An Investigation of Black Students' Experiences in Engineering Teamwork

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Introduction

Team-based, project-based learning has become an integral part of engineering education. Over the past two decades, first-year cornerstone courses, co-curricular design activities, and culminating capstone courses have proliferated in engineering education due, in part, to the belief that such experiences are necessary for preparing students for professional practice [1]. Indeed, team-based, project-based learning experiences are thought to support myriad social, technical, and sociotechnical learning outcomes for engineering students, such as learning to think and communicate in the languages of engineering, technical writing and communication, prototyping and fabrication, and so on [1]–[3]. However, existing research has indicated that the benefits of participating in team-based, project-based learning experiences are not always shared by all students, and sociodemographic characteristics, such as race/ethnicity, sex/gender, socioeconomic status, and international student status, can inform the socioacademic dynamics by which students come to participate (in)equitably in engineering teamwork.

The purpose of this research was to examine the role of race and racialized experiences in Black students' access to learning opportunities in team-based, project-based learning in engineering. While research generally documents patterns of exclusion and marginalization for historically excluded students, such as women and racial/ethnic minoritized students (e.g., Black, Latinx, Indigenous students), a growing body of literature suggests the mechanisms by which these patterns of exclusion and marginalization are manifested in students may differ between, for example, Black and Latinx students, Black women and Indigenous women, and so on [4]–[7]. For example, Cech and colleagues [4] described how learning activities in STEM often require Indigenous students to participate in educational activities, such as dissection, that conflict with their cultural beliefs and values under the guise of scientific objectivity. Similarly, Peralta and colleagues [6], described how racial markers related to language and culture often precluded Latinx students from utilizing their social capital, thereby limiting their ability to become fully integrated into STEM academic settings.

Conversely, prior research has demonstrated how racialized performance expectations shape how Black engineers "show up" in engineering teamwork in education and professional settings. For example, Douglas and colleagues [8] described how "normative standards of professionalism constrained the agency" of Black male engineers, shifting their patterns of engagement with peers in professional settings. In education settings, racialized and gendered performance expectations, where Black engineering students and women in engineering are assumed to be less competent than their White and Asian counterparts, have been found to shape students' access to important learning opportunities and, by extension, their learning outcomes [9]. Concerns about appearing to be the "angry Black man/woman" might shape the communication and task negotiation strategies that inform how students come to participate in the learning activities at the center of team-based, project-based learning for Black students.

This study investigates how eight second-year Black students experience teamwork in project-based learning, focusing specifically on the role of race and racism in shaping access to and participation in team-based learning opportunities. While the broader study includes 29 participants, this paper centers the perspectives of these eight students to provide a detailed, contextually rich analysis of their experiences at this critical stage in their engineering education. Participants reflect the multifaceted nature of Blackness, shaped by distinct personal, academic,

cultural, and linguistic backgrounds, as well as diverse career aspirations. Their perspectives highlight both shared and divergent experiences, emphasizing the importance of a nuanced approach to understanding how racial identity influences teamwork dynamics. Thus, this research was guided by the following research questions:

1. How do Black engineering students' experiences in team-based pedagogies shape their learning in engineering?
2. What role does race/racism play in shaping Black students' experiences in team-based pedagogies in engineering?
3. What strategies do Black students adopt for navigating negative experiences in teamwork pedagogies in engineering education?

Conceptual framework

We drew on the MITA framework in Project-Based Learning described by Fowler and Su [10]. In the model, Fowler and Su begin with the assumption that the tasks students are allocated in team-based learning settings represent important learning opportunities, and the degree to which students gain access to specific tasks informs the degree to which they achieve related learning outcomes. As a result, the process by which students negotiate and allocate tasks holds heightened importance for their learning in team-based, project-based learning settings.

