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Cultivating Critical Consciousness through Pláticas: Empowering Marginalized Students' Engineering Identities

Dr. Joel Alejandro Mejia, University of Cincinnati

Dr. Joel Alejandro (Alex) Mejia is a Professor of Engineering Education in the Department of Engineering and Computing Education at the University of Cincinnati. His work examines the intersections of engineering, social justice, and critical pedagogies. He focuses on dismantling deficit ideologies in STEM, centering Latino/a/x student experiences—especially of those along the U.S.-Mexico border. His work draws on Chicana/o/x studies, raciolinguistics, and bilingual education to explore how language, race, and socialization shape engineering pathways and engineering practice. In 2025, Dr. Mejia received the Presidential Early Career Award for Scientists and Engineers (PECASE) Award for his contributions to engineering education.

M. Sidury Christiansen, The University of Texas at San Antonio
Karla Mariana Escobar, The University of Texas at San Antonio

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Abstract

As part of a larger, multi-year study, this full-length research paper presents a preliminary effort to describe how methodological approaches based on Chicana/o Epistemologies can help cultivate critical consciousness among engineering students at a Hispanic-Serving Institution (HSI). Drawing on Paulo Freire's concept of *conscientização*, we focused on developing students' critical awareness of their sociopolitical context. Specifically, we utilized *pláticas* – collaborative and culturally-grounded conversations rooted in Chicana Feminist methodologies – to analyze readings on the history of engineering. *Pláticas* emphasize collective knowledge, storytelling, and participants' lived experiences, fostering critical reflection – the first component of *conscientização*. This approach aims to empower students to challenge the status quo and systemic inequalities by understanding how these systems emerged. Findings suggest that while students are cognizant of some inequities and injustices affecting their and their peers' experiences in engineering, this awareness is many times superficial and subjective to their own personal backgrounds (e.g. being a man). Through *pláticas,* they begin to recognize the broader systemic and structural, socioeconomic, and ethnoracial inequities that negatively affect them, their peers, and their communities. Additionally, these findings suggest that dedicated spaces for *pláticas* are crucial in engineering programs for fostering critical consciousness and supporting the development of students' engineering identities.

Keywords— critical consciousness, pláticas, critical awareness, engineering identities

Introduction

Introduction

Despite the steady increase of minoritized populations in the United States in the past few years [1], the field of engineering continues to struggle with a lack of diversity among both practitioners and students [2, 3]. This homogeneity has resulted in significant underrepresentation in thought and epistemology within engineering practice [4].
Because engineering has traditionally prioritized problem-solving, without critical awareness of its possible consequences, engineering solutions often continue to fail to adequately meet the needs of underrepresented populations and create projects that disproportionately and negatively impact marginalized communities [5-7]. For example, the design of pulse oximeters has not worked as well in people with darker skin pigmentation for years, and these devices have overestimated oxygen saturation in Black patients [8]. Also, many medical devices overlook the specific needs of women or people of color, leading to discomfort, pain, and even injury [9]. Similarly, transportation infrastructure projects may prioritize the needs of car-dependent commuters while neglecting the needs of pedestrians, cyclists, and public transit users, disproportionately impacting low-income communities and communities of color [7, 10]. These examples illustrate how a male-oriented and ethnocentric perspective within engineering practice can lead to biased and inequitable outcomes. To exacerbate this issue, the current

engineering curriculum frequently fails to provide adequate opportunities for students to develop critical consciousness or awareness and the potential consequences of overlooking them. This lack of critical awareness perpetuates a cycle of exclusion and limits the potential of engineering to address the complex challenges facing our increasingly diverse society and environment.

A pedagogical approach following Freire's concept of *conscientização* has gained prominence in STEM education as a means of addressing the exclusionary barriers that often hinder the participation and success of underrepresented groups [11-13]. *Conscientização* refers to the process of developing critical consciousness – a deep understanding of the social, political, and economic forces that shape individual lives and perpetuate systemic inequalities in order to dismantle oppressive systems [14, 15]. This process involves three key components: (1) critical awareness or the ability to examine the social structures and recognize how they maintain inequalities, (2) critical motivation or the manifestation of desiring to address societal changes to advocate for equitable access to opportunities, and (3) critical action or the transformation of the awareness and motivation into concrete action [15, 16]. By cultivating critical consciousness in STEM classrooms, educators can empower students to become agents of social change, challenge systemic inequalities, and create a more just and equitable future for all students, especially those from minoritized groups and disadvantaged backgrounds going into engineering and STEM fields. Thus, it is important to explore in which ways critical consciousness can be added to engineering programs.

In engineering education, there have been some recent efforts to increase critical thinking and social awareness with mixed results. When critical consciousness projects have been added to some engineering curricula, research has shown that students still struggle to fully consider the broader ethical implications of their work [17, 18]. Despite the various approaches that researchers have utilized, such as journal writing [19], integrating critical literacy approaches [18], user-centered design projects [10], and multi week course projects [4] there are still questions about how to better prepare engineering students to develop their critical consciousness. For instance, while journal writing has shown promise in transitioning students from passive to dialogical learning, students continue to struggle with understanding the complexity of social justice issues [18]. Thus, further research is needed to identify effective strategies for cultivating critical consciousness among engineering students.

This full-length research paper is part of a larger project investigating the experiences that minoritized students have in navigating engineering spaces. A key focus of the larger project is examining how systemic racism manifests within the engineering discourse encountered by these students. Engineering discourse has historically been characterized by deficit perspectives that privilege white, male engineers [13, 20, 21]. This discourse often positions individuals from marginalized groups as deficient, incapable, or unfit for engineering careers. For example, Mejia, et al. [22] describe how colorblind discourse has perpetuated the idea that minoritized engineering students are unfit for engineering careers by positioning them as inherently deficient. These deficit perspectives are not only colorblind but also deeply rooted in racist structural hierarchies [23]. Consequently, the negative and dehumanizing language used to refer to, speak to, and speak about minoritized individuals within engineering spaces has become normalized. This normalization often leads to a lack of awareness and a failure to recognize the harmful impact of these discourses on the experiences and well-being of minoritized students.

