institution, meaning that 25% of the undergraduate student population is Latinx and at least 10% is AANAPISI (Hispanic Association of Colleges and Universities, n.d.; Nguyen et al., 2021). However, the most common race enrolled at this institution is Asian. The term minoritized, as defined in this work, refers to Latinx and African American student populations. Academic outcomes between undergraduate MS in STEM, however, continue to be unequal, with MS graduating at lower rates and leaving STEM programs at higher rates, mirroring both local and national trends.

To examine cultural and social factors that MS articulate, this report relies on two distinct qualitative research approaches: (a) focus groups and (b) diary journal entries. We used these methods to enhance the study's robustness. Focus groups provide a rich variety of narratives and journal entries allowed researchers to delve deeper into the data to solidify emergent themes.

To gauge varied levels of cultural and social capital, and perceived faculty and peer interaction dynamics, 12 focus groups were arranged, each composed of undergraduate MS in STEM in the following academic disciplines: biological sciences, engineering, physical sciences, and information and computer sciences (ICS). We intentionally selected these majors because they enroll the largest number of MS in STEM on the campus. The focus groups were organized by racial/ethnic demographics and students self-identified into their focus groups. Our use of cross-sectional focus groups allowed us to make comparisons between racial/ethnic groups but also within and across several STEM disciplines that have different requirements. To facilitate recruitment, we created an IRB-approved flier that was then circulated to various courses and campus-wide organizations. Undergraduate MS students were recruited for three separate focus groups in each discipline: one with 1st and 2nd year African American students, one with 1st and 2nd year Latinx students, and one with a mix of MS who are in their 3rd, 4th, or 5th year and are poised to graduate. If a student was interested in sharing their experience, but could not attend the prearranged meeting times, the first and second authors conducted individual interviews, while paying close attention to achieving diverse gender distribution. See Table 1 for aggregated participant demographic characteristics. All of the focus groups were 1–2 h in length, and at the end of their participation, undergraduates were compensated with a \$20 gift card for their time.

Table 1 Percentage and number (in parenthesis) of aggregated participant demographics

Characteristics	Total ($n = 52$)
Race/Ethnicity*	
Black/African American	29% (15)
Latinx	71% (37)
Major discipline	
Biological sciences	44% (23)
Engineering	23% (12)
Information and computer science	15% (8)
Physical sciences	17% (9)
Sex	
Female	62% (32)
Male	35% (18)
Non-binary	4% (2)
Year	
1st	40 % (21)
2nd	17% (9)
3rd	17% (9)
4th	19% (10)
5th	6% (3)
Parent education	
Parent has a bachelor's degree or more advanced degree	35% (18)
First-generation college student	65% (34)

*Race/Ethnicity reflect UC campus categorical designations, not student self-identification. African American students self-identified as AA/Black, North African, and Afro-Caribbean/White. Latinx students self-identified as Hispanic, Latino, Latina, Mexican, Indigenous (Mexican-Peruvian), Mexican/Salvadoran, Chicana, Mexican-Vietnamese, Afro-Latinx, and Mexican and Black. Ten students identified with more than one race/ethnicity

To be eligible for the study, undergraduates had to meet the following criteria: self-identify as Latinx or African American, be at least 18 years of age; majored in STEM (biological sciences, engineering, physical sciences, or ICS), and speak English. Study participants filled out questionnaires that queried demographic information that included age, racial/ethnic background (self-identified), gender identity, major, parents' highest level of education and occupation, and parents' annual income before joining a focus group. Our aggregated participant demographics (Table 1) highlights the characteristics of our sample.

The focus group discussions were guided by roughly 20 open-ended questions from a semi-structured interview guide. A research team member attended every session and took copious notes. At the end of each focus group, the moderator informed respondents that they had the option to participate in the journal diaries component of the study. We used this methodology because it changes the researcher-participant power dynamic and allows students to have more autonomy in sharing what they want in a time and space where they can have more privacy (Meth, 2003). All journal diaries ($n = 18$) included at least five entries. These were used to triangulate claims (Denzin, 2003) made by

respondents and provide more richness and detail to the focus group narratives that students might not have shared in this setting. For example, undocumented students may not feel comfortable sharing their precarious legal status in a focus group discussion, as students were informed that we cannot ensure complete anonymity. Moreover, all participants that self-identified as LGBTQ+ submitted their entries. Individuals who elected to provide diary data were further compensated with a \$50 gift card.

