Board 281: Examining Scripts of Whiteness in Engineering Education

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Examining Scripts of Whiteness in Engineering Education

Abstract

Funded by the National Science Foundation (NSF) Racial Equity in STEM Education Program, this project aims to deeply interrogate the influence and pervasiveness of Whiteness in engineering culture. While there has been substantial research into the masculinity of engineering, Whiteness has received far less attention. We claim the centrality of Whiteness in engineering curricula informs the culture, climate, and discourse of engineering education, leading to an exclusionary culture within engineering as reflected by the lack of diversity and lower retention of students and faculty of color, and contributes to systemic barriers negatively impacting racial equity. Moving towards racial equity in engineering education requires a fundamental shift in thinking in two important ways: 1) we must reframe how we think about underserved populations from *minority* to *minoritized by a dominant discourse*, and 2) to begin to dismantle the impacts of Whiteness, we must first make this barrier visible.

In the first year of this project, the diverse team of PIs began to explore scripts of Whiteness in engineering education by conducting a collaborative autoethnography through documenting and analyzing their own experiences facing, enacting, and challenging scripts of Whiteness in engineering spaces. A collaborative autoethnography (CAE) takes a collaborative approach to the process of critical self reflection and can be conducted in many forms, such as such as collecting personal memory data (e.g., journaling), interviewing each other, facilitating intentional dialogue, or observing each other (e.g., in the classroom). CAE is not a linear process, but requires an ongoing dialogue (conversations, negotiations, or even arguments) between researcher team members over a long period (at least months, if not years). Our diverse viewpoints and years-long experience working together facilitated rich conversations that let us interrogate the ways in which Whiteness reveals its form differently depending on one's positionality. In the later years of the project, we will create a faculty development program intended to help engineering faculty develop their critical consciousness and begin to decenter Whiteness from their ways of thinking and discourses (i.e., beliefs, attitudes, value systems, actions, etc.) so they can begin to critically think about promoting and enacting practices that move engineering education toward racial equity. Although the pathway to critical consciousness is not linear, it is a one-way street; once faculty begin to see the systemic barriers (such as those created by scripts of Whiteness) around them, there is no going back. In the long term, we hope to lay the groundwork for recognizing, interrogating, and eventually dismantling forces of systemic oppression in engineering higher education.

Introduction: The Role of Whiteness in Engineering

The global conversation over persistent racial injustices and inequalities during the last several years has forced engineering educators to--finally--reckon with the ways in which we perpetuate systemic racism. While many engineers claim that engineering is objective and divorced from societal context [1], such objectivity is a myth; in fact, engineers, too, are instrumental in upholding systems of oppression [1]–[3]. Consider the design of pulse oximeters, a key technology used in triaging COVID-19 patients. These devices are extremely accurate, but only for White skin [4]. During the course of the pandemic, it was revealed that oximeters systematically over-reported oxygen levels when measuring on Black and Brown skin, resulting

in sick individuals appearing to be healthier than they were. This resulted in people of color, already more likely to be impacted by COVID-19 for a host of reasons, being dismissed home rather than being admitted to hospitals for life-saving treatment.

While at first glance engineers may interpret this story to be primarily a technology problem--that darker skin has different optical properties--it is an example of the systemic barriers posed by the invisibility of Whiteness in engineering. There is no technical reason for these oximeters to perform poorly on people of color--indeed a few companies have made devices that work accurately regardless of skin color [4]. The problem is that the vast majority of companies have simply failed to consider the impact of race in the design and testing of their devices [4]. Someone has to choose how testing is done and who will be involved. Assuming that testing on White skin is sufficient is an example of White universalism [5]. Being accurately diagnosed because a technology was designed for White individuals is a physical manifestation of White privilege [6]. This example, like so much of the COVID-19 pandemic, makes explicit the too often invisible ways that people of color suffer due to the pervasive invisibility/hypervisibility paradox of Whiteness [7].

