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”I’m allowed to be my own person in engineering”: How gender identity-based engineering student organizations support women’s engineering identity development

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"I'm allowed to be my own person in engineering": How gender identity-based engineering student organizations support women's engineering identity development

Background

This work-in-progress paper examines women's motivations for joining gender identity-based engineering student organizations (GI ESOs) and how those organizations support women's engineering identity development. Engineering holds a reputation for being a "prototypical masculine profession" [1, p.351], where "'doing the job' often entails 'doing gender' … performing certain kinds of masculinities" [2, p.4]. Performing masculinity can present itself in the form of distancing from traditional feminine attributes (e.g., social and girly) to embrace the more masculine (e.g., being strong and acting 'normal' in engineering) [3]. An environment that perpetuates masculine social norms creates a hostile environment for individuals who do not perform or present themselves according to those standards [4]. The exclusionary environment perpetuated within engineering can compound feelings of belonging uncertainty as women and other minoritized genders attempt to assimilate into engineering and be recognized as engineers [5]. Existing literature highlights how institutional structures, like engineering student organizations (ESOs), can help socialize students into engineering [6], transition into college [7], improve likelihood to persist [8]-[9], and mitigate feelings of belonging uncertainty [9]-[13].

Engineering student organizations are prevalent at most undergraduate institutions. Students may choose to be involved with engineering student organizations for the various opportunities offered such as professional development [14]-[15], networking events [7], [9], [12], [14]-[15], and leadership opportunities [15]. However, organizations targeting underrepresented groups in engineering function with a deeper motive: to provide a counter space for students to feel seen, understood, and valued in engineering. For example, Latinx/Hispanic organizations have been impactful through their culturally-relevant approach to mentorship and familial sense of community [9], [13], [16]-[18]. Meanwhile, organizations targeting women in STEM often promote inclusivity, emotional support, and community [9], [12]. While existing literature has focused on students' experiences with cultural-based ESOs or ESOs at large, this paper will focus on women's experiences within gender identity-based engineering student organizations (GI ESOs). GI ESOs are organizations that aim to support minoritized genders in engineering (e.g., Society of Women Engineers, Women in Computer Science, Out in STEM, and EngiQueers).

The goal of this study is to understand the factors undergraduate women consider when choosing an ESO membership and how their membership impacted their engineering identity development. This paper will focus on the following research questions:

1. *Which factors motivated women to join gender identity-based engineering student organizations?*
2. *In what ways does involvement in gender identity-based engineering student organizations (GI ESOs) uniquely impact women's engineering identity development?*

Engineering student organizations serve a purpose beyond networking and career development by providing a sense of community among peers with shared backgrounds, experiences, and/or

interests. Institutional support systems, like engineering student organizations, are critical components that inform how students navigate and persist through engineering. It is imperative to understand what factors play into students' developing engineering identity to better serve individuals from underrepresented populations, like women, and further support their journey into and through engineering.

Theoretical Framework

Engineering Role Identity

The guiding theoretical framework for this paper is engineering role identity. Engineering role identity is a role that is specific to the culture of engineering. Role identity is understood within the constraints of an individual's social position and the associated expectations of the role in a given context [19]. Expectations of a role may consider the behaviors, mannerisms, meanings, and attitudes someone in a given role is expected to take on. However, role identity is constructed by the individual and their environment [19]. How an individual internalizes the feedback from their environment helps them redefine what it means to enact a given role.

In engineering, students hold a social position that straddles the roles of engineers and students. Engineering students' understanding of their social position is molded by their own perceptions of the role and the expectations from their environment. As they progress through their degree, engineering students are forced to negotiate their understanding of what it means to be an engineer based on the feedback they receive from their environment. In particular, engineering students face the expectations associated with being in the role of an engineering student: having an *interest* in engineering, *performing* or displaying *competence* in engineering concepts, and being *recognized* by oneself and others [20]. As students become engulfed with the cultural norms and expectations of engineering through their classes, projects, and extracurricular activities, they become aware of who they can be within engineering spaces. When encountering feedback that does not align with who they are and who they are expected to be, some students may choose to reconceptualize their understanding of an engineer while others may challenge perpetuated notions to author their own definition.

