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Being vs. Doing: Student Insights on Engineering Identity from a Collaborative AutoEthnography

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Abstract

In this complete research paper, we use reflective, qualitative methods to investigate lived experiences of engineering identity. Engineering identity is important for student retention and belonging, and is hence a focal point for engineering education research. However, recent work from child psychology shows that *identity-based language* (e.g., "Let's be scientists") can reinforce gendered stereotypes, while *action-based language* (e.g., "Let's do science") can disrupt these stereotypes. Through a collaborative autoethnography with two engineering students and one faculty member we identified two themes, both related to *being* engineers, that negatively impacted our personal experiences with engineering: Performative curiosity is an outward expression of interest in engineering that may not match one's inward feelings, while "earning your place" is a pressure to demonstrate one *is* an engineer through a large volume of engineering work. We detail first-hand experiences with both themes, and connect the themes to extant work on engineering student retention and belonging.

Keywords: engineering identity, qualitative methods, collaborative autoethnography, action vs identity

Introduction

This complete research paper reports on a collaborative autoethnography conducted by two engineering students and one engineering faculty member, interrogating their experiences of engineering identity. Namely, this work was sparked by noticing that two highly successful engineering students "don't quite feel like engineers." This prompted a deeper exploration of their lived experiences with engineering identity.

Engineering identity is an important part of engineering education research, as it is linked to student retention [1] and helps characterize issues faced by minoritized students [2]. A variety of interventions have been designed to promote engineering identity among students, both in higher education [3], [4] and K-5 settings [5], [6]. This work is motivated by the noble goal of retaining and supporting engineering students, particularly in ways that close achievement and persistence gaps [7].

However, supporting students' identity development can be fraught. As recent work in child psychology shows, slight changes in presentation can promote students' development of stereotypical, gender-based beliefs about science [8]. Recent work on action vs identity based language suggests that a focus on *doing* rather than *being* can promote more equitable participation in science [9]. We identified two themes, both related to *being* engineers, that negatively impacted our personal experiences with engineering.

Background

Engineering identity is defined in a variety of ways, particularly engineering experiences and social interactions. In a systematic review of the literature on engineering identity, Morelock [7] classified the frameworks used to define engineering education. These frameworks generally included prior engineering-related experiences. Some interventions, such as portfolio development [10], are designed to leverage these prior experiences to build engineering identity.

The frameworks reviewed by Morelock [7] also generally involved some form of social interaction. For instance, Dehing, Jochems, and Baartman [11] framed engineering identity in terms of acting like, believing oneself to be, and *being recognized as* an engineer. Using the Sustainability and Gender in Engineering (SaGE) survey, Godwin et al. [12] studied engineering identity in terms of competence, interest in engineering, and *recognition by others*.

Social interactions can also help or hinder engineering identity development. These are particularly salient for women in engineering. For instance, Dryburgh [13] found that women had an additional burden in the workplace as "(they) must learn to manage impressions male engineers hold of them." A study of engineering students [14] described the experiences of a student who switched out of engineering, "On top of this academic fear, she felt very intimidated by her peer group. Kim specifically stated that it was not the minority aspect (being a female in a male dominated field) that intimidated her, but rather the fact the [sic] she felt her peers had much more experience with college and engineering specifically." While faculty do not have direct control over student interactions, faculty can influence social interactions through course design, choice of content, and even their choice of language.

The use of language has been shown to impact identity. For instance, identity-based language ("Let's <u>be</u> scientists!") has been shown to promote stereotypical beliefs and to lead to disengagement of children from science [8]. The simple intervention of switching to action-based language ("Let's <u>do</u> science!") has been shown to disrupt these gender stereotypes [9]. While it is unclear how these results translate to a higher education context, they do suggest the power of language and positioning to impact students' development of (engineering) identity. Faculty are in a position to influence social interactions and language in the classroom. Faculty can legitimize (or de-emphasize) prior engineering experiences, through the activities they assign (such as portfolios) and the discourse they encourage.

Methodology and Methods

This work followed a human subjects protection protocol approved by the Brandeis IRB (#23232R-E). This work is part of an ongoing project on engineering student culture in mathematical modelling, conducted at a small liberal arts-style engineering program. However, due to the sustained nature of the project [15] we encountered episodes related to engineering identity that sparked the current work. Namely, there was a shared moment where we—Alex, Leslie, and Zach—mutually realized that we don't quite feel like engineers. Zach (he), the faculty member facilitating the work, was surprised at Alex (they) and Leslie's (her) candid

admission—they are both successful engineering students. Through further discussion, we felt that these lived experiences of students navigating engineering identity deserve exploration.