After each focus group, a research team member and note-taker, who took stock of the discussion, produced an analytic memo with preliminary emergent themes. Data collection and analysis was a recursive process, where analytical memos and themes were discussed to remain responsive to emerging categories and concepts throughout the data-gathering process (Chatfield, 2018). All focus groups were transcribed verbatim, and transcriptions were inputted into MAXQDA, a qualitative coding software that allows for large-scale analysis. We used Braun and Clarke's, (2006) thematic analysis method for analyzing qualitative data by first typing up verbatim transcripts of audio-recorded interviews and then conducting selective or focused coding by categorizing their responses into key themes. Early memo writing included free-writing and analytical exploration of the first few focus groups. Data were analyzed using line-by-line coding, thematic coding, and continual comparison methods (Braun & Clarke, 2006). To arrive at intercoder agreement, we held research meetings to discuss the coding process and reconciled coding discrepancies by revising code definitions or adding, removing, or merging codes to better represent the data (Campbell et al., 2013). During this process, we leveraged each authors' STEM-based backgrounds and knowledge base. The authors consist of an African-American woman with a doctoral degree in higher education, raised in low-income minoritized communities, and two Mexican-American heritage and women sociologists that were raised in minority urban communities. All of the authors possessed relevant experiential knowledge as they either provided support to men, siblings or children, who were pursuing STEM degrees, or personally transitioned out of a STEM major as an undergraduate. All of the authors are women, which led to greater rapport with women respondents that comprised over 60% of our sample, given our insider status. Subsequent focused coding allowed for further exploration of some initial codes that appeared particularly meaningful to understanding variation in terms of student social and cultural locations. For example, we discussed the broad thematic code of STEM peers and developed 15 different subcodes during team research meetings as is evident in our codebook.

All focus group participants ($n = 52$), including African Americans ($n = 15$) and Latinx ($n = 37$), were currently majoring in a field in STEM. The research design aimed to include an equal number of African Americans and Latinxs, but undergraduate students that self-identified as African American proved difficult to recruit due to the low percentage of Black students enrolled (less than 2%) at the research site.

Results

Our first research question gauged how MS described their STEM classroom cultures, which MS students indicated were created by faculty. This led to the development of our first theme. To that end, our second research question's aim was to

assess how MS and non-MS undergraduate students interacted with one another in their programs, which led to the development of our second theme. The focus of our third research question was to interrogate how MS students' experiences are shaped by attending a campus that is both an HSI and an AANAPISI and how they vary by gender. The logical flow of our themes—(1) exclusionary STEM classroom culture fomented by faculty, (2) study group stereotype threat, (3) nuances in Black undergraduate experiences, and (4) unaddressed gendered discrimination—illustrate the mechanisms that contributed to MS difficulty in developing social capital beginning with faculty and extending to peers, with particular racial nuances and gendered consequences that impacted their overall performance.

Exclusionary STEM Culture Fomented by Faculty

Both self-identified Black and Latinx students in this study described the culture of STEM at a majority-minority undergraduate institution as “competitive” and “cold” and noted that faculty had a hand in creating this atmosphere. Even though this research-intensive university was considered a minority serving institution, the STEM course curriculum did not reflect this diversity. Elizabeth, a second-year Latina student majoring in biology, said, “The way STEM is made out to be is more like a general delivery of information” to signify that she could not resonate with the course content and the ways it was being taught. A common area of discontent for minoritized students was having STEM professors that demonstrated patronizing attitudes when they asked for help with the course material. For example, Fátima described professors that would be condescending, and dismissive, even when multiple students were confused. She said,

I've had [STEM] professors who were not open to questions...they acted like students should know all this information already, had such condescending tones, and were not answering the students' questions. They'd be like, 'we don't have time for that 'next.' And we're like, 'well if we don't understand this concept, how are we going to build off of it?' The questions students were asking were very valid, he just didn't want to answer. (Fátima, engineering, Latina, fourth-year)

Fátima pointed out that when professors refused to answer questions on foundational concepts, it created challenges in understanding subsequent materials.

Malik, a North African, biological sciences and community college transfer student, described STEM students as being metaphorically placed in a hierarchical system that ranged from those in the “struggle corner” and “those guys [that] are going to be operating on you.” Malik went on to explain the role professors played in creating this academic hierarchical system in the classroom:

Some professors, who are definitely responsible for this...they make it seem as if you're supposed to know everything after the first time they say it, they [are] like, 'okay go and do it.' The people who are on their game, and like robots, they go and do it and there's a lot of people [that] are like 'what happened?'

Most people I would say need a little bit more explaining, a little bit more understanding of the topic in order to sort of execute [the] orders that they were given...The professors cater most of the time to the most astute students, the way in which they give you instructions...They expect everyone to know everything...I would put the majority of the blame, if not all the blame, on the professors. (Malik, third-year)

Studies have found that some STEM professors contribute to the cold and competitive STEM environment by telling students that most of them will fail based on a lack of effort (Newman, 2011). The lack of personal experience and awareness about educational equity can lead to professors embodying attitudes and demeanors that are patronizing towards students that attended under-funded, and less competitive high schools. Jazmín, a fourth-year ICS major, shared how discouraging it was when professors assumed and expected students to have knowledge that they never had access to before college. She captured the sentiments of other first-generation college students and low-income students:

They assume that we all come from some sort of privileged background. That speaks volumes because I don't... It's very disheartening to hear things like 'Oh, you should know this already' because I'm here wondering like, '[at] what point in my life was I supposed to learn this because I've never been introduced to such high-level concepts until college.'