The MITA framework posits that task allocation in collaborative projects is informed by students' (a) initial predispositions, skill sets, and prior experiences, (b) related self-efficacy beliefs about engaging in teamwork and various sociotechnical tasks, (c) their academic orientation, and (d) team negotiation processes that entail complex interpersonal communication dynamics. Initial predispositions are thought to be informed by students' personal interests and motivations, the skills they bring to the project, and prior teamwork experiences that shape their sense of confidence and safety in team settings. While Fowler and Su [10] discuss the role of gender in task allocation, this research expands that model by discussing race to describe how power interacts with student preferences and predispositions to lead to inequitable outcomes. For example, prior research indicates Black engineers experience engineering education as isolating, hostile, and exclusionary, where students' prior learning opportunities and learning outcomes are impacted by racism in the discipline [10], [11]. It stands to reason that new experiences may be interpreted through the prism of prior experiences with racism in engineering.

Second, Fowler and Su [10] argued that students' predispositions, skill sets, and prior experiences result in self-efficacy beliefs–their judgements about their capabilities to complete tasks in the learning environment [12], such as participating in the social, technical, and sociotechnical tasks that team-based learning activities entails. For example, students who have no prior engineering teamwork experiences, or whose prior experiences were negative, may have negative self-efficacy beliefs about participating in teamwork, which might inform their approach to negotiating task allocation, as well as the task they seek to complete [10]. Similarly, Henderson [2] described how engineering students pursued tasks for which they were confident, had prior mastery experiences, and were perceived by others to be more competent.

Third, Fowler and Su [10] argue that initial predispositions are "interpreted through an academic orientation filter," influencing students' motivations for learning in team-based environments. For example, students motivated to master technical skills may strategically pursue tasks aligned with those skills, while others might overstate their experiences to access specific roles [2].

Conversely, students with negative prior teamwork experiences or low self-efficacy may avoid tasks where they feel less competent, leading them to defer to peers [2]. Therefore, students' dispositions and preferences do not always translate into equitable learning opportunities.

Finally, teams negotiate task allocation, further influencing learning opportunities. Fowler and Su [10] highlight that "who speaks up during that (i.e., task allocation) meeting, how much they advocate for themselves, and how receptive teammates are to their preferences" [10, p. 314] shapes access to learning opportunities. Social power dynamics and inequities in performance expectations also play a role. Stereotypes about who is a competent engineer—often male, White, or Asian students—can influence task negotiation outcomes. These biases may limit Black students' access to meaningful tasks, affecting their participation and learning. Thus, racialized and gendered power dynamics significantly shape access to learning opportunities in team projects, underscoring the need for further research on equitable team-based pedagogies.

Methodology

This study investigates how race and racism shape access, participation, and agency for Black students in engineering teamwork pedagogies. Using Thematic Analysis (TA) [13], we identify patterns of inequity in task delegation, voice safety, and team dynamics while exploring how Black students navigate and resist these experiences. This study focuses on eight second-year Black engineering students, providing a rich context for understanding racialized experiences in team settings. The second year is a critical transition from foundational courses to complex concepts that shape engineering identity [14]–[19]. During this period, Black students navigate racialized environments and hidden curricula embedded in institutional norms and cultural climates, which often lack support systems tailored to their needs and perpetuate systemic inequities [20]–[25]. As students face new academic and psychosocial challenges, effective curriculum design and support systems are vital [26]. Our analysis explores how structural elements of learning environments intersect with student agency. We also examine how diverse educational backgrounds can be leveraged through collaborative problem-based learning to transform diversity into a learning asset [27]–[29]. This study advances understanding of how racialized dynamics influence Black students' learning opportunities and outcomes in engineering teamwork.

Data Collection

Participants for this research self-identified as Black/African American engineering undergraduate and graduate students from U.S. universities. Recruitment occurred from Winter 2023 to Spring 2024 through online surveys, direct outreach to institutional leaders (e.g., diversity officers, department heads), diversity initiatives (e.g., LSAMP, student affairs), and student organizations (e.g., NSBE). Efforts ensured diverse representation across a range of sociodemographic factors including, for example, academic levels, gender identities, international status, and institutional contexts. While the full sample includes 29 participants, this paper focuses on the experiences of eight second-year Black engineering students (Table A1).