Building on this foundation, this paper seeks to explore how minoritized engineering students at an HSI engage in *pláticas* to develop their critical consciousness to critically examine and become aware of the normalizing discourses that shape their experiences in engineering. *Pláticas* are collaborative and culturally-grounded conversations that emphasize collective knowledge, storytelling, and participants' lived experiences, fostering critical reflection. They resemble informal talks which are not guided by the researcher, and in which the researcher is one more participant subject to vulnerabilities for sharing also their own experiences. By centering *pláticas* as an epistemological tool from Chicana Feminist Epistemology, this study aims to uncover the ways in which students identify and resist these narratives, fostering a deeper understanding of the systemic forces that influence their educational journeys. Specifically, we address the question: How and in what ways do engineering students use *pláticas* to become aware of normalizing discourses that influence their experiences in engineering? Through this lens, the paper contributes to broader conversations about how culturally affirming practices can empower minoritized students and challenge the exclusionary norms embedded in engineering education.

Theoretical Framework

Freire's concept of *conscientização* [14] has become increasingly influential in STEM education [11-13]. Central to this framework is the development of critical awareness, which involves examining social structures to understand how they perpetuate inequalities. In STEM contexts, this means encouraging students to critically analyze the historical and systemic factors that have marginalized certain groups, such as the lack of access to quality education for bilingual students [24] or the exclusionary practices within STEM disciplines [25]. By fostering critical awareness, educators can help students recognize the broader societal forces that influence their experiences and challenge the dominant narratives that frame STEM as neutral or meritocratic [26, 27].

The second component, critical motivation, builds on this awareness by cultivating a desire to advocate for change and address inequities [15]. In STEM education, this involves inspiring students to see themselves as agents of change who can challenge exclusionary practices and advocate for equitable access to opportunities. Critical motivation is nurtured through pedagogical practices that connect STEM concepts to real-world social issues, demonstrating how technical knowledge can be leveraged to address systemic challenges [6]. This component is particularly important for underrepresented students, as it validates their lived experiences and empowers them to envision a more inclusive and equitable future within STEM fields.

The final component, critical action, transforms awareness and motivation into concrete steps to dismantle oppressive systems and create meaningful change [15]. In STEM education, critical action may involve students collaborating on projects that address societal inequities, participating in advocacy for policy changes, or implementing inclusive practices within their academic or professional environments. For educators, it requires creating opportunities for students to apply their technical skills in ways that challenge systemic barriers and promote social justice. By integrating critical action into STEM curricula, this pedagogical approach ensures that students are not only equipped with technical expertise but also empowered to contribute to a more equitable and just society. Together, these three components—critical awareness, motivation, and action— form a holistic framework for transforming STEM education into a tool for developing critical consciousness within engineering spaces.

Methodology

This study adopted a qualitative research design grounded in critical education theory and Freire's conceptualization of critical consciousness to explore and understand social processes and behaviors. This approach aligns with Freire's emphasis on dialogue, consciousness-raising, and the active participation of subjects in the research process, providing new insights in areas where deeper understanding is needed to transform social dynamics within educational settings [14]. This kind of qualitative design is important particularly with a small number of participants, as it focuses on in-depth data collection and analysis rather than generalizability [52]. We used *pláticas* to gain an understanding of how engineering students understand the discourses around them and the effect of these discourses on their experience navigating systemic inequities in engineering spaces. To answer the research questions, we collected data from 3 participants (1 female, 2 males) enrolled in different engineering programs at a Hispanic Serving Institution of around 35,000 students in the U.S. Southwest. The two males self-identified as *transfronterizo* Mexican American and came from similar backgrounds – both grew up in communities located in the U.S.-Mexico border. Both students started off as mechanical engineering majors but one switched to computer engineering and the other to electrical engineering. The female participant self-identified as white and Mexican American and was native to the area where the HSI is located. At the time of this study, she was pursuing a biomedical engineering major. The community where the university is situated is known as a bicultural/bilingual community with a long historical presence of Mexican heritage. Weekly *pláticas* took place in-person and online during a period of three months in 2024.

It is important to remember that as a qualitative investigation with a small participant pool of three students, including only one female student, the findings are not meant to be generalizable to a larger population. Instead, this study prioritizes in-depth analysis of the nuanced processes through which students develop critical consciousness. By focusing on a small group, we were able to closely examine the intricate ways in which individual experiences, including race, gender, socioeconomic status, and prior educational experiences, shaped students' understandings of the historical and social context of engineering. In addition, the study involves a very specific population (i.e., Latiné students at a Hispanic Serving Institution with strong ties to the borderlands) that is significant to maintain a focus on the specific phenomena being studied while allowing the researchers to adequately gather rich, relevant data that directly addressed the research focus.

This study emphasizes the importance of qualitative research methods, such as *pláticas,* in capturing the nuances of student learning and the development of critical consciousness. By prioritizing in-depth analysis of individual experiences and the dynamics of group interaction, we are offering a glimpse of the valuable insights into the complexities of students' challenges and opportunities when fostering critical reflection to enact social change within engineering education.

Data collection

Our primary data collection was through the use of *pláticas* [28, 29] as a way to explore how *pláticas* could effectively foster critical consciousness while students are building their

engineering identities. This methodology was chosen because it views participants as knowledge holders and co-creators of knowledge, and brings to the center front the participant's everyday lived experiences for research inquiry [30]. *Pláticas* involve a two- directional approach, based on reciprocity, vulnerability, and reflexivity. That is, it positions the researchers and participants in an equal field of knowledge production [28].