Our chosen methodology is *collaborative autoethnography* (CAE) [15]. CAE is *autoethnography*—reflective study of the self in a context [16]—conducted in a *collaborative* mode [17]. As a qualitative methodology, CAE is not aimed at statistical generalization (*nomothetic* research), but rather at deep understanding of specific human experiences (*idiographic* research) [18]. Relative to quantitative methods, autoethnography has the advantage of making innermost thoughts visible [17]. The participants in CAE are truly researcher-participants—engaged in the culture they aim to study. Consequently, CAE provides unique affordances to center participant voices; in this case, engineering students [15].

We adopted the *concurrent model* of Ngunjiri et al [17], collaborating at all stages of the work: data collection, analysis, and writing. The data collection and analysis consisted of repeated cycles of individual reflection and group discussion. All three authors wrote an individual reflection in response to a prompt ("Why don't I quite feel like an engineer?"), met as a group to discuss all three reflections, and wrote additional reflections to explore emergent ideas. We used close reading to identify themes, and used collaborative discussion to ensure the themes resonated with all three participant-observers, supporting communicative validation [19].

Core to our ethical practice is a process of ongoing informed consent [15], [20]. There is a tension inherent to this work: We have experienced episodes of personal struggle that speak powerfully to the nature of student experience with engineering identity. However, there is real risk in sharing these episodes in the non-anonymous, recorded form of a manuscript. To that end, we each exercise a right to unilateral veto of the inclusion of any quotation or detail, and we hold ourselves to a practice of mutual care when reviewing work for release. In practice, this not only supports the protection of human research subjects, but also promotes research quality by building mutual trust in a way that serves to explore lived experience—ethical validation [21].

Results

Theme 1: Performative Curiosity

At the beginning of this study, we each wrote a reflection on the question "Why don't I quite feel like an engineer?" This question emerged from past discussions among the group: We had all come to the realization that we don't quite feel like we "fit" in engineering. One reason Alex pointed out was their "lack of curiosity,"

> Alex: Another thing… is my lack of curiosity. I don't look at something and immediately wonder how it works. I don't really care how the things around me are made, as long as they work as they're supposed to… I think of an engineer as someone who is always curious and always asking questions… but I don't wonder about things without prompting.

Here, Alex discussed how their lack of curiosity about their environment made them feel less like an engineer, because they perceived an engineer as someone who is always curious. They observed that their peers seemed to possess an innate curiosity about the world around them.

In response, Leslie brought up their own experience, where a professor said that he wanted to instill in his students a sense of amazement and curiosity about how everything works. Furthermore, he wanted students to be excited about sharing that amazement with others, even if it was “annoying.” Reacting to the professor's goal, Leslie thought,

> Leslie: And I was like, I’m… not that kind of [person], is that like, performative?

Leslie questioned if expressing curiosity is performative. She wondered that if she was not performing this amazement, was she lacking as an engineer? Was she lacking in some quality that all engineers possess?

This introduced an idea we call “performative curiosity”: when engineering students are pressured to express a certain level of fascination with engineering that they might not experience. Leslie was expected to be "amazed" by the environment and mechanisms around her, but she was also pressured to *express* that excitement to her peers. This is the 'performance': to deliberately and publicly make visible one's interest in engineering.

In response to Leslie, Alex elaborated on their feelings towards curiosity,

> Alex: If I see something where you can see the mechanism, or you see a good work of craftsmanship, I'll think that's cool… and I'll get excited about it. But I won't really have that kind of reaction unless it's explicitly prompted by something, I guess.”

Alex shared that they are not typically curious about their environment, unless they see something especially interesting. Alex has an openness towards amazement when it comes to engineering, but they do not feel the need to “perform” curiosity.

In response to this idea, Zach wrote a reflection on his experiences as an undergraduate. He discussed how he pursued different engineering projects, as he perceived that “students with the ‘coolest’ projects were the ‘best’ engineers.” He wrote about joining the performance,

> Zach: With all these projects, I planted myself in public. I'm not entirely sure why I did things this way: I was self-conscious that my projects were really basic, so I don't think it was to show off. But I'd seen other students doing work in the open, so perhaps I was just mimicking their behavior.