Through engineering role identity theory, this paper examined the ways supplementing an individual's environmental feedback via engineering student organizations can influence their engineering identity development. As women engage in counter spaces (e.g., GI ESOs) that deviate from the prominent engineering culture, it is important to note the ways their identities are being affected. By understanding the impact membership within a GI ESO has on women, we can begin to adopt institutional measures that mirror the support created by and catered to women in engineering and their success.

Methods

Recruitment and Data Collection

Purposeful sampling was used to recruit participants for this study at one public four-year ABET accredited U.S. institution. GI ESO student leaders and advisors were contacted to share an email

invitation for the study with their members. Targeted GI ESOs consisted of one engineering sorority, one LGBTQ+ in STEM organization, and four different disciplinary women in engineering organizations. The email invitation was also sent out through a student success center newsletter. In the email invitation, students were asked to fill out a general interest survey that consisted of questions regarding ESO memberships, degree of involvement, and general demographics. There was an intentional effort to hear perspectives from individuals from different majors and varying degrees of ESO involvement. Selected individuals were invited to take part in a 60-90 min semi-structured interview with the lead researcher during the Fall of 2023. The interviews focused on topics such as participants' various involvements with ESOs, the impacts of their membership on their engineering experiences and identity, and their biggest takeaways from their membership in GI ESOs. This study received IRB approval.

Participants

This work-in-progress paper will focus on four participants. All four participants identified as women, used she/her pronouns, and were involved in at least one GI ESO. Participants provided information about their engineering student organization memberships, the time they spent engaging with each ESO, and any leadership positions they held. It should be noted that some participants engaged with ESOs that are not directly tied to their major or the intersection of their gender and their specific major. In this paper, GI ESOs will refer to an engineering student organization that targets support towards specific individuals based on their gender, while major-based ESO refers to a disciplinary engineering student organization that is typically tied to a larger national organization (e.g., American Society of Mechanical Engineers). A summary of the participants' demographics are in Table 1.

Table 1.
Participant Demographics

Pseudonym	Major	Year in School	First Gen?	Race/Ethnicity	ESO Affiliation	Commitment to ESO (hours/week)
Avery	Mechanical	3rd	No	Asian and White	Gender Identity ESO*	5-10
					Engineering Honor Society*	1-2
Elise	Biomedical	2nd	No	Asian	Major-based ESO*	1-2
					Gender Identity ESO	1-2
Olivia	Computer Systems	2nd	Yes	White	Gender Identity ESO*	2-5
Zoey	Electrical	1st	No	White	Gender Identity ESO	1-2
					Major-based ESO	1-2

*Note. Participants held a leadership role for this student organization

Data Analysis

The interviews were audio recorded and transcribed verbatim. The interview transcript was reviewed for accuracy by both the researcher and the participants. Participants had the opportunity to clarify, redact, or remove any information to more accurately align the transcript with their experiences. Reviewing the transcript allowed for the researcher to become familiar with the data. Analysis of the data was conducted through thematic analysis, as outlined by Nowell et al. [21]. The first round of coding consisted of deductive, structural coding using the preliminary codebook. The preliminary codebook consisted of pre-established codes related to engineering identity constructs, ESO-specific resources, and ESO culture. Structural coding was used to capture all instances in which participants addressed specific ways their involvement in a GI ESO affected different dimensions of their identity development. Structural coding allowed for the data to be "initially categorized… to examine comparable segments' commonalities, differences, and relationships" across the participants [22, p.98]. Interrater reliability was conducted with a peer to evaluate the consistency of the codes. Feedback from the interrater reliability led to refined codes and descriptions. The second round of coding consisted of eclectic coding that allowed for the interviews to be re-coded with the newly refined codes and allowed for other codes to be developed inductively. The final round of coding used axial coding, which aims to center the coding around the most salient topics [22]. The researcher engaged in continual peer debriefing and analytical memo writing to engage in reflexivity as they engaged with the data in more profound ways [21]. The themes for this paper were determined during the final cycle of coding and aim to capture the most salient topics described by the participants. Any redactions or author's notes inserted for clarification are noted in italics and brackets. The themes are further explored in the findings section below.

Findings

This work-in-progress paper is focused on understanding four women's motivations for joining a GI ESO and how their membership impacted their engineering identity development. The following section will provide findings associated with the participants' experiences engaging with GI ESOs at their institution. It should be noted that three of the four participants were also involved in other engineering student organizations and an effort was made to differentiate the unique support they received from GI ESOs. There are three themes that will be highlighted in this paper: 1.) Women sought out ESOs that would support them at a personal and professional level, 2.) GI ESOs' organizational opportunities supported women's engineering identity development, and 3.) Women's identities were affirmed when they were automatically recognized as engineers in GI ESOs. The following section will address each of the findings.