We conducted weekly *pláticas* over a period of 3 months. The topics discussed ranged from common practices related to language, communication, and social interactions that contribute to biased beliefs about what constitutes engineering knowledge, who is considered a suitable engineer, and who is recognized as a legitimate engineer [31]. To initiate the *pláticas*, our first two sessions, which were moderated by the first two authors, only asked students about how their experiences in engineering had been so far and how these have shaped their lived realities in their respective engineering programs. Based on the topics given on these two sessions, all of which were specifically directed by the students themselves based on their questions or concerns, we gave students six different journal articles that included raciolinguistics [32], perceptions of engineering [33], gendering in engineering [34, 35], forming an identity as engineering [36], and history of engineering [37, 38]. One basic component of *pláticas* is that there are symbiotic and dyadic in nature, meaning that they rely on reciprocity, cultural bonding, solidarity, and rely on two-way interactions [28, 29]. In essence, the first two *pláticas* allowed the researchers to identify the topics that could be included to build upon their interests for conversation and create a dynamic, interactive exchange of ideas.

These readings were chosen because participants mentioned the topics specifically in those first two meetings and we chose them because they provided students with a general knowledge of history of engineering, the development of engineering programs at universities in Mexico and in the U.S., and on language and ideologies. Our thinking was that after hearing their stories, we would enhance the *pláticas* with the readings, and then participants would highlight the parts that they were interested in the most. The goal of each *plática* was to let the participants guide the conversation rather than the research team setting the pace of the conversation. *Pláticas* lasted around 60 minutes each, and we always started with a general question such as "what is new this week?" Participants would then share their thoughts and, gradually, they would start connecting their experiences with the reading materials. All *pláticas* were audio recorded and transcribed for coding, and analysis.

Another tool we used to determine the impact of *pláticas* was asking participants to provide written journal reflections for each reading. We provided participants with a journal format that included questions on the topic of the article, the inclusion of the most memorable quotes (in one column) and in an adjacent column how they related that quote they chose to prior experience, current experience, something about their life, or any relation to social media, media, or the world in general. The purpose of the reading reflection was to elicit these connections between them and the readings so that they could all relate in some way during the *pláticas*, if needed. The purpose of these reflections was two-fold: (1) to analyze the meaning- and sense-making of the participants as they became more aware of the words and the world around them [39], and (2) to prompt participants to engage in critical dialogue with others.

Data Analysis

We transcribed all 7 *pláticas* and collected a total of 6 reading reflections from participants. We employed a critical discourse analysis approach (CDA) [40] to analyze all the textual and multimodal data collected. We chose CDA because it considers language is used purposefully, whether consciously or unconsciously. CDA centers on analyzing language describing, interpreting, and explaining ways in which discourse builds, perpetuates, and legitimizes social inequalities. To make sure we understood both conscious and unconscious ways insidious discourse is understood or experienced, we employed a three-cycle coding approach: descriptive, categorical, and analytical coding [41].

In the descriptive phase, we coded the data for instances where the participants' discourse exhibited explicit or implicit awareness of inequalities or negative experiences in their engineering journey. We also coded for instances in which the participants implicitly or explicitly exhibited through their discourse a lack of awareness that there was something negative. That is, we coded using "unaware" those times when there were instances of normalized discourse that they did not think anything of even when asked explicitly. Finally, in this phase, we coded for themes that emerged from their experiences such as job opportunities, sexism, racism, or pedagogical practices that they liked or disliked. This descriptive coding allowed us to make notice of the topics that are relevant to the students.

The categorical phase helped us notice the nuances of what type of awareness students had or in the case of unawareness, how they were reaching a certain level of critical consciousness. With this phase we built summaries of their thinking processes to show how participants used *pláticas*, reading, reflections, and *pláticas* again to gain critical consciousness. Coding in this phase enable us identify the ways in which students were reaching consciousness and what led them to those critical moments. We identified three main ways of reaching critical consciousness: (1) by reflecting on their readings using their prior experiences and contexts, (2) by asking questions and getting clarifications on their understanding or interpretations, and (3) by hearing the understandings of others through hearing other's own experiences.

In the analytical phase, we identified the processes of meaning negotiation and coded for the ways in which *pláticas* fostered a space for understanding and collaboration or inhibited certain topics. We identified the instances in which the understanding was local, meaning more personal and understanding of personal experiences, and contextual and societal, that the understanding affects beyond personal experiences (or not). To conduct member checking and to triangulate the data, during one of the *pláticas* we specifically asked students to share with us what they already knew about the topics, what they learned, and what specifically helped them learn or become aware of the issue. This activity was not considered data collection but as a way to gauge whether our interpretations of the data were accurate.

Limitations

Previous research in engineering education has demonstrated that women are acutely aware of the "toxic culture" and lack of understanding of women's intersectionality within the field [42-44]. While the female participant in this study demonstrated a high level of awareness regarding

these issues, the *pláticas* also provided valuable insights for all participants, regardless of gender. The diverse perspectives and experiences shared within the group, including those of the male participants, enriched the discussions and facilitated a deeper understanding of the complex and intersecting social and power dynamics that shape the engineering profession. Future work will seek to increase the number of participants and the female voices in the dataset.

Researchers' Positionalities

The first author identifies as a first-generation, bilingual (Spanish as a first language and English as a second), Mexican American engineer from a low-income background. As a *transfronterizo*, he has navigated the borderlands both geographically and metaphorically, sharing lived experiences like those of the participants in this study. This shared understanding allowed the researcher to build the *confianza* necessary to conduct this work. His personal and professional journey across the United States and Mexico has informed his commitment to integrating social justice issues into engineering education, particularly by fostering critical consciousness to challenge dominant narratives in engineering spaces.

The second author is a Mexican-born woman who immigrated to the U.S. twenty years ago and studied in the fields of applied linguistics and sociolinguistics. She utilizes ethnography and self-reflective methodologies to understand the identity construction and linguistic experiences of multilinguals of transnational backgrounds living in the U.S. Growing up as part of a society that has normalized classism and racism, she has had to engaged in critical self-reflexivity to recognize the insidious discourses that she unconsciously believed and perpetuated negatively affecting her own opportunities and perhaps those of others. She constantly shares her experiences of critical consciousness and the processes she has gone through understanding how to dismantle the systemic inequalities perpetuated by normalized discourses.