Zach felt the need to work on projects in public, even though he didn’t think they were impressive. Quite the opposite, he was worried that his peers would think they were “basic”. While Zach may have possessed an innate curiosity and excitement about engineering to pursue these projects on his own, he was also encultured to join the performance.

This idea of performative curiosity may seem relatively harmless, but it can have negative effects on engineering students and the development of their engineering identities. Leslie shares her reaction upon arriving to college,

> Leslie: I wasn’t interested in the same things as other people. I didn’t have experience in robotics, which over 50% of our class, I think… did… I always didn’t feel quite like an engineer. I wasn’t interested in the same things as my class, and I also didn’t have the [same] experience as the rest of my class.

When Leslie first arrived at college, it seemed like all of her peers were talking about their engineering experiences in high school, e.g., FIRST robotics. In Leslie's experience, an environment of performative curiosity made her feel "(not) quite like an engineer." She didn't match the performance she saw around her.

Alex shared their experience with a project team in college. While they had initially found the project motivating, as they progressed through the team, they started to feel burnt out and stressed. Despite their peers on the team being under similar stressors, Alex felt like they were falling behind. They shared their thoughts in that moment,

> Alex: I felt like I was missing something. I couldn't understand why I wasn't able to make the same sacrifices to my mental health that they were because they were so passionate about engineering.

To Alex, it felt like their peers were passionate, almost obsessed, with engineering and the team's project. Their teammates' interest in engineering seemed to eclipse any negative emotions associated with the project, but Alex could not feel the same. Alex struggled to put on a performance to match the environment they saw around them. They expressed one of the reasons they felt the need to join the performance,

> Alex: I was mentoring several new, first year members at the time, and I wanted them to be excited about engineering and the whole college experience, so I tried to push down my own stress and perform the excitement I saw the rest of my peers expressing.

Alex mirrored excitement to younger members because they felt the need to perpetuate performative curiosity to students just entering the field. When Alex was unable to maintain this performance, they felt different from their peers and guilty for what they perceived as a lack of passion and commitment to the team.

Like Alex reflected in the first quote, this lack of fascination with engineering can lead students to feel disconnected from their peers. Both Alex and Leslie felt less like engineers because they do not view their curiosity as "innate." However, it is unclear if the "innate" curiosity they observe from peers is genuine or a performance. Unlike Zach, Leslie and Alex don't act in ways to try and fit in with the idea of engineering they see around them. This may exacerbate the feeling the two have that they are not engineers, despite successfully completing engineering course work with high grades and securing internships in the engineering industry.

Theme 2: "Earning Your Place" in Engineering

We have felt the need to "earn our place" in engineering. Leslie reflected on her experience in an internship in the aerospace industry,

> Leslie: I don't want to constantly have to prove myself in the aerospace industry and prove that I'm qualified to be there. So I was like, I'm just not going to do aerospace.

During this high school internship, Leslie heard from her colleagues that she would have to prove that she belonged amongst her peers to succeed in the aerospace industry. Despite being surrounded by employees she describes as “very, very nice,” she experienced pressure to prove not only that she was qualified, but that she *was* an engineer. Instead of feeling supported by the aerospace community, Leslie decided that she was not “ interested in trying to prove myself constantly”. The pressure to “earn her place” in this engineering environment led her to abandon aerospace as a possible career path. For Leslie, it didn’t feel like she was doing enough by *doing* an engineering internship—she still had to prove that she *was* an engineer.

Alex recalled the myriad of engineering and engineering adjacent activities they did before college. As their high school itself did not offer many engineering opportunities, they found ways to be involved with engineering outside of school through robotics, various camps, and personal projects. While Alex did enjoy robotics, they did plenty of other, less meaningful projects to validate their identity as an engineer. Alex reflected on building websites after learning HTML and CSS at a summer camp,

> Alex: The more complicated features I could fit into the website, the more like an engineer I felt. I didn’t care about making a website, I cared about showing off my technical abilities, because that’s what made me feel like an engineer.

Even though Alex barely showed the website to other people, they pursued interest in certain activities because it made them feel more like an engineer. They didn’t actually enjoy the process of building websites that much, in fact they found it rather tedious, but they did like having a tangible artifact of “being an engineer.” Alex believed that if someone questioned if they were an engineer, they could point at their website to prove that they were.

