Engineering Culture: Ideologies, Mindsets, and Infrastructure

Abstract:

This paper uses a critical Science and Technology Studies (STS) lens to explore how educational infrastructure shapes power dynamics in engineering education. By examining how built environments influence identity and belonging, the authors highlight how infrastructure can sustain or challenge exclusionary norms.

Introduction:

Engineering culture and ideology powerfully shape education [1], [2], [3], [4], [5], [6], yet the influence of physical spaces in reinforcing or challenging these forces is often overlooked. Using a critical STS lens, this study examines how infrastructure—lecture halls, labs, makerspaces—communicates power and impacts belonging, particularly for marginalized students. Unlike deeply embedded ideologies, spaces are more easily modified, offering a tangible entry point for fostering inclusion in engineering education.

Methodological Overview:

In 2023, 16 identity-based focus groups with 73 students explored how engineering spaces (e.g., classrooms, labs, and communal areas) shaped feelings of inclusion and belonging, especially among underrepresented groups. Through activities and dialogue, participants revealed how spatial and affective dimensions influence their engineering identity formation.

Qualitative Data Analysis:

While each vignette (below) has a potential counternarrative, we chose to center student stories that interpreted infrastructure as signaling exclusion to highlight often overlooked aspects of the educational environment. This focus aims to spark broader conversations about how design, policy, and community-building intersect in engineering education.

Vignette 1: The Infrastructure of Isolation. Jalen, a transfer student from an under-resourced public school, feels isolated and unprepared in an engineering environment defined by curved grading and impersonal lecture halls (Figure 1). He shares,

> "We are asked to perform at a disturbing level. And especially when a lot of your classes are graded on a curve, it's like you're constantly working based on how everyone else is working. The teacher shows the class average, the lowest and the highest grades on the screen during lecture. And there is some anxiety and mental health issues that come with constantly

Figure 1: Image of a Traditional Lecture Hall

> comparing yourself to others around you…because if you're below, then that means you're not doing as hot. I just think that in a lecture hall we are all just a bunch of nameless faces"

His experiences challenge the idea of meritocracy in engineering, revealing how infrastructure and teaching practices can reinforce exclusion and isolation rather than support.

Vignette 2: The Infrastructure of Insecurity. Samira, a sophomore in mechanical engineering, finds the campus makerspace (Figure 2) intimidating and unwelcoming, particularly as a woman lacking prior experience with the tools and machines. She explains,

> "I took a picture of the wood shop, a part of the makerspaces on campus. I'm interested in applying… but whenever I look inside, I feel hesitant to enter. I feel like I can't walk in. I lack the experience they [other students working there] have, and it feels like I'll be out of place or stared at if I go in to ask questions."

Figure 2: Image of a makerspace

Though meant to foster innovation, such spaces often reinforce gendered barriers and sort students by confidence rather than ability.

Vignette 3: The Infrastructure of Anxiety. Dara, a first-generation Cambodian-American student, struggles with his engineering program's ties to military projects (Figure 3), which conflict with his family's history. He states,

> "So, I'm Cambodian. My parents are Cambodian refugees—they survived the Vietnam War and the Khmer Rouge, which was a communist genocide. But a lot of that history had to do with the United States going into Southeast Asia and interfering. So, there's always been that identity tension for me where I'm thinking I can't work for the military because the United States military caused harm to my parents in the past."

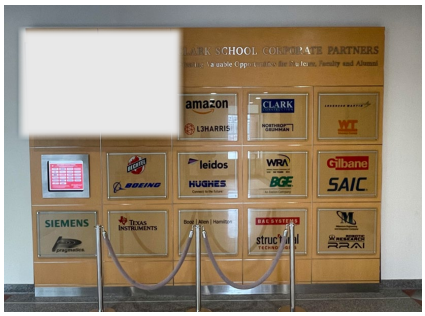

Figure 3: Image of Corporate Sponsors and Military Organizations

His story highlights how engineering education often overlooks political and cultural contexts, marginalizing students with global or justice-oriented perspectives.

Vignette 4: The Infrastructure of Representation.

Aisha, a junior in bioengineering, feels excluded by the Innovation Hall of Fame (Figure 4), which prominently features white male figures and lacks representation of women and people of color. She explains,

> "I call it the old White men wall. I know the Hall of Fame is more of a historical thing, but here, I'm like, then what's the point? It's all the names of the buildings, which means it's tied into money. Engineering is heavily White-male dominated, and there's not a lot of women in my classes, let alone Black women. So, when I walk through the Innovation Hall of Fame…it's just a hall of old White guys, and I think it needs to be updated to show the contributions of people of color and women to engineering. But I really do like walking outside and seeing the banners of all the diverse successful people that have come out of Clark Engineering. That's my sense of belonging."

Figure 4: Image of the Innovation Hall of Fame

While outdoor banners feature more diverse faces, the Hall of Fame sends a different message about who is celebrated in engineering. Her experience shows how symbolic spaces shape belonging by reflecting who is seen as part of engineering's legacy and who can be part of its future.

Conclusion:

Since this study concluded in 2023, several changes across the School of Engineering—such as more inclusive common areas, updated imagery, and a reimagined Hall of Fame—align with concerns raised by participants and reflect a shift toward greater recognition and belonging. These developments signal growing awareness that infrastructure is not neutral but deeply entangled with identity, power, and culture. To truly transform engineering education, educators and institutions must treat physical and symbolic spaces as starting points for reimagining equity, designing for community, care, and inclusion.

References

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