"I Don't Like Thinking About this Stuff": Black and Brown Student Experiences in Engineering Education

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Abstract

In this paper, we discuss the results from our study on the experiences of first-year Black and Brown engineering students in engineering teams. This work is part of ongoing research on identifying teams engaging in marginalizing behaviors against minoritized (race, gender, LGBTQ identity, nationality) students. Using a diary study methodology, we explore the team experiences of Black and Brown students by examining two research questions: 1) what does racial marginalization look like within engineering classrooms where teamwork is a primary feature and 2) what experiences from the dairies inform researchers and faculty about participants' experiences and personal knowledge of how race and racism operates in teams. We identified two central themes: 1) participants often avoided conversations when race could be a potential topic, and 2) participants believed that racism was a normal part of teams (in both the classroom and workplace). Participants explained that even if race was not explicitly discussed during their group work, they sensed that implicit bias and discrimination were affecting their experience. Further, when we asked participants how to increase support related to their teaming experience, they reported feeling unsure of what can be done to eliminate behaviors of racism and marginalization from engineering education. The participants expressed that change needed to happen so that other Black and Brown students are welcomed into the field, but that no one on campus (peers, faculty, and staff) has asked them about ideas for

change. This diary study provides important insights into how Black and Brown engineering students contextualize their experience with marginalizing behaviors in teams.

Introduction

Racial inequity in engineering education is a longstanding problem, especially in teams. This study set out to understand the teaming experiences of Black and Brown first-year engineering students at an American midwestern public university. In these teams, Black and Brown students faced microaggressions, overt discriminatory messages and actions, and coded language that is often minimized or brushed-off as all in "good" humor. Participants indicated that coded marginalized messages framed as a joke put the responsibility on Black and Brown students to keep composure during worktime in order to have a chance to equally participate in assignments and other group tasks.

We used Critical Race Theory [1] (CRT) to understand teams as a part of the university's social structure, because teams are social structures that are not impervious to racial power dynamics. CRT examines how race and racism are integral parts of United States institutions [2]. For example, we wanted to know more about how race and racism played a role in participants' every day team experience. The structure of teams and subsequent teamwork perpetuated relationships rooted in expecting whiteness as a credential to be educated [3]. Therefore, it is important to know how peers marginalize their Black and Brown teammates. This paper shares results from a daily diary study that is part of a broader NSF-funded project titled, "Identifying Marginalization and Allying Tendencies to Transform Engineering Relationships" or I-MATTER.

To understand how to create inclusive environments in engineering education classrooms, it is necessary to examine all units of the pedagogy. One such important pedagogical aspect is teamwork. Detrimental experiences happen in engineering education groups, and especially in the first year of university. Behaviors that marginalize Black and Brown students manifest in numerous ways. We understand how minoritized students experience microaggressions in terms of three types of transgressions - microinsults, microassaults, and microinvalidations - that depict the ways marginalizing behaviors appear in everyday exchanges [4].

Similar to the larger project, this particular study recognized racial identities (as well as minoritized identities that intersect with race, such as gender and socioeconomic status) as social constructs with real-life effects that happen during engineering teamwork and class [3], [5]-[7]. We collected a series of qualitative data in the form of electronic diary entries and education journey maps. Participants also shared further context in follow-up individual interviews. Data were collected at a large research-intensive university in the Midwest that is a mostly-white institution. We set out to answer the questions:

1. What does racial marginalization look like within engineering classrooms where teamwork is a primary feature?

2. What experiences from the dairies inform researchers and faculty about participants' experiences and personal knowledge of how race and racism operate in teams?

To answer research questions, participants first created an education journey map inspired by Annamma's [8] work. Participants were asked to map out the educational path they took towards their engineering major and then to explain their journey maps during a follow-up interview. For example, most participants started their education journey map by drawing their elementary

school and writing a blurb over the school stating "good at math" or "I liked to build things" to express early interests that determined their steps to enrolling in engineering coursework at the college level. The daily diaries were then completed online to capture everyday experiences of marginalization during teaming experiences. As participants completed interviews to discuss their daily diary entries, participants told us that this study is the first time they were asked to think about how engineering education could look if the curriculum and pedagogy truly supported Black and Brown students. We decided to share one student's experience (Isabel) to explore the overarching themes we found from our data. Isabel's story is transferrable across participants' experiences.