Conversely, undergraduate students reported a preference for STEM courses with active learning as opposed to didactic pedagogy (Rainey et al., 2019). Students noted that professors that employ active learning strategies and include their ethnic cultures are perceived as more caring (Rainey et al., 2019; Valenzuela, 1999).

The competitive culture of STEM courses generated by faculty, coupled with negative racialized stereotypes of Black and Latinx students, set the stage for Latinx and Black students to be socially and academically excluded by their peers, particularly by their Asian peers, who were numerically overrepresented in their courses and the campus overall. They felt that many of their non-Black and non-Latinx peers displayed distrustful, non-engaging, and uncollaborative behavior which contributed to the unwelcoming environment. For example, Dionne, a second-year, African American woman in biology, described her STEM courses as cutthroat and unfriendly:

They're very cold, it's definitely a very competitive atmosphere so there's not a lot of friendliness. You feel like everyone's kind of against you, especially in these higher classes. There's more hesitancy to share and [to] try to be number one. So that's definitely something I've recognized. Socially, it's always a kind of a race...everyone's trying to be the best, and so it can often lead to feeling like, 'okay you're not really my friend,' or just a lot of mistrust and coldness among other students.

Participants described their STEM peers as selective with who they helped academically, usually choosing classmates that mirrored their identities or who they perceived as intelligent.

The cutthroat nature of STEM courses fomented by faculty, whom Black and Latinx students described as socioeconomically disconnected from them, contributed to their academic exclusion from peers. Marie, an African American biology major, recalled an instance where she was gradually excluded by her Asian peer when she developed a connection with another co-racial peer:

I started to notice they [Asian peers] would start to leave me out of conversations a little more...I kind of started to work out problems on my own because they wouldn't really talk to me. In the beginning we would turn and talk to each other and then a third [Asian] girl kind of [joined] our conversations, too. Then it started to shift. They were both Asians and they would talk to each other and leave me out of it.

These forms of exclusion are normalized by professors or their teaching assistants that subconsciously reinforce negative intellectual stereotypes about Latinx and Black students. For example, Luis, a first-year engineer, recounted an instance where a teaching assistant (TA) incorrectly assumed he had gotten a problem wrong while working in an all Asian peer group:

In one of my classes there was a group of us working on practice problems. Everybody in the group was Asian, except for me—I'm Mexican. I proposed an idea, but the rest of the group disagreed, so we went with the majority. We then finished and turned the work in to the TA to check for us. The TA came to our table and automatically accused me of making a major mistake. One of my peers eventually spoke up and took blame for the mistake. During the exchange I felt very upset... I felt like even though I was the only one who was correct, I was still seen to be the problem. (Luis, journal entry)

The TA's subconscious racialized biases might have made them quick to assume that Luis had to be the person in the group responsible for the mistake. Our findings coincide with previous research that highlight a concomitant racialization process of Asian valorization and Mexican inferiority was reproduced in higher educational settings (Ochoa, 2013), making Latino students feel like they were underperforming when they were not.

Latinx and Black students explained they experienced exclusion by their mostly Asian peers in their STEM courses and in social gatherings. Luis, further shared his experience of being excluded from Asian "parties" because he was not a member of their racial group:

Living in [this city], the majority of the population is Asian. This usually isn't a problem to me in any way, but there was a time when it made me feel excluded. There's a floor in my hall where almost everyone is Asian. They are always hanging out and having a noticeably good time. I always say 'hi' to them and they seem[ed] to be really nice. Oftentimes they have little parties or kickbacks. There have been instances when they come down and invite my roommate to hang out with them saying, 'you're Asian too, you should come over.' I understand if I'm not invited because they don't

know me too well but sometimes it seems like I'm not included because I'm not the same race as them. (Luis, first-year, journal entry)

While the site where we conducted this research is considered a minority serving institution, Latinx students felt routinely excluded from STEM-centered events and gatherings. Luis's not being invited to social events prevented him from developing community with other students that may be in his major. Because Asian students were a sizable number in these courses, it was more common for them to procure, secure, and share resources with one another.

Study Group Stereotype Threat

Stereotype threat in conjunction with the culture fomented by faculty in STEM classrooms negatively influenced the experiences of MS in STEM when trying to form study groups with their peers. Both Latinx and African American students recounted difficulty forming study groups, which affected their ability to develop a sense of belonging, successfully navigate their coursework, and gain access to opportunities within their major. Their challenges joining study groups were not only complicated by the fact that they were both numerical and racial minorities in their classes, often being the “only” or “one of the few” students from their racial/ethnic group, but because they also felt that their White and Asian peers devalued their presence and scientific contributions in class in similar ways that faculty and TAs did. For example, Abdul, an African American student majoring in biological sciences, said:

It can be difficult. Sometimes I have been the only person of color in [my] classroom but how I see it is you have to take it for what it's worth and keep pushing through...It's hard to find study groups at times because you don't really know the whole vibe of what people are thinking about you.