RQ1: Which factors motivated women to join gender identity-based engineering student organizations?

Finding 1: Women sought out ESOs that would support them at a personal and professional level

All four of the participants in this study were women who sought out external organizations, beyond the classroom, to feel supported in engineering. Specifically, the women in this study sought out student-driven organizations to supplement their personal and professional needs in engineering. For example, Olivia, a computer systems engineering major, had been involved in

student organizations since high school. She had greatly benefited from her involvement in a 'Woman in STEM' organization as it provided an environment that combated the lack of representation in her STEM coursework, where she was often the only girl in the class. When describing her search for college involvements, she mentioned:

> "And I think in college, the reason that I sought that [*GI ESO*] was because that [*student organization*] experience was so beneficial for me in high school. So I was looking for something similar…And why [*I*] chose [*GI ESO*] is because it was national. The conference was really exciting for me. And then also all of the leadership programs that they had. So I did some research on the website. And that kind of just swayed me over like, "yes, I'm gonna join this. I'm gonna become more involved."

Olivia sought out an environment that emulated the supportive nature of her previous student organization. Olivia's involvement in a GI ESO served for the purpose of countering the dominant masculine culture of engineering. She later went on to say that her GI ESO was her safe space where there was "no need to prove [*herself*]." This sentiment was not unique to Olivia; Avery and Zoey shared similar motivations for their decision to join a GI ESO. The GI ESO environment allowed all of the women to embrace their identities as women and engineers within an engineering context. This greatly aligned with the women's expectations for their GI ESO membership.

GI ESOs also supported women's future professional endeavors through opportunities like conferences and leadership positions. Elise, a biomedical engineering major, perceived her GI ESO more through a professional development lens than a community-oriented one. She perceived her GI ESO to have a variety of career development opportunities. When describing why she joined a GI ESO and a major-based ESO, she described:

> "I joined [*the GI ESO*] more for the opportunities. I thought that even on their Instagram or on their [*student organization portal*] they posted so many new opportunities for not only networking, but like career opportunities which is really important to me… For [*major-based ESO*] I would say that I joined really to meet more people who were in my major…I thought that the club really helped provide me a way to like meet new people and just people who also are looking for friends within the major."

While the other participants primarily perceived their GI ESO involvement as a means to build community with other women in engineering, Elise was keenly aware of the unique professional opportunities that were offered through the GI ESO. GI ESOs provided these women with both a sense of community and support beyond their classroom and opportunities for engineering identity formation and professional development.

RQ2: In what ways does involvement in gender identity-based engineering student organizations (GI ESOs) uniquely impact women's engineering identity development?

Finding 2: GI ESOs' organizational opportunities supported women's engineering identity development

GI ESOs typically host workshops, guest speakers, networking events, and other professional development events for the edification of their members. In particular, Avery, a mechanical engineering major, attributed professional development events as a means for holistically supporting her identity as a woman in engineering. Avery described the various resources available through her GI ESO and the outcomes she's received from her engagement:

> "We can help you volunteer. We can help you get an internship. We can help you get a job. We can help you, oh we're gonna bring in people at [*the institution*] who are doing research, if you want to get involved with that. Like there's so many ways that they try to get people involved and like doing things outside of just [*GI ESO*] that it's really awesome."

> "I think just being in [*GI ESO*] has more supported me as a person, like encouraged me as that. Like they see you as a person first, and like an engineer second… I feel like [*GI ESO*] has really helps me be like, "I'm allowed to be my own person in engineering.""

Avery viewed her GI ESO as a well-rounded organization that provided its members with opportunities to learn, grow, and give back in ways that were meaningful and interesting to them. The organization helped Avery feel like a well-rounded individual that was encouraged to flourish as an individual and engineer. As a result, she felt empowered to exist in engineering spaces in her own way, further challenging masculine engineering norms and expectations.