We conducted semi-structured interviews from April 2023 to April 2024. The interview protocol was designed to elicit rich, first-person accounts of teamwork experiences, with a focus on salient elements of our conceptual framework such as voice safety, task allocation, and teamwork and communication dynamics. Questions also explored how intersecting identities (e.g., race, gender, sexual identity) and access to socio-academic support systems influenced

students' experiences and learning. Techniques such as open-ended prompts and follow-up questions facilitated participant-led narratives, ensuring the flexibility needed to capture in-depth experiential data. Sample protocol questions are provided in Table B1.

Analytical Framework

Our analytic strategy balances inductive (e.g., data-driven) and deductive (e.g., theory-driven) coding approaches [13], [30], [31]. The inductive approach allowed us to identify themes and patterns from participants' narratives without imposing pre-existing frameworks, grounding our analysis in their lived experiences. The deductive approach was guided by the Model of Inequitable Task Allocation (MITA) to examine how Black students' experiences in team-based learning manifest in predictable ways. By integrating these methods, we connected empirical insights with theoretical assumptions about racialized teamwork dynamics.

We began by immersing ourselves in the interview data, repeatedly reading transcripts to develop a deep understanding of participants' narratives. We took exploratory notes capturing descriptive, linguistic, and conceptual reflections, which laid the foundation for researcher-constructed themes [31], [32]. Using an inductive process, we identified themes organically, clustering recurring patterns into broader categories and synthesizing them into cohesive narratives supported by participant quotes. This process connected findings to existing literature, revealing nuanced insights into systemic and interpersonal racial dynamics in teamwork. Simultaneously, our deductive approach was guided by MITA's sensitizing concepts, focusing on how students described their initial predispositions, self-efficacy beliefs, academic orientations, and team negotiation processes [13], [30], [31]. This allowed us to explore how racialized power dynamics influence task allocation and participation in team projects. Sample codes from both approaches are presented in Table C1.

To ensure trustworthiness and validity [33], our team of Black engineering education researchers engaged in reflexive practices to critically examine how our positionality [34]–[37], including our racialized experiences in engineering, shaped the research process. We maintained reflexive journals documenting how our intersecting cultural, social, and academic identities informed our data collection, interpretation, and analytic decisions. Post-interview discussions facilitated collaborative reflection on the interview protocol's effectiveness and the resonance of participant narratives with our experiences. We examined how intersecting identities (e.g., race/ethnicity and gender) [30], [31] influenced our interpretations, ensuring our positionality was explicitly considered. Recognizing the diversity within Black experiences, we engaged in deliberate dialogic processes to integrate diverse perspectives, enhancing the interpretive depth and authenticity of our findings. Our collaborative reflexive approach advances the understanding of racialized dynamics in engineering teamwork by offering a nuanced representation of participants' lived experiences while acknowledging the complexities of race, identity, and power in team-based learning environments.

Findings, Discussion, and Implications

The findings presented herein are preliminary, and do not represent an exhaustive list of themes that we have found in the data. Herein, we focus on factors internal to student teams, such as interpersonal power dynamics and task negotiation processes, that appeared to be informed by race and racism, with implications for Black students' socio-academic motivations, approaches to teamwork, and learning outcomes.

Racialized Influences on Interpersonal Power Dynamics in Task Negotiation Processes

The MITA framework highlights the critical role of task negotiation in team-based learning environments, where interpersonal power dynamics and inequities influence access to meaningful learning opportunities [10]. Expanding this framework, our findings indicate that racialized performance expectations, embedded in systemic inequities and reinforced through interpersonal interactions, profoundly shape Black students' experiences with task allocation and participation in team projects. These dynamics appear to dictate whose contributions are expected to be valued, who meaningfully participates in decision-making, and whether Black students are empowered to engage fully or driven to disengage from teamwork as a space for learning and growth.

Mike entered his computer engineering class eager to collaborate but quickly encountered challenges rooted in racialized assumptions about his competence. Despite his strong coding skills, his teammates frequently dismissed his ideas without discussion. He explained:

> It was like whatever they said would go, and whenever I pitched in, they'd be like, 'Oh, that's not going to work.' And then I would code it myself and make it work, and they'd be shocked that it worked—like it was some miracle that I actually knew what I was talking about.