Abdul's words illustrate that he felt isolated and “really awkward” when approaching other students and wondered what his peers thought about his scholastic aptitude given negative racial stereotypes of Black students (McGee, 2016, 2018). To further expound on this point, Dionne, an African American undergraduate student majoring in biological sciences, felt awkward when trying to find study partners especially when it appeared that several groups had seemingly formed along racial-ethnic lines. She expressed,

I'd say everyone kind of groups together with their own race. It's predominantly Asian so the biggest clique is going to be that. I don't really have people to clique with so I'm usually kind of isolated. I've started to notice that there's a lot of like Hispanic students that also don't really have many people to clique with. People who don't really have people to clique with kind of clique with each other...

Black STEM students shared that Black people were the last ones chosen for an academic peer group and that it was common to not have any non-Black people sit next to them in class (Dortch & Patel, 2017; Mwangi et al., 2018). To mitigate feelings of exclusion, Black students in our study would gravitate to one another

in their courses (Dortch & Patel, 2017; Mwangi et al., 2018) or form groups with Latinx students who also found themselves underrepresented in these spaces and whose intelligence on the subject matter was also doubted.

Both Black and Latinx participants, especially women and non-binary participants, discussed the ways that their STEM peers treated them as less competent or intelligent. For instance, Jessica, a Black third-year physical science student, described mitigating the marginalization she experienced in “majority white spaces” by trying to form peer groups with other Black peers because “when you’re learning with other people who look like you, ... you don’t ever question if your intelligence is different.” Further, Adan, a first-year biological science major and Hispanic student, described the typical condescending responses he received from his White and Asian peers when trying to ask for help: “they give you a face, or they give [you] a remark like ‘Oh, you don’t know that already?’” Kimberly, a Latina in physical sciences, noted the condescending ways that white men in her lab courses responded when she attempted to contribute. She said, “the response I get is not only negative, but the tone that they use makes it seem like they’re talking down to you because they think you are stupid.” These types of responses from White and Asian peers illustrate the condescension that Latinx and Black students are subjected to when merely trying to access academic support or engage in the process of what it means to be a student. Dominique describes how she experienced social and academic exclusion among her Asian peers:

I was in a STEM friend group and they’re all Asian and they all hang out outside of class and they don’t include me...even though we all met at the same time... If I asked for help, they usually don’t give me help but they’ll answer other people’s questions in the group chat ...One of the people in it ... complains about affirmative action all the time saying that Black people are more likely to get into med school and I asked him randomly— cuz he’s trying to apply right now, he’s taking the MCAT. I was like ‘what score should you get on the MCAT to get in? What’s a good score?’ And he’s like, ‘well for you it might be different. I think you guys are allowed to score lower.’ That’s not what I asked. So, it’s stuff like that they say all the time. [It] makes you feel out of place and stupid and they don’t reciprocate when you help them... (Dominique, biological sciences, Afro-Caribbean & White, fourth-year)

These experiences left Dominique feeling unwelcome and put-down after her Asian peers denied her academic support, socially excluded her, and complained about policies that promote equity for historically excluded students. While McGee, (2018) argues that stereotype lift is harmful to Asian students when they “underperform,” here we see how Dominique felt that her non-minoritized Asian peers would use condescending non-verbal and verbal remarks to demarcate their perception of her place in STEM. In minority serving institutions, both Black and Latinx students felt as if they were intellectually positioned below their Asian peers.

Nancy, a first-year shared how unforgiving and patronizing their STEM peers can be when they made a simple calculation mistake:

I did the calculations and got them wrong, and everyone stared at me. I ask questions and they look at me as if I am asking dumb questions. It seems to be tedious for my group. It doesn't help that they call it "easy" or "common sense." The people in my group don't expect much from me either. I think they acknowledge my effort when I participate but acknowledgement is not enough. I notice when they talk to me, their word choices change. Instead of saying net force, they say force facing up. Which is not the exact definition either. (Nancy, aerospace engineer, Afro-Latinx, journal entry)

Women and students of color report greater levels of stereotype threat based on the fear of being deemed less competent than their peers (Beasley & Fischer, 2012). Stereotype threat is positively correlated with MS STEM attrition because it contributes to exclusionary academic environments (Beasley & Fischer, 2012). Nancy underscored how "unmotivating" it was to be surrounded by peers that "treat me like I'm dumb," by simplifying academic language or responding to a miscalculation as evidence of her incompetence. Other students shared that they were treated as less intelligent than their non-MS peers even when they considered themselves well-versed in their field. For example, Laila, a Black biology student, was selected to be a peer tutor because of her demonstrated mastery of the material; however, felt that she still had to prove her intellectual capacity to her peers:

It feels like you have to prove yourself as one of the smart ones to be accepted, ...when I used to be a peer tutor for biology. Although [it] was online it did feel like I saw some of my peers who were not minorities were getting a lot more people to show up to their office hours, although we were still tutoring for the same class. We had a very similar time, so it wasn't like the timing that was off. (Laila, Black, third-year)

Laila felt that she needed to work extraordinarily hard to demonstrate her "qualifications" and to receive the same respect that some of her White peers gained automatically. She noticed that students were less likely to attend her office hours despite her position as a peer tutor because of her stellar academic performance. Black and Latinx students in this study felt it was assumed they were not competent in STEM, which is something they articulated their non-minoritized peers did not experience. Stereotype threat forced Black and Latinx students to pull together in institutions where Asian students were racialized as intellectually superior.

Because of the nature of the discipline, ICS undergraduate majors that self-identified as Latina/o (4 men and 4 women) were less likely to form study groups because much of their coursework was independent. However, because they were often one of a few MS in their classes, they had difficulty developing the academic and professional networks necessary to advance in their area of interest. This manifested itself, for instance, when important team-building activities became available like campus competitions. Michael, a fourth-year Latino student, said he formed a group with the few Black students in his computer science major:

I felt that was hard as well because we are supposed to form groups for [the hackathon]. It was hard trying to look for groups because it already

felt like people had cliques. It was kind of hard inserting myself but again, I found the other minorities in the competition. I went back to one of my other friends, this Egyptian girl actually that I still talk to today. I guess [she is] Black...There weren't a lot of girls [in the] competition.

It is important to note that there are zero African American ICS student voices reflected in this article despite heavy recruitment efforts. Notable about Michael's words are that he found the one other student that was underrepresented in ICS to form a two-member group.

Nuances in Black Undergraduate Student Experiences

While Latinx undergraduates experienced pushback when they contributed to classroom discussions, African American students shared that their mere presence in STEM classes and on campus was a source of tension. They “felt” this tension before they said a single word (Lee et al., 2020; Serrano, 2020). Abdul, a phenotypically dark-skinned African American student, discussed how he felt walking into large lecture halls that were mostly White and Asian. He said, “It’s not really overt. It’s more covert. So, hidden a little bit. But if you’re walking into a room there are long stares and people are like, ‘what are you doing here?’ Questioning if you belong in the room.” Marie, an African American student and second-year majoring in biological sciences, shared, “Walking around campus...people look at me like they’ve never seen a Black person before. Yes, I’m here. There are multiple of us here. I know we’re rare.” Marie, a darker-skinned woman, acknowledged that there were very few numbers of African American students at this HSI campus, yet she was greatly surprised by the fact that she felt some Asian students on campus never had interactions with Black people. Black men and women students felt hypervisible on school grounds, and it intensified in their classes. Marie continued:

I feel like we all know, [this university] is predominantly Asian...They’re not friendly towards me from what I’ve noticed. Even just walking around, I don’t know if it’s in my head, but I feel like I get a lot of looks. I’ve noticed it too often for it to be in my head...I don’t think it’s very inclusive or open. I’ve never really felt that way honestly.

Unlike Latinx undergraduates that could see themselves reflected in the institution’s growing enrollment numbers on campus, African American students could not. Latinx students were able to walk around campus more freely, but their sense of hypervisibility heightened specifically in STEM classes. Javier, a first-year Mexican/ Vietnamese engineering major, observed that in his online engineering classes, there were not many “Hispanic people just [by] looking at Zoom names,” however in his general education, “writing class almost half the class is Hispanic.” Even in courses with an online or hybrid format, due to the Covid-19 pandemic, Latinx and Black students were aware of the lack of MS representation. Despite being a sizable number of students on campus, Latinx, like African American students, did not feel they were receiving the support they needed

to succeed from faculty (see García, 2019; Brooms, 2022) or personnel in their STEM majors. This made them drift towards one another.

Nancy, a first-year Afro-Latinx student majoring in engineering, also identified as non-binary and they explained,

Honestly, sometimes I feel unwelcome because I am Afro-Latinx. When I walk around engineering, I feel people staring at me as if I don't belong. One time I remember there was this guy like giving me a stare-down. Like, 'what am I doing there?' It's happened a couple of times to me in engineering. Honestly, it feels lonely...I didn't know there were [not] many Hispanic engineers in my classes. I think there's only like one, two others.

Nancy identified more closely with Hispanic students. They became more aware of the low numbers of Hispanic peers, and how that contributes to their loneliness, as a non-binary person in engineering. To that point, Dionne, an African American woman student majoring in biological sciences, became more aware of the low numbers of Black students in STEM when her courses switched from online to in-person. She said,

It can be hard to find your place. If you see other people with their friends with their study groups...it's almost hard to put yourself into that type of environment, especially if you don't see other people like you. I guess I kind of knew what I was getting into, but it was really eye-opening to see it in real life and visually in the classroom.