The third author is a first-generation bilingual Mexican American social researcher and teacher raised in a border town in west-northern Mexico. As a transnational woman living with a disability, she possesses a unique understanding of the challenges faced by both students and educators. Navigating this intersectional identity has profoundly shaped her professional perspective, driving her to advocate for inclusive higher education. Through intercultural dialogue, she investigates practices and educational barriers faced by marginalized groups, exploring alternative approaches, such as accessible learning practices, to create equitable learning experiences for all students.

Findings

All three participants showed had some level of awareness of negative discursive practices that have impacted their experiences as engineering students even if this awareness was superficial or centered in their own experience only and not on others. The findings section provides descriptions (in bold text) of those instances where participants (1) exhibited explicit or implicit awareness of inequalities or negative experiences in their engineering journey, (2) self-reflections on questions that contributed to their development of critical consciousness, and (3) the processes of meaning-making and meaning negotiation that resulted from this increased awareness. For instance, in the following excerpt Demetrio (all names are pseudonyms) shares his realization of

hierarchies within engineering. He then goes from acknowledging seeing some hierarchical differences, to recognizing experiencing these differentiations, especially as he switched from mechanical engineering to computer engineering in his junior year. He shared,

> I never realized that there was hierarchies or different engineering. So, there's computer engineering, electrical, mechanical. And each engineering student views them differently. There are **the jokes every now and then like, oh, this is harder. But people do take it seriously**, especially when it comes with industrial engineering. I didn't know that even to be in an engineering major and to be kind of, belittled, or be considered business or not really engineering [just for socializing]. That's why it's called imaginary engineering. And **I haven't caught that yet. I haven't seen that**, at least in my experience in the engineering field. Maybe they call it imaginary engineering because **we** are not really designing as much, we're more just about making things efficient. **They don't see us as true engineers**. They might look at us as not real. The article spoke to me because, well, it's crazy. Like you would think everyone in the same major would be like helping each other or everything or like, you know, lifting each other's spirits, but kind of the opposite.

In this excerpt, Demetrio described having some awareness of jokes that perpetuate hierarchies among engineering majors (in bold letters), and he recognizes that mechanical engineering is perceived as having more value or status among students than other majors prior to the reading of the assigned article by Foor and Walden [33]. What was new for him was to learn that because other engineering majors do not require the same level of creativity (and perhaps assumed rigor) than others, including his (i.e., computer engineering), they would be considered imaginary or not even engineering at all. It is important to notice that towards the end, Demetrio states "they don't see **us** as true engineers," positioning himself along the side of those who may be considered "imaginary" [33] or unreal engineers. It is important to note that the schism between electrical engineering and computer engineering had recently occurred at the institution, and there were several conversations about computer engineering and computer science becoming a different unit and moving to a different campus. This excerpt describes a glimpse of Demetrio's awakening of his critical consciousness, especially when he realizes that the systems of inequality in the hierarchy of engineering sets students to attack each other instead of helping or uplifting each other.

Our analysis of the data also indicated that all three participants benefited from *pláticas* because they were constructed and seen as a safe space to ask questions, talk about their own experiences, and discuss amongst each other. This time and space, which is not really allocated in their courses, either because the classes are large or the focus is on technical content, is necessary for students to begin the development process towards critical consciousness. For example, through *pláticas* and reading reflections, Cosme and Sally realized that what was presented as fair and as giving opportunities to everyone in engineering is only social, ethnic or racially motivated to keep hierarchies and segregation. The following excerpt provides a snapshot of their *plática*:

> Cosme: … It's weird because I never thought of engineering as military school… **Another similarity I found was hierarchy. Everywhere in engineering, there's always some sort of hierarchy, whether it's by gender or by race or by social status. There's always this amount of division of the people in engineering.**

> Sally: All of those things are things I also noticed when talking about the hierarchy and stuff. One of the quotes I have is that engineering was viewed as an organism with specialized technical labor for different purposes. **And I really like that because it had the idea that every person had their part to play, and every job had a purpose**. But then in other articles we'd also see the difference in technician versus engineer – that [an] engineer was seen as a higher position than technician. This article didn't necessarily reflect that when they were reviewing the history of – oh, it's an organism where everyone has their part. It was kind of like the **hierarchy is there whether you believe it is or not**.

Cosme and Sally's conversation reveals a critical awareness of the hierarchical structures within engineering. Cosme highlights the militaristic and hierarchical nature of the field [38, 45], drawing parallels to historical power dynamics. Sally, while initially drawn to the idea of a specialized and collaborative "organism," recognizes the inherent power imbalances within this structure, particularly the distinction between engineers and technicians. This exchange exemplifies how hierarchies in engineering, often intertwined with race and gender, are subtly maintained and normalized. The historical marginalization of certain groups within the field, such as Black and Latinx engineers, contributes to these power imbalances [23, 27].

While the previous excerpt does not mention race or gender explicitly, the following conversation does, which happened later in *Plática* 4. The participants continued stating what they learned from the readings, and Cosme made a comment regarding the mention of the phrase "white manhood" [38]. He noticed the entire article did not mention race again and questioned it openly. The conversation about hierarchy in engineering then turned into discussing the racial motivations for hierarchical structures:

> Cosme: The Antebellum [article] says this is a good point to study white manhood in the antebellum era. **And I was like why did they say *white* manhood?** And then you go on read[ing]… They don't mention anything about race until near the end...
>
> Sally: In [the] Slaton article on page four, it says it talks about the training for mechanical and industrial engineering and how they did the training, but they, like the **black students, were still not credited for engineering jobs. They got lower pay. They were considered technicians even though they had, you know, the paper that says engineer.** They were still given technicians. And I noted for my connection that that's still kind of similar to what we see today, even though it may not be out in the open. There's still, you know, wage discrimination or people assuming someone is, you know, lower in a like they're a technician versus an engineer just by assumption, because there's universities saying one is more valuable than the other, when in reality they're both education.
>
> Demetrio: I, uh, I had to find it odd that back then, of course, with being an engineering technician and an engineering like sufficient like the one from College Park is like higher status. Since how? Sally said. They're both education and they're both experience like you're going to get, uh, something out of both no matter what. Um, **but if you compare it to, like, nowadays, how not taking a degree is not. A degree is a degree**. And it will

help you benefit for the future for a job. But you can learn how to be an engineer not through college anymore, but you can use it through the internet, and you can learn probably better through the internet, depending on the person. And you can't be classified as an engineer, but **you're definitely at a level of engineering**...