Background

Racism is prevalent within engineering education [9]. Within this section, we assert that marginalization and microaggressions are part of everyday life, and therefore, a part of teams in engineering classes as well. It is vital to delve into the understanding of the current state of engineering teams allowing for marginalization to be legible to instructors at the undergraduate level. Teamwork is included in engineering coursework because group collaboration is useful for problem-solving and innovation [10, 11]. As teamwork continues to be a valued pedagogical factor, it is important for faculty to understand situations where students are likely to marginalize others in order to intervene properly in support of Black and Brown students.

Teams have a social complexity of their own influenced by discriminatory social exclusion pervasive in larger U.S. society. For example, researchers and educators cannot visibly see the "rules" or social norms related to race that dictate behavior and relationships in engineering

education; researchers and educators can attempt to understand how these rules are felt through microaggressive behavior carried out by peers. Currently, most ways instructors create student teams often result in marginalizing minoritized students [12]. There are tools, such as Team-Maker in CATME (www.catme.org), that aim to increase instances of inclusive teams; however, data shows there is a lack of a positive team experience for minoritized engineering students [12]. For example, white students often devalue the knowledge of Black and Brown students by being dismissive of their contributions [13]. Likewise, white students often overlook Black and Brown women when using laboratory equipment or delineating tasks having to do with figuring mathematics for the homework assignment [13].

Marginalizing behaviors begin with team formation, where self-selection practices result in less gender and racially diverse teams [14]. Team formation by self-selection is still pervasive despite overwhelming evidence of the problematic outcomes [14]. In cases where team formation is controlled by instructors, race, gender, and other salient characteristics that may serve as markers of difference within teams should be carefully considered in the execution of team-based learning. Marginalization happens because of many social factors, but selectivity of who to include and internalization of U.S. hegemonic ideals reinforce marginalization through microaggressive behavior.

Microaggressions are discriminatory statements and actions made by people to demean minoritized people. Johnson and Joseph-Salisbury [13] explain microaggressive behaviors as not welcoming or collaborative, which affects team sustainability. Miner, Diaz, and Rinn [15] reported that Black and Brown students experience racial microaggressions routinely and the

cumulative effects result in higher psychological distress and decreased academic self-concept. Wolfe and colleagues [10] also found that students felt as if nothing could be done to stop microaggressive behaviors because that is just "the way real-life works."

Microaggressions are brief and commonplace. They are verbal sayings or comments as well as behavioral actions, with detrimental cumulative effects on Black and Brown students. On a larger scale, microaggressions signal to Black and Brown students regarding how their teammates feel about their race and culture [4]. Microaggressions are categorized into three types: microinsults, microassaults, and microinvalidations [4]. *Microinsults* are expressions that demean Black and Brown identity, such as how Black and Brown students to have hear, over and over again the often-experienced comment of "wow, you're so smart for a Black person" [16]. *Microassaults* happen when a peer intentionally says or does something that is marginalizing, but claims their statement or behavior is a joke [16]. Microassaults are also cited to be more overt, constituting verbal and non-verbal attacks and avoidant behaviors, like not wanting to work alone with Black and Brown students [16]. Lastly, *microinvalidations* occur when the lived experiences of marginalized peoples are negated, invalidated, or diminished (e.g. claiming to be "colorblind") [4].

Our current study is situated at the intersection of research on team dynamics, both in engineering and extending dynamic principles outside of a professional work context. For example, we work to understand broadening participation in engineering while offering Black and Brown student perspective on marginalization and microaggressions. For engineering teams to be inclusive learning spaces, marginalization must be disrupted in the classroom. Instructors

must respond to incidents of peer-to-peer marginalization for more inclusive teamwork to disrupt marginalizing behavior that interrupts collegial progress in engineering teams [13].

Theoretical framework

Using CRT, we analyzed data with an understanding that racism in U.S. education intentionally structural and systemic [1]. For this study, this meant that we assumed prior to data collection that participants experienced racism. Inclusion cannot occur until instructors, staff, and students are aware of how systemic racism informs our social practice on campus. Investigating forms of racism, like marginalization and microaggressions, within the university's social structure is critical; the process of excluding Black and Brown students (marginalization) and critiquing their culture and identities (microaggressions) reinforces white, patriarchal norms and limits inclusion of Black and Brown students in engineering. According to CRT, there is racial bias within education institutions, and the racial bias extends to teamwork. Marginalizing behaviors intentionally restrict Black and Brown identities through the expectation of producing racial social norms of whiteness during teamwork. For example, Black and Brown students are expected to talk, behave, and respond in certain ways that make white students feel comfortable engaging in teamwork with them. Experiences of marginalization must be called out in order to challenge the racialized hierarchical power present in team structures.