This dismissal of Mike's abilities, fueled by racialized biases, forced him to repeatedly prove his worth. Instead of engaging in the intended collaborative learning process, Mike directed his efforts toward overcoming exclusion and demonstrating his competence. This dynamic not only denied him the full benefits of teamwork but also perpetuated a cycle where his contributions were undervalued.

Similarly, Miracle's experiences exemplified how racialized power dynamics in team settings can profoundly undermine Black students' ability to participate meaningfully in collaborative learning. Initially, Miracle approached teamwork with enthusiasm, yet patterns of exclusion and marginalization quickly emerged, as she was consistently relegated to peripheral or menial tasks. These dynamics limited Miracle's opportunities to engage with core technical responsibilities, ultimately eroding her confidence and willingness to contribute fully. As Miracle explained, her offers to take on meaningful tasks were frequently dismissed:

> I did wish to do more of [the technical work]. Because I do think that was just a very valuable learning experience to have. But it was kind of a situation where they were already disregarding everything I said, and if I would offer to do something, they would just go ahead and do it when I wasn't there.

The dismissal of her contributions compounded feelings of exclusion, leading her to withdraw from team discussions and approach the work as a transactional necessity rather than an opportunity for growth. Miracle pointed to other racial markers, such as her Nigerian background and accent, as other reasons she felt her work and contributions were not taken seriously. Over time, she became increasingly aware of the racialized nature of her treatment, rationalizing her marginalization as a product of stereotypes tied to her race and nationality.

These experiences illustrate how racialized performance expectations and systemic inequities not only dictate who is trusted and valued in team settings but also drive Black students, like Miracle, to disengage from collaborative opportunities. Her story underscores the need for

deliberate efforts to address racialized power dynamics in team-based pedagogies to foster equitable and empowering learning environments.

In contrast, Juan described how a supportive team dynamic transformed his initial apprehension into a meaningful learning opportunity. Initially hesitant about using advanced laboratory instruments, he credited a peer's mentorship for creating an environment where he felt encouraged to engage and contribute. Juan shared:

> I was scared of even touching [the instruments], but having one of my group mates who had used them before helped me learn. That made me more comfortable thinking more publicly and sharing ideas.

These findings point to the pervasive impact of racialized power dynamics in shaping Black students' experiences within team-based learning environments. Racial isolation and systemic biases in predominantly White institutions (PWIs) often position Black students as less competent, even before tasks are allocated. These biases become especially apparent during task negotiation, where racialized perceptions of ability dictate whose contributions are valued and whose voices are excluded. This marginalization relegates Black students to peripheral roles, limiting their access to meaningful learning opportunities and perpetuating cycles of exclusion.

For many participants, these dynamics led to a shift in their academic orientation, from seeking mastery and exploration to focusing on mere task completion and conflict avoidance. Mike and Miracle, for example, described how repeated instances of dismissal and undervaluation eroded their sense of belonging and led to disengagement. This disengagement, characterized by participation limited to the bare minimum, reflects the broader systemic inequities in engineering education, where racialized assumptions about competence dictate who is trusted, included, and empowered in collaborative settings. These patterns undermine the potential of team-based pedagogies, as students are denied the opportunity to fully engage and develop their skills.

Expanding the MITA framework to explicitly account for the role of race and racism underscores the need for intentional interventions in engineering education. Task negotiation processes are deeply informed by entrenched social hierarchies, and without targeted efforts to disrupt these dynamics, inequities will persist. By fostering inclusive team environments and addressing racialized biases, educators can ensure that all students, particularly those from historically excluded groups, have the opportunity to thrive. Reimagining team-based pedagogies with equity at the forefront is essential to creating collaborative learning spaces where every student is valued and empowered to contribute fully.