In contrast, Cole, a mixed African American/Irish/Native American student in engineering, described his experience as being "pretty good" and expressed not feeling "too out of place" compared to students that "solely" identified as Black in STEM classrooms. While Cole felt that "while I am all three, I'm not truly one" in terms of his mixed identity, he did indicate that the Black experience in STEM was nuanced. Cole explained,

Obviously, the Black culture will definitely accept me because that's how I appear...I don't necessarily feel accepted in the other two if that makes sense. So, when you go into a classroom when you're this combination, you don't necessarily feel out of place because you can identify with all three if that makes sense. People [that] feel solely Black? I see no one like them. It can be a lot more of a culture shock and I wouldn't say that it's been [like that] for me.

While Cole was physically recognized as part of the Black community, he felt that his mixed racial/ethnic background allowed him to navigate these spaces with greater ease.

Black students have diverse lived experiences though people that display negative racialized behaviors tend to treat them monolithically. For instance, Rozmond and Katrina were both first-year students in physical sciences and noted that their parents held middle-class occupations and were raised in affluent homes. Rozmond explained that both of her parents were registered nurses and that her

mother earned a doctoral degree. Katrina's mother was college educated, having worked in Human Resources. Her father was a police officer. Yet, despite the academic and professional achievements of their parents, both Rozmond and Katrina experienced implicit bias, racial microaggressions, and racialized stereotypes from their STEM peers and professors. Katrina described a racist interaction with a professor during office hours that made her "dread" reaching out to him for help: "[the professor] mentioned [the] George Floyd murder ... he said something to the effect of 'I would have given them the \$20.' It was almost alluding to ... 'it wouldn't have happened because he would have given him the money.' ... I was like, 'okay, so if I wasn't Black, would you have brought that up?'" Katrina's professor was insinuating that George Floyd, a Black man, was to blame for the police brutality that he endured because he did not give police a twenty-dollar bill, which he was accused of counterfeiting. Katrina avoided this professor after this incident, which she felt caused her to fall behind. Katrina and Rozmond felt that there were small efforts to acknowledge the first-generation college experience at Hispanic Serving Institutions (Garcia, 2019), but much fewer resources dedicated to understanding racism and anti-blackness in science.

Some African American participants also recalled having an immigrant parent that was an academically trained STEM professional in their country of origin. For instance, Tristan arrived in the USA with his family at 14 years old and attended an inner-city high school in Los Angeles. He explained that his father was an elite and educated immigrant that worked as a doctor for Egyptian celebrities, the rich and famous, and people in need of medical assistance back home. Because his father was a successful heart surgeon, Tristan hoped to follow in his footsteps as a biological sciences major. Contrary to the lived experience of Black students from the USA (discussed in the earlier parts of this study), Tristan felt like his peers were warm, and welcoming, and felt that this was due to his experience as a Black immigrant student. He said, "They're so gentle with my background and they know where I came from. Sometimes I couldn't understand the materials and I asked 'how should I do this? And how should I do that?' and they're really helpful, to be honest." As an Egyptian immigrant, Tristan was aware that his experiences were markedly different from those of his US-born Black peers. Feliciano, (2005) developed the concept of immigrant educational selectivity and notes that some immigrant groups are positively selected; meaning that their high levels of education in the home country positively affect their own children's educational outcomes by providing them with a form of cultural capital they can pass on.

Malik, mentioned in earlier parts of this study, also noted that his father was a chemical engineer in Northern Africa. He explained that his family "is all STEM" and it was "unimaginable for him to diverge from the STEM path." As the child of elite migrants, Malik was aware that he possessed a form of cultural capital that first-generation, and MS that attended K-12 schools in the USA (often fraught with racial hierarchies and systemic inequities) lacked. He explained:

There is this sort of stigma where, if you are from the Middle East or North Africa then you are sort of programmed to be good in STEM and so...a person of that background it's sort of expected of you. It's not something to brag

about in the community, because if you say, ‘Hey, I’m doing a STEM degree’—whether it’s dentistry or trying to become a physician then that’s expected of you so it’s not a big of a deal.

Because Malik’s family was well-versed in various STEM fields and possessed important forms of cultural capital due to their elite class status in their home country, he may have been aware of the process of successfully navigating postsecondary education. He ostensibly understood that he could enroll in courses at a local community college, and then transfer his credits to a top-tiered UC institution. Consequently, Malik had guidance for the pre-medical pathway that many other first-generation college students struggle to find during their first 2 years at a 4-year university.