This need to earn one’s place is in contrast to Zach and Leslie’s experience with other disciplines. Leslie, who has a strong interest in material science, reflected on that difference,

> Leslie: Then I did material science, and I really fell in love, because it… had the environment, the supportive environment of learning and education and being a Woman in STEM. The more that I've now identified with being a material scientist, the more I realized… that this [engineering] ain't my thing.

Leslie experienced a much more supportive environment in the material science community. She didn’t feel like she had to earn acceptance from others, it was just available to her. Similarly, Zach reflected on his experience in the statistics community, where a senior colleague told him,

> Zach: If you’re doing statistics, then you *are* a statistician. That felt so refreshing to me. And it felt so different from engineering, where, at least in my experience, it’s always felt like engineers are looking for you to prove yourself.

In Zach’s experience, the act of practicing statistics makes one a statistician. One might expect that the act of practicing engineering would make an engineer, but in our experience this is not the case. All three of us encountered this idea of having to "earn your place” in different settings: Alex in high school, Leslie in an internship, and Zach in his faculty role. In our experiences, *doing* engineering was not enough to *be* an engineer.

How does one earn their place in engineering? One way is through the performative curiosity, described above. By performing one's excitement towards engineering, one can further cement their place as an engineer in other's eyes, bolstering their own engineering identity. However, creating this environment of performative curiosity can alienate those who do not fit the mold—people who are excited about engineering but do not broadcast that excitement, or people who simply aren't all that fascinated by engineering despite practicing it.

Limitations and Discussion

As noted in the Methodology and Methods, CAE is aimed at deep understanding (idiographic), not statistical generalization (nomothetic) [18]. Consequently, there are key limitations to interpreting our results. Foremost: These are the experiences of two students and one faculty member, which should not be taken to universally characterize experience. This study cannot make claims—and indeed does not seek to make claims—about the rate at which the phenomena of performative curiosity and "earning your place" manifest in engineering settings. However, the work *does* serve to illuminate the phenomena, and provides an initial exploration of their nature. In the discussion that follows, we describe how our resulting themes relate to observations in the engineering education literature.

Prior engineering experiences support the *individual* development of engineering identity [7]. However, these experiences can be socially positioned in a way that harms *other* students' engineering identity. The case of Kim shows that seeing peers with more engineering experience can lead to intimidation and convince a student to leave engineering [14]. We identified performative curiosity as a social phenomenon that can contribute to student feelings of intimidation and exclusion: As Leslie described, being surrounded by a peer group where prior engineering experiences dominated conversations led to a sense that she "didn't feel quite like an engineer." While faculty do not have direct control over student culture, they do stand as representatives of their disciplines and do exert influence over the social space of higher education: As seen in our results, some faculty may even encourage students to engage in performative curiosity—possibly to the detriment of students' engineering identity.

Engineering programs have a reputation of being competitive [22] and the discipline has a broader reputation of being exclusionary [23]—both can contribute negatively to students' development of engineering identity. A social pressure to "earn your place" would certainly make engineering a competitive and exclusionary environment. Two of us found that our experiences in other disciplines (material science, statistics) did not exhibit a pressure of "earning your place", suggesting that technical professions can operate without this pressure. In Zach's reflection ("If you're doing statistics, then you are a statistician") we see parallels with early education research, where action-based language ("doing statistics") has been shown to disrupt stereotype threats to engagement in science [9]. Paradoxically, reframing engineering for our students to be less about *being* an engineer to more about *doing* engineering may help a more diverse set of students develop a healthy relationship towards the discipline.

Conclusion

Inspired by an initial observation of successful engineering students who "don't quite feel like engineers," we conducted a collaborative autoethnographic study of two engineering students and one faculty. We identified two themes: *performative curiosity* is when one makes visible an interest in engineering, while "earning your place" is an expectation that an engineer is engaged in engineering work to an almost obsessive degree. Our reflection data shows how these two phenomena negatively impacted the engineering identity of the researcher-participants involved in this study.

This work has implications for developing students' engineering identity. Supporting engineering identity development remains important [7]. However, if identity interventions reinforce performative curiosity (e.g., through faculty emphasizing traits an engineer should have and express) or "earning your place" (e.g., emphasizing a high volume of engineering activity), these interventions run the risk of alienating engineering students, particularly those already at risk of marginalization.

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