Method

This qualitative study employed a diary study approach. Pawley and Phillips [5] suggested that storied cases can help researchers and educators to understand the current state of ruling relations within engineering education. In order to increase the insight into daily diary entries, we asked

participants to create an education journey map [8] and discuss the map during follow-up interviews. An education journey map is a document where participants illustrated their experiences about their time in schools (K-12 and university). Participants created two maps; the first was a pre-interview activity to situate the study, and participants completed the second version of the map including experiences throughout the duration of the study. Both maps were discussed in separate follow-up interviews. The map could be based on time, emotion, insight, or knowledge gained while in STEM, engineering, and school contexts about what it meant to a racially minoritized person broadly in education. We used the education journey map to connect the significant times/insights shared on the map to their current identity as an engineering student. The goal of the map allows students to have epistemic agency in the knowledge they share with the project.

After participants made their first version of their map, we explored their experiences in an interview. After the interview, we instructed participants to upload daily to their electronic diary. Participants posted in their diary once a day for one week using a secure mobile application called Indeemo (www.indeemo.com). There were three phases of entries over three months, which totals three weeks of data gathered. Some diary prompts included:

1. "Talk about if you were aware of your race at any point today—please describe what happened that made you aware of your race. And, if you did not think about your race today, please let me know why you did not think about your racial identity."

2. "There are many times throughout our day where we need to "fit in" whether it be for jobs/internships, to make friends, or to get group work done well, and we include or

exclude parts of our identity based on these things. Describe places where you felt

comfortable being yourself—these could be peer groups, school-work groups, jobs, etc."

3. "Please share other insights, thoughts, perspectives you had about your racial identity and

    how it affects your ability to feel comfortable at all times at the places you've been in

    today."

After the third and final month of dairy entries, participants updated their education journey map

to include lessons learned during the diary phases. Lastly, participants discussed in an interview

with the researcher examining the second version of their map as well as the whole of their diary

entries.

Analysis

The research team conducted thematic analysis of education journey maps alongside transcribed

diary entries and interviews. Once transcripts were assembled, the research team began data

analysis by first readings through the entirety of the artifacts. Then, the team reviewed all data,

highlighting and writing down significant statements, quotes, and ideas that provided context to

Black and Brown student experiences of racial marginalization in teams. The researchers took

analytic memos identifying how each participant described peers' marginalizing behaviors. We

read for an overview of their teaming experiences with marginalization and instances of

microinsults, microassaults, and microinvalidations. We then began the coding process of

highlighting for experiences of coded language, overt expressions of racism, invalidating

experiences, back-handed jokes/compliments, and exclusion based on race (and other identities).

We selected codes for repeated patterns across data with three cycles of analyzation ensuring

completeness of coding schemes. We categorized participant teaming experiences as

microinsults, microassaults, and microinvalidations. Importantly, the majority of participants identified as women, and the microaggressions shared with us had to do with race and gender. Then we identified two themes from participant experiences in their first year of engineering classes: "We Don't Talk about Race" and "We Can't Fix This."

Findings

We Don't Talk about Race

To illustrate these themes developed across participants, for this paper, we explore one participant's experience as a way to include rich and transferrable insight into the engineering teaming experience for Black and Brown students. Isabel is a Latinx woman in her first year of university courses. Isabel shared that there is no time to talk about race and her experiences of racial marginalization. The decision to avoid topics of race and racism are both Isabel's choice and related to engineering curriculum—Isabel wants to keep up with her grades and engineering peers and faculty did not seem to care about racial marginalization. There were two prevalent ideas related to our "don't talk about race" theme: 1) the curriculum is not set up to discuss the topic and 2) talking about race reminded them of their differences from white peers. These ideas often presented together. According to Pawley, Mejia, and Revelo [17] engineering education programs deal with color-blindness in the sense that educators and students are taught that programs are an objective meritocracy, and so faculty members (especially at Predominantly White Institutions) are not moved to examine racial marginalization within curriculum.

Before attending college, Isabel explained that family and friends warned her that speaking about race made white professors and potential group members uncomfortable. Isabel explained she

avoided talking about race as to not stand out (in a bad way) among professors and peers. For example, Isabel shared:

"So, I mentioned a little bit about just like picking engineering and then, um, there was a lot of different stigmas around that [because of my race and gender] and people were always kind of just talking about like, oh, that's a great choice, but like, is it going to be hard because there's not a lot of women, there's not a lot of Latinos…there's not a lot of anybody, except like white males, in that major. So, like, is that going to be difficult for you? And so that really opened my eyes to how different it was going to be from what I was used to."