Engineering identity is informed by other constructs such as interest, recognition, and performance/competence. The women in this study emphasized how their GI ESO membership influenced their *interests* and *performance* in engineering. All the women in the study accredited an increase in *interest* in engineering to their GI ESOs events and announcements. Specifically, they mentioned feeling more interested in engineering after their GI ESO advertised on campus opportunities (e.g., research and service learning projects) and hosted company presentations. For example, as Elise engaged with the workshops from her GI ESO, her interest in engineering increased because she "...found so many other opportunities. I've become very interested in looking at different pathways that I could go. And [*GI ESO*] had opened that up in a very general sense…for me."

Additionally, GI ESOs have supplied their members with various professional development opportunities like workshops for elevator pitches and resume building, as well as online discourse channels to discuss professional attire. Having access to these channels of new information led members, like Zoey, an electrical engineering major, to gain confidence in their ability to *perform* as engineers.

> "[*GI ESO*] had that like thing about like your elevator pitch and stuff like that. And that was really helpful, for like with the networking event. And I know it's definitely gonna be helpful for like career fairs and stuff in the future… but like in the [*GI ESO*] Slack, they have like a channel for like professional dress… So I was like "what do I wear? What is business casual mean? Like I'm not really sure." So that's really nice… just have people be like "Go to this store. They have good things for this specifically." And I'm like, "Thank you!""

GI ESOs supported women's interest and performance as engineers by providing avenues for their members to engage with different professional development opportunities and resources. The culture of the student-led GI ESOs fostered an environment that embraced access to and transparency of information within the engineering community, which counters the individualistic culture of engineering. As a result, these organizations provided their members with means for developing the interests, knowledge, and skills needed to be successful as engineers.

Finding 3: Women's identities were affirmed when they were automatically recognized as engineers in GI ESOs

In a space dedicated to embracing women in engineering, all four women felt affirmed because they engaged with a space that automatically recognized them as engineers. Forthem, being in an environment that did not question their presence in engineering was refreshing. Zoey explained:

> "It's just like walking into the meetings and like knowing there's people like me there, and like people aren't really like, you know, asking like questions… it's more just like a feeling. Like feeling accepted."

GI ESOs provided an alternative engineering culture that brought a sense of intrinsic acceptance for its members. Additionally, women received bids for recognition and saw representation, subsequently affirming that they do not need to change to fit engineering culture and norms. For Olivia, the mentorship program within her GI ESO provided her with access to upper-division students as role models. Her role models shaped her perspective on what it takes to be an engineer and affirmed that she was on the right path:

> "[*GI ESO*] definitely helped me feel recognized. They just started the mentorship program... So that has been able to like group people up with their majors… It's helped me to meet people that are in my major. So I can kind of also see like what they did to get to the point that they're at. And like, if those steps line up, it's like confirmation that I am going in the right direction. And also having them like as a mentor really helps because they can give me some like guidance on like the next steps. And then having a community like [*GI ESO*] where you feel like you belong like, you know that you have something to fall back on, even if everything else goes wrong."

The mentors within the mentorship program gave insight into their own trajectory and provided advice for Olivia to reach her goals. Olivia also found that conversations with alumni provided her with external recognition as they helped her feel capable of becoming an engineer too. When Olivia was asked if her involvement in GI ESO helped her feel more or less like an engineer, she said:

> "Oh, definitely more…I think that happened because of the exposure to people that are working in the industry. So some of those people like at the Industry Mixer were alumni from [*GI ESO*]...And they're able to kind of like validate a lot of the same feelings that I'm feeling, or that I feel like now, like imposter syndrome, of course, and then feeling

> like all of the dedication that I put in is never going to be enough. They have personally outspoken, and said that they like felt that way too. And now they are secure in their positions. They know that they are capable like, that's not even a question anymore… So kind of having, like all of those negative feelings that undermine how I feel about being an engineer really helps to make me feel like those are kind of things that I'm telling myself and not things that are real. So 100% has helped me to feel like more of an engineer."

The GI ESO created a space for Olivia to feel seen and understood by individuals who had gone through her same path. By observing the success and confidence of the alumni, Olivia found a sense of hope that she could be successful in engineering too. For her, this became a moment that acknowledged her social position and identities without invalidating her ability to be an engineer. The alumni provided her a sense of recognition by acknowledging their shared experiences and motivating her to persist. As a result, the alumni provided external recognition which supported Olivia's engineering identity. The mentorship program and industry mixer were opportunities for Olivia to feel understood and supported in her own vision of success in the present and for the future.