Researcher: These narratives continue to be present in engineering spaces, right? Um, like this idea of who can be an engineer or who cannot be an engineer who brings knowledge, right? Who has superior knowledge.
Right? Or what is considered superior knowledge?

Cosme: Um, in job interviews, right? When they ask you, what would you what would you graduate from if you say MIT. And someone from say like, oh, South Texas or something, college, university or whatever, **they're probably going to hire the, the MIT one, right. Because they consider that one superior education**.

This excerpt demonstrates a growing awareness among the participants of the historical and ongoing impact of race and power dynamics within the field of engineering, now made explicit by their own comments. For example, Cosme's observation about the omission of race in the article that initially mentioned "white manhood" is a significant moment. This highlights the subtle yet pervasive ways in which race is often implicitly present and influential, even when not explicitly discussed. It suggests that the default or *unmarked* within the field is often assumed to be white, making the experiences and perspectives of people of color invisible or further marginalized. Sally's explicit connection between historical wage disparities for Black engineers and contemporary inequities is also crucial. Her observation underscores the enduring legacy of racism within the field, where systemic biases continue to impact opportunities and outcomes for Black engineers and women and other people of color. Finally, towards the end, the participants reflect on how these disparities affect engineering programs. Thus, Demetrio's observation about the perceived prestige of different educational institutions further emphasizes the role of social capital and implicit biases in shaping career trajectories. The preference for graduates from prestigious institutions like MIT, even when individuals from other institutions possess equivalent skills and knowledge, reflects a subtle form of elitism that can perpetuate existing inequalities. This conversation demonstrates the power of *pláticas* to facilitate critical reflection on the historical and contemporary realities of race and power within engineering. By engaging in open and honest dialogue, these students were able to connect historical injustices with contemporary challenges, deepening their understanding of the systemic barriers that continue to hinder diversity and equity within the field of engineering.

Later, Cosme and Demetrio observed that despite possessing the same knowledge and access to engineering education, individuals from certain institutions or backgrounds are often perceived as having an inherent advantage. This perception stems from the prestige

and social capital associated with these institutions [46], leading to the assumption that graduates from these institutions are inherently superior and more desirable candidates, even when their actual skills and knowledge may be comparable. The following is an excerpt of this dialogue during *Plática* 4:

> Cosme: **Why is it so important for engineers to have prestige?** Because I was thinking if I was going to be an engineer, yes, I would want prestige. But when I worked so hard to keep it, that's the whole point. And it's and **it's what I keep seeing in these articles, like always putting others down, whether that's other careers or whether that's people, uh, like it's always trying to, like, get – like elevate themselves** basically. but. I can understand the prestige. Like it's a hard career. What I don't get is why put it – why put other people, like, you know what I mean?

Cosme's statement highlights the problematic nature of the pursuit of prestige within engineering. He keenly observes that while the desire for recognition and professional success is understandable, the constant need to elevate oneself by "putting others down" – other careers, other people – is both counterproductive and ethically questionable. This observation reveals a critical awareness of how discourses of competition and hierarchy within engineering can contribute to a culture of exclusion and marginalization [27].

Cosme's comment implicitly acknowledges the systemic barriers that may limit his own access to the "highest" levels of prestige within engineering. His recognition that achieving and maintaining prestige requires significant effort and potentially involves navigating complex social and economic structures suggests an understanding of the unequal playing field that many students from marginalized backgrounds face.

Another example of students going from superficial and subjective awareness to more critical reflection can be seen in the following excerpts. In *Plática* 3, researchers shared articles exploring sexism in language and in the field of engineering [35]. This provided an opportunity for students to critically examine and discuss language that was either sexist or racially biased. Beyond simply identifying words like "bachelor's degree," "draftmen," and "black lie" as perpetuating male privilege and white supremacy, participants connected these observations to previous readings to understand the nuanced ways in which expectations about women in engineering are shaped and reinforced by language:

> Sally: I was going to relate [this exercise] to the reading. Faulkner talks about man and wife. She talks about the **value of a woman being heterosexual and being like a sexual woman**. That's the norm in engineering, I guess…
>
> Cosme: Dang, I just realized what a black lie is. That's – that's crazy. That is really bad for tomboy.
>
> Demetrio: Tomboy. **It doesn't bother me as, too much**, but I think it's the way how certain people would use it. And for what it is – because on the reading, I think it was Faulkner's **how women have to be, like, they have to choose to be, like, really girly, or they have to be, uh, like a tomboy.** Like they have to be, like, physical, get dirty, not get

their nails done, or look pretty. **Like, *real women* where they're saying**.

Demetrio: Yeah.

Cosme: **They have to prove they're real engineers, but also have to prove, like, [they're] *real*. So, *real women*.**

Demetrio: Yeah. Because, like, sometimes I know a lot of my family, like, there's some girls who are tomboys. But **when it's worded in that way where like, it's, uh, they have to neglect their, like, uh, like their female [femininity]**.

The excerpts reveal how deeply ingrained gender stereotypes and biases are within engineering discourse. The discussion highlights the reinforcement of harmful stereotypes, such as the expectation that women must conform to specific gender roles, either as "tomboyish" or hyper-sexualized, to be accepted in the field. The normalization of gendered labor divisions, where women are relegated to "imaginary" or less prestigious roles while men transition into management positions, further perpetuates inequality. Moreover, the emphasis on a masculine ideal of "true" engineers, characterized by strength and competitiveness, creates a double bind for women, who are expected to simultaneously embody both technical competence and traditional feminine traits [47]. Notably, Demetrio's initial indifference towards the term "tomboy" evolves into a critical understanding of how this label can be used to restrict women's expression of their femininity and force them to conform to narrow and limiting gender roles. These subtle yet pervasive biases, embedded within the very language and discourse of engineering, serve to limit the opportunities and aspirations of women in the field, ultimately contributing to a system that perpetuates existing power imbalances and reinforces a masculine ideal of the "true" engineer. This recognition underscores the importance of critical reflection and dialogue during *pláticas* to challenge and uncover the subtle yet pervasive ways in which gender stereotypes and biases operate and further marginalize women and black, indigenous, and people of color (BIPOC).