Unaddressed Gendered Discrimination

Latina/x and Black women/non-binary students narrated experiencing sexism in their STEM courses, and in some instances recalled implicit or explicit evidence of gendered racism (López, 2002) that was rarely addressed by faculty. For example, Elisa, a first-year majoring in biological science, described belittling experiences with men peers:

I was in my bio discussion actually and have to do group work — I was doing [it] with three other males and I was really discouraged after the class, because every time I would ask a question, they would either ignore me or they’ll push me to the side, and it did not feel good. They were kind of hesitant to answer me, like pushing me away. Being a woman of color and a STEM major is a little bit harder, because in my experience, people are hesitant to help you out. (Elisa, Hispanic)

Elisa described feeling dismissed as the only woman in an all-male peer group and as a person of color, which she believed made her peers “hesitant to help you.” This form of sexism among students remained largely unaddressed by faculty.

Along the same lines, Nancy shared the way their gender identity led them to feel disrespected and ostracized in their male-dominated engineering major. They said,

My pronouns are they/them. There are very few people who respect that. In my math class, we were told to share pronouns and this guy said, ‘Who cares? It’s obvious.’ Then proceeds to misgender me. In my engineering class, I told my group my pronouns and they never respected that...I know that engineering is a male-dominated field and to be a woman in STEM is rare, but it feels rarer to be non-binary in engineering. The groups won’t let you in. They don’t talk to you unless you are ‘one of the boys.’ This isn’t the case for every guy in engineering because some are welcoming and respectful, but the loudest ones are the ones that don’t respect you. (Afro-Latinx, journal entry)

Nancy lamented not knowing any other non-binary students of the same ethnic background so that they “wouldn’t feel as alone in this field.” Transgender and gender non-conforming students persist in STEM at lower rates than cisgender students

and professors' range in their understanding and implementation of inclusive practices for them (BrckaLorenz et al., 2021; Maloy et al., 2022; McEntarfer & Iovannone, 2020). Some faculty described remembering students' pronouns as burdensome, minimized the impact of misgendering students, and objected to "changing the English language" to accommodate non-binary students (i.e., using they/them pronouns). Although not all students correct professors or their peers for misgendering them, most report experiencing significant hurt and stress when misgendered in their classes.

Further, Latina/x and Black women participants shared experiences where racism and sexism intersected, creating inhospitable environments for women of color. For example, Jazmín, a Latina majoring in ICS, remarked that "being a woman and being Latina — it was not a very good mixture" if you wanted to be treated as competent in STEM. Jazmín described an instance where she was working on a group project and everyone on the team kept ignoring her suggestions, but when a White man peer repeated her exact suggestion, her team had a completely different response: "they were like 'oh my gosh like, why didn't we think of that?' And it was revolutionary, but when I said it, it was like, 'okay, it's just another woman talking.'" Jazmín, too, felt that she was marginalized in STEM because of her gender and ethnicity as Salvadoran and Mexican, and these belittling moments left her feeling "discouraged" and like she "didn't belong" in her major. When women of color took up sonic classroom space (Bailey et al., 2020; Lee & McCabe, 2021) and were shut down or ignored, their sense of imposter syndrome heightened and made them question their capabilities and whether they belonged in STEM. Dominique also witnessed gendered racism at play while serving as the only Black learning assistant (LA), or peer tutor, for a biology course. She said,

There are maybe one or two Black students in the whole class and the one girl she's very quiet and shy, but I heard the other peer tutors talking about her and they're like, 'she's really mean and rude.' And I'm like, 'she's just quiet.' So, I feel like they were discriminating against her because she was Black and they're trying to project onto her [by] saying she was rude and disrespectful even though she wasn't.

Dominique felt that the non-Black learning assistants were projecting their stereotypical perception of Black women onto a shy Black student. Black women are often subjected to the "angry Black women," trope, which is a negative stereotypical representation of Black women as overly aggressive (Collins, 2000; Mwangi et al., 2018). In this case, the learning assistants may have been normalizing their exclusion of Black women in STEM.

Much like Bailey et al., (2020) who found that women's in-class participation and performance increased with more women peers, the women of color participants in our study found comfort and understanding in other women peers and professors of color. For instance, Melissa, a fourth-year, Latina biological sciences major, stated, "I think the time I felt the most comfortable in my small lab section was when it was mostly women in the classroom." Similarly, Jessica, an African American physical science student talked about how connecting with a Black woman professor made her feel comforted and understood during a tough quarter:

Lauren was the sweetest the most understanding person, and the angel I encountered in such a difficult quarter...that disconnect of when you're talking to a POC [person of color] teacher and when you're talking to a White teacher and I've noticed with my POC teachers they've been so flexible [...] And it's been comforting because it's like 'they made me feel like it's okay, you're human, things happen, you could get through it.' (Jessica, 3rd year)

Jessica felt encouraged and comforted by her Black woman professor who allowed her the flexibility she needed when other professors were more reluctant.

Discussion

Several studies have examined retention and attrition rates of underrepresented groups in STEM and have highlighted the impact that stereotype threat plays in their experiences in predominantly white institutions. We add to this literature by strategically forming focus groups that allow for cross-sectional analysis not only by race/ethnicity but also by other social location characteristics such as gender and across STEM disciplines to focus on the important link between classroom culture and social capital development. In grouping advanced Black and Latinx minoritized undergraduates together, the focus groups created an opportunity for them to share and learn about similarities and differences in marginalization from each other.