Discussion

One of the goals of this study was to examine the motivations for women's memberships in GI ESOs. The findings of this study suggest that participants sought out GI ESOs to fulfill personal and professional needs. In particular, the women in this study sought out opportunities to engage with other women in engineering and grow as professional engineers. These motivations are consistent with previous literature that identified fulfilling personal interests and finding a sense of community as leading motivations for first-year students to join extracurriculars [23]. Most prevalent in this study were Avery, Zoey, and Olivia's desire to engage with a community of support that mitigated underrepresentation in their classes and engaged like-minded individuals. It is evident that classroom environments are not suited to support women in engineering on their own. An engineering culture that perpetuates masculine social norms forces women to grapple with the perceived incongruence between their identities as a woman and engineer. As such, these women in engineering chose to seek out counter spaces to feel appropriately supported within engineering.

Additionally, GI ESOs were desirable for their accessibility to professional development. For Elise, engaging in opportunities for professional development were her main motivations for joining her GI ESO. Olivia also understood the importance of participating in a nationally recognized organization and attending conferences. GI ESOs are outlets that provide women with tailored gender-responsive information, advice, and resources to succeed in engineering. The women in this study opted into environments that would support them as current students and future professional engineers. GI ESOs allowed these women to engage with a community that centers women's experiences and supports them at all stages of their careers.

This study also aimed to understand how a GI ESO membership affected women's engineering identity development. Although the participants attributed increased interest and performance in engineering to the events and resources provided by their GI ESO, GI ESOs resistance toward

the masculine engineering culture was the most prevalent way women's engineering identity development was supported. When women engage in a culture that does not question their presence in an engineering space, it validates them as engineers [12]. GI ESOs fostered environments that intrinsically recognized women as engineers. As a result, GI ESOs welcomed definitions of an engineer that go beyond the traditional stereotype. For Avery, challenging the traditional image of an engineer and feeling empowered to say "I'm allowed to be my own person in engineering" gave her the confidence to feel like an engineer. Her experiences in her GI ESO reinforced her sense of agency to redefine what it means to be an engineer. Research has supported that identity-centered ESOs innately provide a form of resistance through general membership because the counter space functions to break stereotypes and form a strong sense of community [24]. However, opportunities like role modeling and community outreach provide students with the agency to enact a form of resistance to the dominant engineering culture [24]. Avery's empowerment to author her own definition of an engineer may have been encouraged by her ability to engage in engineering in ways that were meaningful to her through her GI ESO (e.g., volunteering, leadership, advocacy). Additionally, Wofford, Smith & Branch [12] found that possibility models, or possible versions of an enacted role, inspired women in STEM student organizations to join their peers in breaking stereotypes by empowering agency and gender expression. As Avery authored her own definition of an engineer, she enacted her own possibility model. She served as an example of how one can author their own definition of an engineer and still be validated and recognized.

Another form of resistance was depicted in the relationships developed and conversation fostered with GI ESO upper-division students and alumni. Carlone and Johnson [25] emphasized that women's science identities were affirmed when they received external recognition from meaningful others. In this study, GI ESOs were a space where women could intrinsically feel understood and recognized by peers and alumni. For Olivia, knowing that her current pathways were similar to those of successful upper-division students and alumni acknowledged her experiences and reassured her that she could be an engineer too. Overall, GI ESOs provided new environmental feedback that allowed the participants in this study to be intrinsically recognized as engineers in spite of underrepresentation in the classroom and imposter syndrome. As a result, these women could re-envision what it means to be an engineer in ways that align with their values, experiences, and current social position.

Limitations and Future Work

This work-in-progress paper remains with its limitations. Although there was an active effort to recruit other minoritized genders and racial/ethnic groups, only women from well represented racial/ethnic groups in engineering responded to the general interest form. More work is needed to showcase the experiences of other minoritized genders and the outcomes from their GI ESOs membership. This work will continue to be expanded to include eight more participants. The expanded work will address outcomes from women's engagements with GI ESO compared to non-GI ESOs. Additionally, there will be an emphasis on understanding the various negotiations minoritized genders in engineering make about their ESO membership to supplement their needs. Conversations on motivations and barriers for joining GI ESOs will be further explored, specifically targeting gaps in access to, awareness of, and activation of membership within ESOs. Student recommendations for student support services targeting women will be included.

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