Racialized Influences on Students' Academic Orientations

The MITA model posits that students enter team-based, project-based learning environments with initial predispositions, skills, self-efficacy beliefs, and academic orientations and that these individual characteristics evolve as a result of their experiences with learning activities in their respective teams. While the MITA model focuses attention on the ways that the tasks allocated to students, which are presumed to be important learning experiences, shape the evolution of students' skills, self-efficacy beliefs, and academic orientations, findings in this research indicate that both positive and negative racialized experiences in team-based, project-based learning settings shape can also shape students' academic orientations.

For example, we asked Artemis to describe both negative and positive teamwork experiences. While describing the factors that shaped his positive experiences, Artemis pointed to comfort speaking up, asking for support, and sharing ideas.

> Or, maybe if you run into problems, we were pretty good with telling each other what was going on. So everybody was really comfortable. Everyone was really open. Every now and then you get a group where maybe one or two people are talking a lot below persons may be shy, or, like closed off for talking. But in this situation, everybody was more than okay, with talking.

Conversely, while describing his negative experiences, Artemis described how he did not feel his teammates valued his idea contributions. Importantly, Artemis described how such negative views of his work and contributions, which he attributed to racialized performance expectations, resulted in changes in his academic orientation, where he became motivated by proving his teammates wrong about his capabilities.

> So a lot of the time you go through wondering if people like, what people think about you, because there's more Asians than it's white people than as Black people. So as a Black person in the group, you're always thinking, "Oh, do they, they value your opinion as much?" So that's something that you do have to think about. Or if you're in a class…sometimes, I talk to my friends…who are Black people, I tell them, "Oh, these people, they probably think, 'Oh, we're just here to make up numbers,'" So I was telling my roommate, you know, we got to gotta do good to show them that we're not here just to make them numbers. We're actually here because, you know, we're good at what we do.

Other students similarly described shifts in their academic orientations–their motivations for learning–that resulted from their perceptions of racial isolation and hostility, patterns of exclusions, and distrust of their contributions or comfort, support, and collegiality. For example, Juan described how, initially, he was apprehensive about working in one of his university's laboratories, but the supportive, collaborative relationship he shared with one of his peers led him to feel more comfortable in the learning environment.

> The final project we did for my [class], which is materials and manufacturing, involves us going to Laboratory_1 and having to work with a lot of new instruments that I had never used in my life. Yeah. And so at first, I was so scared of even touching [the instruments], because they're, like, very expensive, and like, complicated. But having some one of my group mates who was a sophomore, and, you know, he was, he told me, he had used them before in high school, at the start block workshops. And, okay, we had some video tutorials on how to use them before going to the lab. But, you know, being there in the real place is different. So he helped me learn how to use them. And like, I felt more comfortable, like learning it from my fellow students.

Juan later discussed how this supportive environment resulted in his being more comfortable "thinking more publicly," sharing ideas to his team that would eventually become their final project. Whereas Juan initially appeared motivated to avoid looking incompetent, Juan's experience in the supportive learning environment encouraged him to participate more fully in his team:

> So, you know, having suggested something and seeing it being accepted, and we ended up doing it, and it was pretty well, gave me, you know, the hope that okay…even though you know, you're new at this, you can actually think about something and suggest an idea that will be helpful. So that is also a good thing that I got from the group setting.

This supportive interaction not only increased Juan's self-efficacy for understanding and using laboratory instruments but also empowered him to contribute ideas that became central to the team's project. His experience illustrates how equitable and inclusive team dynamics can counteract the isolating effects of racialized biases, enabling Black students to thrive in collaborative learning environments.

Worryingly, many students articulated how racial isolation and hostility, patterns of exclusions, and distrust of their contributions resulted in a shift in their academic orientations from fostering new knowledge or mastering new skills to what we call "diverted engagement." That is, students regularly described becoming frustrated to the extent that their goals became to simply complete their projects, earn a good grade, or exit their teams without negative socio-academic consequences. For example, Becky shared how her perceptions of negative performance expectations left her to engage with classmates differently, choosing to "keep it professional" and "get it [projects] done" despite her frustrations with patterns of exclusion in teams:

> You can just tell they don't think that I'm as smart as they are. Or I don't deserve to be in the program. I don't socialize with them. If we're doing projects, I know how to keep it professional, obviously and get it done. But they're not people that I want to see outside of the classroom if that makes sense.