This study improves the knowledge and understanding regarding challenges related to STEM retention and attrition rates faced primarily by Latinx and African American undergraduate MS in two key ways. First, focus groups, individual interviews, and journal entries highlight that Latinx and Black undergraduate students experience a series of uncomfortable situations rooted in racial/ethnic, gender, and cultural conflicts in STEM courses, beginning from the moment they walk into their classrooms. Both African American and Latinx participants described the culture of their STEM courses as competitive and cold and indicated that faculty had a hand, whether consciously or subconsciously, in creating this atmosphere. As a result, this environment trickled down to their peers who then displayed distrustful and non-colaborative behaviors when it came to offering academic support or resources. Moreover, Black students noted that walking around campus or down the classroom steps marked them as hypervisible and immediately made them doubt if they belonged, elevating their feelings of stereotype threat. While the institution where we collected the data held both the HSI and AANAPISI designations, both Latinx and African American students felt marginalized, isolated, and alone in STEM, making them gravitate towards one another in order to reduce feelings of stereotype threat. Unlike Black students, however, Latinx students felt hypervisibility mostly in their STEM classrooms and not around campus. This suggests that campus context can play an important role in students' feelings of inclusion and administration and faculty need to actively create inclusive environments for all of their students (BrckaLorenz et al., 2021), especially those that are numerical racial minorities in certain subfields.

Second, not only did Black and Latinx students have difficulty developing relationships with STEM faculty but also with their peers. MS undergraduates were

frequently subjected to exclusionary behavior as one of a few students that represented their racial-ethnic background; and expressed that their racial and ethnic group was often racially stereotyped as unintelligent (McGee, 2016), making it harder to develop social networks with non-MS peers who were well represented in their classrooms. While participants have nuanced lived experiences, and varying levels of privileges, and/or disadvantages surrounding gender, class, ethnicity, race, etc., our participants reported instances where their social identities interacted with systems of domination to create marginalizing experiences (Zinn & Dill, 1996). These marginalizing experiences included being subjected to anti-blackness (Brooms, 2022; Pirtle et al., 2021), gendered racism, classism, racial stereotypes, and sexism which STEM faculty rarely took time to discuss, address, or deconstruct in their classrooms and that students noted would make a significant impact.

This data was collected during the Covid-19 pandemic when some students (mostly first years) had only experienced taking STEM courses online. Therefore, we were unable to assess if their experiences changed once teaching requisites changed back to the in-person format. However, even in the online context, students still expressed that they were numerical minorities in the zoom classrooms and instances of exclusion and marginalization became even more visible. Moreover, the pandemic exacerbated racial inequalities in higher education as Black and Latino students were more likely to plan to cancel or postpone their studies (Ahn & Dominguez-Villegas, 2022). Finally, it is important to note that while we recruited heavily across the research site, the sample size of African American students was small. All things considered; however, this study still offers useful data for future policy-making, and it elucidates key elements that all universities across the nation can work to address STEM equity. Future studies should compare and contrast the experiences of white and Asian American students of deprived backgrounds and how they are received by faculty and peers to gain a more nuanced view of how stereotype lift (or promise) hurts lower-income groups that are subsumed under umbrella racial labels. To help achieve this, we asked all MS participants in our study what they thought would promote inclusion in STEM. Their top three recommendations were (1) addressing and preventing racist peer exchanges in STEM, (2) professors showing students more compassion about the challenges of STEM, and (3) providing more support for finding clubs or communities that support marginalized people in STEM.

Given the findings of this study, we suggest directing resources to initiatives in the form of educational grants to design programs with a twofold goal of (1) creating inclusive and collaborative learning environments for Latinx and Black students and (2) fostering positive faculty-student rapport so that MS can build social capital networks necessary to succeed. The first can be achieved by professors developing course community agreements that include anti-racist norms, addressing gendered discrimination and respecting students' pronouns, pre-assigning team members in student group work to minimize racial exclusion, incentivizing peer-to-peer support and providing information about clubs, communities, or academic homeplaces (Serrano, 2020) that supported marginalized people in STEM.

Moreover, being intentional about hiring Latinx and Black faculty would benefit minoritized undergraduate students who suffer from a lack of social capital

networks. This is not always feasible, and for this reason, it behooves faculty already working at research-intensive universities to be mindful of how implicit bias may inadvertently be embedded in their course syllabi and actively seek to expand their training and understanding of anti-racist pedagogies and equitable instructional practices to create inclusive environments for minoritized students. Internal incentives also play an important role in improving STEM culture among faculty to fit a changing and diverse undergraduate student population.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s41979-023-00103-y>.

Declarations

Conflict of Interest The authors declare no competing interests.

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