From the diary prompt asking about "what happened that made you aware of your race," Isabel wrote:

"I don't always feel like I fit in. Sometimes it's because of background. Sometimes it's because of gender. Sometimes it's for other reasons. And today, in particular, I definitely felt out of place. It was just because I had to work extremely hard to get to where I am with math and [college], and everything that I've done in my life, but it still hurts to know that other people are able to just do these things without a lot of effort, and it takes me a lot of effort."

From there, Isabel explored how she intentionally did not talk or think about race during team sessions. As a Latinx woman with lighter skin, she hoped that her racial identity would be less salient to peers; however, she often wrote in her diary "I don't always fit in," and quickly followed it up by writing she felt "too preoccupied with exams to think about anything else." Isabel expressed that taking time to call out marginalization took up too much time—it was not

that racial injustice did not happen during group work, but she had so much going on to stay afloat in classes that she took the advice from her family and friends and did her best to stay focused solely on academics despite existing marginalization. When Isabel did talk about marginalization, she wrote about microassaults on the intersection of race and gender. She felt uncomfortable doing tasks alone with men as they were likely to comment on how long it took her to do parts of the assignment.

We Can't Fix This

Isabel wrote in her education journey map that she tries to approach the difficulties at university "one week at a time" and that courses like Differential Equations and Physics leave her "slightly overwhelmed." When asked how the engineering department can support Black and Brown students, Isabel said that she never thought about how to improve race relations on campus. Often, she would express that other students with dark skin tone have it worse than any marginalizing interactions she experienced. We noticed the alarming theme of students' desire to downplay differences because there is nothing that can be done—it is upsetting for us to hear that Isabel felt as if nothing can ameliorate her teaming experience on campus. Isabel chose to focus on work because she found the engineering coursework specifically overwhelming to the point where there was no room in the curriculum to process inequitable learning environments. Isabel also often expressed that she wanted to get along with their group members, and Isabel hoped that her group members (all white students) had best intentions. Isabel noted that addressing marginalizing behaviors done by peers is out of her control, but she felt that she controls her ability to study and remain focused on her end-goal of graduating with an engineering degree.

Isabel believed that the deficit perspectives of Black and Brown students were part of everyday life, something that they would need to get used to while at college, and especially throughout their career. Our theme of "Marginalization is just part of Life" also aligned with findings reported by Wolfe et al. [10]. For example, in Wolfe et al.'s work, exclusion based on race and gender often happened for women of color, and the consequences of exclusion have real effects on excluded students, such as a lower grade or omission from technical experience. Admittedly, it was difficult for us to get specific examples about the different microaggressions Isabel experienced because it was clearly painful for her to discuss it with us. The research team did not want to probe any further because our intention is to not inflict more harm. However, her unwillingness to relive racial trauma was not because marginalization did not happen, but because racial trauma is painful to recount. Students do significant intellectual and emotional work simply in experiencing marginalization; we must do further work in navigating spaces in order to contribute and be recognized for those contributions as well as the additional intellectual and emotional work to process marginalization. And, finally, it is defeating when there is no pathway to changing. It should not be the work of marginalized students to rectify what are ultimately systemic deficiencies. Improving marginalization on teams is a structural undertaking that requires change from many parts of an engineering curriculum and department or program, and minoritized students should feel like there are pathways for change.

Conclusion

We suggest that curricula and overall pedagogy of engineering education must shift to hold space for Black and Brown students to be their full selves. This means that discussions of race and racism are encouraged in the class and coursework. From the data, it is clear that Black and

Brown students felt as if there was no place to talk about marginalization that affected their learning. Instructors need to incorporate space for Black and Brown students as well as have conversations about racial marginalization with white students. Importantly, understanding marginalization, knowing how to disrupt it, and having ideas about how to decrease marginalizing behaviors should not rest solely on the shoulders of Black and Brown students and faculty.

Through our findings we see that Black and Brown students need the support of faculty to forge a new way of experiencing teams; however, many faculty members are inexperienced at disrupting and identifying marginalizing behaviors [12]. Thus, our work indicates that there needs to be institutional support to inspire change that will positively affect Black and Brown students [17]. We see work from this paper adding to future work that calls for faculty to see inclusion as part of education that is fundamental to an engineering education program. In addition, faculty's roles as educators striving for inclusion is vital to a program's success in facilitating a positive educative experience for minoritized students.

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