In later *pláticas*, participants began to transcend their immediate personal and subjective contexts, recognizing that systems of hierarchy, including those within engineering, are deeply intertwined with broader systems of power, even outside of engineering. They began to understand how these systems operate across different domains, including the power of language. Demetrio eloquently summarized this realization in *Plática* 6, highlighting how hierarchies are not confined to the engineering discipline but are pervasive across various social and institutional contexts:

Demetrio: Uh, like management wise, as in, like **there's lower level workers. So, like, I'm thinking of construction, how there's the lower level workers, which are usually people Hispanic.** Most of the time you go higher up. It's more Hispanics, of course, but **maybe they have more proficient speaking**. And then higher up, higher up, the more it goes. It's just more complex and more **professional speaking**. That's what came to my head, **is more like a system of power**. **Education counts as well, but that can only take you so far**.

In this excerpt, Demetrio observes the hierarchical structure within the construction industry

saying, "the lower level workers, which are usually people Hispanic," highlights the racialized nature of labor divisions. He further emphasizes the role of language as a marker of social status, noting that higher positions are often occupied by those with "more proficient speaking." The statement that higher-level positions are predominantly occupied by those with greater language proficiency, highlights the racialized nature of not only power dynamics in the workplace but also of language (i.e., perceived accent as a marker for language proficiency). This observation suggests an awareness of how race and ethnicity intersect with class and social status to create and maintain inequalities.

Demetrio's emphasis on the importance of "professional speaking" in achieving higher positions within the hierarchy underscores the role of language as a marker of social status and power. While acknowledging the importance of education, Demetrio also recognizes its limitations in overcoming systemic barriers. His observation that education "can only take you so far" suggests an awareness of the complex interplay between education, social class, and racial discrimination in determining individual outcomes.

Discussion

Engineering education has traditionally prioritized learning technical aspects of engineering work, often at the expense of fostering critical conversations about equity and social impact [7, 48-50]. This narrow focus on technical skills and rote learning leaves little room for students and educators to engage in meaningful discussions about the systemic inequities embedded within engineering itself. Without spaces for critical dialogue, engineering perpetuates exclusionary norms and fails to address how historical and structural inequalities shape who has access to the field and whose voices are valued within it. The absence of these conversations not only reinforces deficit-based perspectives but also hinders the development of more inclusive and equitable practices. Creating intentional spaces for critical reflection and dialogue is essential to reimagining engineering as a discipline that actively challenges inequities and centers diverse ways of knowing, being, and doing.

A common theme across the *pláticas* was the students' collective lack of exposure to the historical and social context of engineering, particularly the ways in which the field has been historically shaped by systems of privilege and power, often privileging white, heterosexual male individuals and marginalizing all others. These excerpts demonstrate how constant dialogue in a private and trusting setting (i.e., *plática*) facilitate the development of critical reflection among students.

By engaging with historical readings and connecting them to their own personal experiences, students begin to frame their understanding of the world in a more critical and nuanced way than staying at their subjective personal level. Students began to question the structures and systems that shape their lives. After the readings, they started to recognize how historical events and social inequalities have impacted their own experiences, the experiences of their families and communities, and the opportunities available to them (such as the explicit recognition of social capital and hierarchies within engineering programs regardless of the knowledge attained). Moreover, the *pláticas* environment encouraged students to connect their personal experiences to broader social and historical contexts. By sharing their stories and listening to the experiences of their peers, they begin to understand how their own lives are intertwined with the larger social

and political realities. One example is noting the double standard that women face in engineering programs where they are required to be both knowledgeable (as men are) to be considered true engineers, but feminine in a hyper-sexualized way to be considered true women. This process of reflection and dialogue helped students move beyond personal experiences and develop a deeper understanding of systemic inequities, as can be seen in Demetrio's view of the use of the derogatory label "tomboy". They begin to question the assumptions and biases that shape their own perspectives and the world around them. This was also apparent when students realized how hierarchies were systematically created and are perpetuated even currently. As Freire emphasized, the process of critical consciousness begins at the personal level, and by connecting their own experiences to broader historical and social contexts, students can begin to understand how these systems operate and how they can work towards creating a more just and equitable society achieving a higher level of critical consciousness.

Through open and honest dialogue, participants began to recognize and challenge the subtle yet pervasive ways in which gender, race, and class stereotypes are embedded within the language, narratives, and practices of the engineering profession. For example, discussions about the historical marginalization of women in engineering, the impact of racial bias in hiring and promotion, and the role of social capital acquired in the institution where the engineering degree is from in determining career trajectories highlighted the complex interplay of social and power structures within the field.

Students began to identify and challenge the assumptions and biases that continue to operate within engineering today, such as the emphasis on a masculine ideal of the "true" engineer and the devaluation of fields like industrial engineering. Furthermore, *pláticas* provided a safe space for students to critically examine their own internalized biases and assumptions. By sharing their personal experiences and listening to the perspectives of their peers, students began to recognize how their own beliefs and attitudes are shaped by the broader social and cultural context.

Conclusion

This study underscores the importance of incorporating culturally-grounded and student- centered pedagogical approaches into engineering education. By fostering critical reflection, challenging dominant narratives, and empowering students to become agents of change, "*pláticas*" can contribute to the creation of a more just, equitable, and inclusive engineering profession. Findings suggest that while students are cognizant of some inequities and injustices affecting their and their peers' experiences in engineering, this awareness is many times superficial and subjective to their own personal backgrounds (e.g. being a cisgender male). Through dialogue, participants began to recognize the broader systemic and structural, socioeconomic, and ethnoracial inequities that negatively affect them, their peers, and their communities. Additionally, these findings also suggest that dedicated spaces for *pláticas* in the engineering curriculum are crucial for fostering critical consciousness and supporting the development of students' engineering identities.