These shifts in academic orientations are particularly concerning because opportunities to explore, make mistakes, communicate and clarify ideas, and refine contributions represent important learning opportunities that help students develop new knowledge and master new skills [2]. Findings in this study indicate that Black engineering students might demur from these opportunities as a result of negative, racialized experiences in their team-based, project-based learning environments. These findings expand on the MITA model by centering the role of race, racialized performance expectations, and racialization in students' socio-academic motivations for learning.

Discussion

This study examines how race and racism shape Black students' experiences in engineering teamwork, influencing access, participation, and agency. Our findings reveal that racialized performance expectations, embedded in systemic inequities and reinforced through interpersonal interactions, significantly impact task allocation and participation, shaping Black students' learning opportunities. By expanding the MITA framework [10], we demonstrate how these expectations contribute to inequitable task distribution, affecting whether and how Black students gain meaningful learning experiences. Some students adapted their academic orientations in response to team dynamics, while others found their engagement constrained by racialized interactions.

Racialized performance expectations consistently shaped Black students' experiences with task allocation and participation, dictating who is trusted and whose ideas are valued. For example, Mike, a skilled coder, faced racialized assumptions that required him to repeatedly prove his

competence, leading to his ideas being dismissed until independently validated. This aligns with research showing that Black students often must overperform to be seen as competent [25], [38], [39], echoing broader patterns observed in educational and professional engineering contexts (e.g., [8], [40]–[42]). Like other Black students in the study, these experiences eroded Mike's self-efficacy and socio-academic motivation, illustrating how racialized scrutiny contributes to exclusion [10], [43], [44].

Similarly, Miracle encountered racialized power dynamics that limited her access to technical tasks, relegating her to non-technical roles that did not align with her learning goals. This marginalization undermined her confidence and led to disengagement, reinforcing inequities in engineering teamwork. These experiences underscore the importance of addressing systemic biases that limit Black students' participation and growth in team settings.

Conversely, supportive team dynamics demonstrated the transformative potential of equitable collaboration. For example, Juan's experience, where he received mentorship on a challenging technical task, highlights how inclusive environments promote voice safety and belonging. This support shifted Juan's academic orientation from performance-avoidance to mastery-oriented motivation, driven by a desire to learn and contribute fully. Juan's narrative underscores the value of inclusive team dynamics that validate intellectual contributions and encourage epistemic inclusion, allowing Black students to engage without fear of racialized judgment. This finding emphasizes the importance of designing collaborative experiences that foster voice safety, equitable task distribution, and recognition of diverse contributions.

Our findings align with existing research on racialized performance expectations in STEM while advancing the literature by centering Black engineering students' experiences in team-based pedagogies. Participants reflected the diversity within Black identity, shaped by cultural, academic, and personal contexts, challenging monolithic views of Black students' experiences. This complexity illustrates how systemic inequities intersect with race, culture, and identity. For example, Richardson [45] identified three distinct groups within the Black student community—African Americans, Black Caribbean students, and Black African international students. Existing research suggests both inter- and intra-racial dynamics shape engagement patterns for Black students in college [7], [46]. Our future analysis will explore how these groups differently experience teamwork, rely on varied socioacademic resources, and achieve diverse learning outcomes.

This study underscores the need to reimagine team-based pedagogies in engineering education by centering equity and addressing systemic inequities. By creating inclusive learning environments, educators and institutions can ensure all students, particularly those navigating racialized dynamics, have the opportunity to thrive in team-based, project-based learning contexts. This commitment is essential for broadening participation in engineering and fostering a more just and inclusive educational landscape.