Reframing Racial Equity in Engineering Education

Throughout this project, we use the term Whiteness to refer to an ideology of privilege rather than a skin color. As Dyson, a racial justice scholar, explains,

> *Like the rest of race, whiteness is a fiction, what in the jargon of the academy is termed a social construct, an agreed-on myth that has empirical grit because of its effect, not its essence. But whiteness goes even one better: it is a category of identity that is most useful when its very existence is denied. [8, p. IX]*

The social construction of Whiteness as the norm in engineering has played an important role in providing privilege for some while minoritizing others. Whiteness is observed in engineering curricula and research [9], discourse [10], [11], beliefs and rites of passage [2], [12], [13]. The culture of Whiteness is even directly reflected in the artifacts engineers create, such as the racist pulse oximeter. There are a plethora of other examples that demonstrate the ways in which Whiteness manifests in engineering design, including an overpass bridge that stops buses from accessing a wealthy White neighborhood [14], a GPS app which unintentionally promotes residential discrimination and racial segregation [15], and facial and voice recognition systems that work better on White individuals exacerbating racial profiling in policing [16]. Analyses of these designs reveal the technologies' inequitable long-lasting implications, based on who the technology is designed by and for [17].

Engineering has historically privileged the values, beliefs, experiences, and perspectives of the predominant culture created by White males [18]. White men are overrepresented in engineering, comprising 66% of the engineering workforce compared to only 31% of the US population [19]. Miller argues that American engineering being disproportionately White and male is intentional -- this demographic and culture were cultivated by early engineering institutions [20]. Hacker describes how engineering education's military roots perpetuate a legacy of rigidity and dominance [21], such as in textbook examples that tend to show White men and militaristic or masculine examples (e.g., bullets or sports cars) [22]. The pervasiveness of this culture of

domination can even be seen in engineering terminology, where we take terms of oppression for granted. In electrical engineering, vocabulary such as "master and slave" are used to describe how one device controls another [23], [24]. In mechanical engineering, "male and female" components are used to describe fasteners with protrusions or sockets. While the culture of masculinity within engineering has been studied [25]–[30], Whiteness has received far less attention. Our goal in this project is to deeply interrogate the influence and pervasiveness of Whiteness in engineering culture. We claim that Whiteness is a central part of the exclusionary culture within engineering, and hence the originator of systemic barriers negatively impacting racial equity.

The culture of Whiteness also regulates which individuals participate in engineering**.** Engineering is an exclusionary space, as reflected by the lack of diversity and lower retention of students and faculty of color [31]–[34]. The analogy of a leaky pipeline is often used to examine the underrepresentation of students of color in engineering, but this flawed analogy places an exclusive focus on the supply side of the "underrepresentation problem" [35], [36]. The problem is not the low input into the system, but the culture of the system itself which marginalizes those that do not conform to the White male hegemonic discourse. A continued focus on *underrepresentation* instead of *historically excluded and marginalized by a racist system* is a barrier to achieving racial equity. The lack of diversity in engineering is a consequence "of a STEM education system perfectly functioning as designed by the system's architects" [37]. **Moving towards racial equity in engineering education requires a fundamental shift in thinking, a reframing of our understanding of our culture.** Representation is not the same as power. We need to start seeing underrepresentation not as a problem itself but as a symptom of the root cause -- which is that the culture of engineering creates an inhospitable environment for students and faculty of color.

Conclusion

The culture of Whiteness is an unnamed yet omnipresent systemic barrier to achieving racial equity in engineering education. Naming the scripts of Whiteness is the first step in challenging this barrier and will be a significant advance in knowledge for racial equity in engineering. We begin this NSF project by co-constructing these scripts through a collaborative autoethnography within the PI team. By first studying ourselves, our goal is to identify best practices to implement throughout the creation of our faculty development program that helps engineering faculty develop their own critical consciousness. Through this research, we aim to create foundational knowledge upon which future projects for racial equity can stand. Revealing the scripts of Whiteness has the potential to transform our culture. We aim to lay the groundwork for recognizing, interrogating, and eventually dismantling forces of systemic oppression in engineering higher education.

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