A key finding was that *pláticas* provided a unique space for students to become aware of the normalizing discourses that influence their experiences in engineering. *Pláticas* provide a crucial space for students to explore and critically examine topics rarely addressed in traditional

coursework. By engaging with readings about the history of engineering, students are empowered to re-evaluate their own positions within the field, recognize the diverse experiences of others, and gain a broader understanding of the historical and societal contexts that shape their work. These discussions, combined with reflective writing and opportunities for personal and peer-to-peer connections, facilitate deeper processing of the material. Without these interactive elements, the impact of reading alone would be significantly diminished. *Pláticas* are essential for students to develop an awareness of the systemic inequalities and racism that shape the engineering profession and to critically examine their own roles within these systems of power. Reading-empowered *pláticas* are a steppingstone for students to develop critical consciousness.

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References

[1] E. Jensen *et al.* "2020 U.S. Population More Racially and Ethnically Diverse Than Measured in 2010."

[2] American Society for Engineering Education, " Engineering and Engineering Technology by the Numbers 2019," Washington, D.C., 2020.

[3] National Science Board. "Science and Engineering Indicators 2018." National Science Foundation. https://www.nsf.gov/statistics/indicators/

[4] D. I. Castaneda, "Exploring Critical Consciousness in Engineering Curriculum Through an Ill-Structured Problem," in *2019 IEEE Frontiers in Education Conference (FIE)*, 2019-10 2019, pp. 1-5, doi: 10.1109/FIE43999.2019.9028370.

[5] R. Benjamin, "Catching our breath: Critical race STS and the carceral imagination," *Engaging Science, Technology, and Society,* vol. 2, pp. 145-156, 2016.

[6] R. Benjamin, *Race after technology: abolitionist tools for the new Jim code* (no. Book, Whole). Cambridge, UK; Medford, MA;: Polity (in English), 2019.

[7] S. Costanza-Chock, *Design justice: community-led practices to build the worlds we need*, 1 ed. (no. Book, Whole). Cambridge, Massachusetts: The MIT Press (in English), 2020.

[8] W. Annalies and N. Jurmo. "The Problem with Pulse Oximeters: A Long History of Racial Bias."

[9] I. Rodríguez-Calero, "Engineering a Future for Women: The Role of Medical Device Design in Gender and Health Equity," ed, 2023.

[10] D. A. Chen, M. A. Chapman, and J. A. Mejia, "Balancing Complex Social and Technical Aspects of Design: Exposing Engineering Students to Homelessness Issues," *Sustainability,* vol. 12, no. 15, p. 5917, 2020.

[11] D. Riter and J. Holly Jr., "Critical Scoping Review of Critical Consciousness as a Framework for Precollege Engineering Education," *Journal of Pre-College Engineering Education Research (J-PEER),* vol. 14, no. 2, 2024-07-02 2024, doi: 10.7771/2157-9288.1406.

[12] J. Holly Jr. and M. Buford, "An Exploration of the Role of Critical Consciousness in Pre-College Engineering Education (Other)," in *2022 ASEE Annual Conference & Exposition*, 2022/08/23 2022.

[13] J. Mejia, R. Revelo, I. Villanueva, and J. Mejia, "Critical Theoretical Frameworks in Engineering Education: An Anti-Deficit and Liberative Approach," *Education Sciences,* vol. 8, no. 4, 2018, doi: 10.3390/educsci8040158.

[14] P. Freire, *Pedagogy of the oppressed*. New York: Bloomsbury, 2003.

[15] P. Freire, *Education for Critical Consciousness*. A&C Black (in en), 2013, p. 169.

[16] M. A. Diemer, L. J. Rapa, A. M. Voight, and E. H. McWhirter, "Critical Consciousness: A Developmental Approach to Addressing Marginalization and Oppression," (in en), *Child Development Perspectives,* vol. 10, no. 4, pp. 216- 221, 2016 2016, doi: 10.1111/cdep.12193.

[17] T. Sarker *et al.*, "Validating a Critical Consciousness Scale for Civil Engineers," *Journal of Civil Engineering Education,* vol. 150, no. 2, 2024, doi: 10.1061/jceecd.Eieng-1748.

[18] J. A. Mejia and R. A. Revelo, "Critical literacies in practice: Deconstructing engineering through an engineering and social justice course," in *Literacies of Design: Studies of Equity and Imagination in Engineering and Making*, A. Wilson-Lopez, E. Tucker-Raymond, A. Esquinca, and J. A. Mejia Eds. West Lafayette, IN: Purdue University Press, 2022, pp. 244-259.

[19] B. A. Korgel, "Nurturing Faculty-Student Dialogue, Deep Learning and Creativity through Journal Writing Exercises," (in en), *Journal of Engineering Education,* vol. 91, no. 1, pp. 143-146, 2013 2013, doi: 10.1002/j.2168-9830.2002.tb00684.x.

[20] A. E. Slaton, "Ambiguous reform: technical workforce planning and ideologies of class and race in 1960s Chicago," *Engineering Studies,* vol. 2, no. 1, pp. 5-28, 2010-04-01 2010, doi: 10.1080/19378621003598957.

[21] R. L. Stitt and A. Happel-Parkins, "" Sounds like something a white man should be doing": The shared experiences of Black women engineering students," *Journal of Negro Education,* vol. 88, no. 1, pp. 62-74, 2019.

[22] J. A. Mejia, R. A. Revelo, and A. L. Pawley, "Thinking about racism in engineering education in new ways [Commentary]," *IEEE Technology and Society Magazine,* vol. 39, no. 4, pp. 18-27, 2020.

[23] A. E. Slaton, *Race, rigor, and selectivity in US engineering: The history of an occupational color line*. Harvard University Press, 2010.

[24] National Center for Education Statistics, "English Learners in Public Schools," in "Condition of Education. U.S. Department of Education, Institute of Education Sciences," Washington, D.C., 2024. [Online]. Available: https://nces.ed.gov/programs/coe/indicator/cgf

[25] M. M. Camacho and S. M. Lord, "Latinos and the exclusionary space of engineering education," *Latino Studies,* vol. 11, no. 1, pp. 103-112, 2013.