Conclusion

This study, part of a larger investigation into Black students' experiences in engineering teamwork pedagogies, demonstrates how racialized power dynamics and systemic inequities shape participation, learning opportunities, and academic orientations. Focusing on the experiences of eight second-year Black engineering students, our findings bring attention to the profound influence of race and racism on task allocation, interpersonal dynamics, and

collaborative engagement. By expanding the MITA framework, this research illustrates how these dynamics dictate whose contributions are valued, whose voices are heard, and whose opportunities for growth are constrained in team-based settings.

Our findings highlight both the barriers Black students face and the transformative potential of equitable team environments. Participants described navigating exclusion, dismissal, and undervaluation rooted in racialized performance expectations, which often led to disengagement and a shift from mastery-oriented learning to mere task completion. However, their narratives also revealed the transformative potential of inclusive and supportive team environments. Moments of mentorship and validation highlighted how intentional strategies, such as equitable task distribution and open communication, can empower Black students to thrive in collaborative learning spaces.

The study contributes to the growing body of research on Black students' experiences in team-based pedagogies and emphasizes the urgent need for systemic interventions at the faculty, institutional, and policy levels to address racialized inequities in engineering education. Future research should continue exploring the intersection of race, identity, and collaboration across diverse institutional contexts. By integrating evidence-based practices that foster equity and inclusion, educators and institutions can ensure that all students, especially those from historically excluded groups, are provided with equitable opportunities to succeed, advancing broader participation and transformation in engineering education.

APPENDIX A

INTERVIEW PARTICIPANTS AND SELECTED DEMOGRAPHICS

Table A1. Interview Participants and selected demographics (N = 8)

Pseudonym	Gender	Engineering Major	Institutional Context	National Status
Debby	Woman	Industrial and Operations	Large Public (midwest)	U.S. Domestic
Claire	Woman	Computer Science	Mid-size private (northeast)	U.S. Domestic
Artemis	Man	Polymer Science	Mid-size private (midwest)	U.S. Domestic
Juan	Man	Mechanical	Mid-size private (northeast)	International
Miracle	Woman	Chemical	Large Public (midwest)	International
Spirae	Man	Civil	Large Public (midwest)	International
Mike	Man	Chemical	Mid-size private (northeast)	U.S. Domestic
Patrick	Man	Mechanical	Mid-size private (northeast)	U.S. Domestic

APPENDIX B

INTERVIEW PARTICIPANTS AND SELECTED DEMOGRAPHICS

Table B1: BSET Interview Protocol Sample Questions and focal constructs

Constructs	Interview Question(s)
Task Delegation	How did your team delegate technical and non-technical tasks?
Voice Safety & Enactment	Did you always feel comfortable sharing your ideas with your teammates?
Salience of racial identity	How often do you think about your race on your teams?
Racial identity	How do you think race affects your interactions with your teammates?

APPENDIX C

CODING ARCHITECTURE

Table C1: Sample Codes

Code	Definition & Empirical Indicator
Initial Predispositions	Pre-existing interests, skills, and experiences that shape team engagement—evidenced by references to past teamwork, personal interests, and mentions of prior racialized encounters influencing confidence and task selection.
Self-efficacy Beliefs	Judgments of one's ability to engage in team tasks—indicated by expressions of confidence or doubt, descriptions of mastery experiences, and self-assessments of competence in technical or communicative roles.
Academic Orientations	The motivational lens (mastery, performance, performance-avoidance) that shapes learning engagement—demonstrated by expressions of ambition, reluctance to risk failure, and behaviors aimed at avoiding negative evaluations.
Team Negotiation Processes	Interpersonal dynamics during task assignment—reflected in accounts of team meetings, who speaks up, self-advocacy or deference, and observations of how power dynamics (influenced by race and gender) impact task distribution.
Task Allocation Outcomes	The final distribution of tasks resulting from individual predispositions and team interactions—evidenced by patterns of unequal task assignment, reflections on fairness, and consistent assignment of students to non-technical or less desired roles.
Cultural Transition and Racial Identity	Navigating the transition from African countries to the U.S. required adapting to racialized contexts where Black identity shifted from being less emphasized to a defining characteristic; including differences in communication, grading, and peer interactions

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