[26] E. A. Cech, "The (mis) framing of social justice: Why ideologies of depoliticization and meritocracy hinder engineers' ability to think about social injustices," in *Engineering Education for Social Justice*: Springer, 2013, pp. 67- 84.

[27] A. E. Slaton, "Meritocracy, technocracy, democracy: Understandings of racial and gender equity in American engineering education," in *International perspectives on engineering education*, A. E. Slaton Ed. Cham, Switzerland: Springer, 2015, pp. 171-189.
[28] C. O. Fierros and D. D. Bernal, "VAMOS A PLATICAR: The Contours of Pláticas as Chicana/Latina Feminist Methodology," (in en), *Chicana/Latina Studies,* vol. 15, no. 2, pp. 98-121, 2016 2016.
[29] F. Guajardo and M. Guajardo, "The power of plática," (in en), *Reflections: A Journal of Public Rhetoric, Civic Writing, and Service Learning,* vol. 13, no. 1, pp. 159-164, 2013 2013.
[30] D. Delgado Bernal, "Critical race theory, Latino critical theory, and critical raced- gendered epistemologies: Recognizing students of color as holders and creators of knowledge," *Qualitative inquiry,* vol. 8, no. 1, pp. 105-126, 2002.
[31] J. A. Mejia and M. S. J. Christiansen, "WIP: Racialized Discourses in Engineering Education: What Can We Learn from Raciolinguistics to Inform Broadening Participation in Predominantly Latino/a/x Engineering Spaces?," presented at the 2023 IEEE Frontiers in Education Conference (FIE), 2023.
[32] N. Flores and J. Rosa, "Undoing Appropriateness: Raciolinguistic Ideologies and Language Diversity in Education," (in en), *Harvard Educational Review,* vol. 85, no. 2, pp. 149-171, 2015-06-01 2015, doi: 10.17763/0017-8055.85.2.149.
[33] C. E. Foor and S. E. Walden, ""Imaginary Engineering" or "Re-imagined Engineering": Negotiating Gendered Identities in the Borderland of a College of Engineering," *NWSA Journal,* vol. 21, no. 2, pp. 41-64, 2009 2009.
[34] W. Faulkner, "CAN WOMEN ENGINEERS BE 'REAL ENGINEERS' AND 'REAL WOMEN'?: Gender In/Authenticity in Engineering," in *Gender in Science and Technology: Interdisciplinary Approaches*, W. Ernst and I. Horwath Eds.: transcript Verlag, 2014, pp. 187-204.
[35] W. Faulkner, "Nuts and Bolts and People' Gender-Troubled Engineering Identities," *Social studies of science,* vol. 37, no. 3, pp. 331-356, 2007.
[36] G. L. Downey and J. C. Lucena, "Knowledge and professional identity in engineering: code-switching and the metrics of progress," *History and Technology,* vol. 20, no. 4, pp. 393-420, 2004.
[37] A. E. Slaton, "Engineering Segregation: The University of Maryland in the Twilight of Jim Crow," *Magazine of history,* vol. 24, no. 3, pp. 15-23, 2010, doi: 10.2307/maghis/24.3.15.
[38] J. Miller, *Engineering manhood: race and the antebellum Virginia Military Institute* (Engineering Manhood). Ann Arbor, Michigan: Lever Press, 2020.
[39] P. Freire and D. Macedo, *Literacy: Reading the word and the world*. Routledge, 2005.
[40] N. Fairclough, *Critical Discourse Analysis: The Critical Study of Language*, 2nd edition ed. London: Routledge (in English), 2010, p. 608.
[41] S. N. Hesse-Biber, *The practice of qualitative research: engaging students in the research process*, Third edition. ed. Los Angeles: SAGE, 2017.
[42] K. J. Cross, R. Mendenhall, K. B. Clancy, P. Imoukhuede, and J. Amos, "The pieces of me: The double bind of race and gender in engineering," *Journal of Women and Minorities in Science and Engineering,* vol. 27, no. 3, 2021.
[43] L. A. Leyva, "Black women's counter-stories of resilience and within-group tensions in the white, patriarchal space of mathematics education," *Journal for Research in Mathematics Education,* vol. 52, no. 2, pp. 117-151, 2021.

[44] E. O. McGee, J. B. Main, M. L. Miles, and M. F. Cox, "An intersectional approach to investigating persistence among women of color tenure-track engineering faculty," *Journal of Women and Minorities in Science and Engineering,* vol. 27, no. 1, 2021.
[45] D. Riley, *Engineering and social justice: Synthesis Lectures on Engineers, Technology, and Society*. San Rafael, CA: Morgan and Claypool, 2008, pp. 1-152.
[46] N. L. Cabrera and S. Hurtado, "The Ivory Tower Is Still White: Chicana/o-Latina/ o College Students' Views on Racism, Ethnic Organizations, and Campus Racial Segregation," in *The Magic Key: The Educational Journey of Mexican Americans from K-12 to College and Beyond*, R. E. Zambrana and S. Hurtado Eds. New York, USA: University of Texas Press, 2021, pp. 145-167.
[47] D. A. Chen, J. A. Mejia, and S. Breslin, "Navigating equity work in engineering: contradicting messages encountered by minority faculty," *Digital Creativity,* vol. 30, no. 4, pp. 329-344, 2019.
[48] J. A. Leydens and J. C. Lucena, *Engineering justice: Transforming engineering education and practice*. Hoboken, NJ: John Wiley & Sons, 2017.
[49] J. A. Leydens and J. C. Lucena, "Social Justice: A Missing, Unelaborated Dimension in Humanitarian Engineering and Learning Through Service," *International Journal for Service Learning in Engineering,* vol. 9, no. 2, 2014.
[50] G. D. Hoople, D. A. Chen, S. M. Lord, L. A. Gelles, F. Bilow, and J. A. Mejia, "An Integrated Approach to Energy Education in Engineering," *Sustainability,* vol. 12, no. 21, p. 9145, 2020