Diversity and Inclusion in Engineering: Students' Perceptions of Learning and Engaging with Difference

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Introduction

This project explores how engineering students understand diversity and inclusion within their engineering programs, and how these understandings are shaped by aspects of the environment in which they are situated.

Our study is a component of a broader research project that is examining the seemingly intractable problems of diversity and inclusion that emerge through the converging threads of formation of professional identity and culture of engineering disciplines. In this study we utilized a qualitative analysis of interview data to explore the undergraduate students' perceptions of diversity and inclusion within the School of Electrical and Computer Engineering (ECE) at Purdue University [1]. Our interview draws upon cultural dimensions of engineering disciplines that encourage student to reflect upon and assess diversity and inclusion efforts within ECE [2].

To interrogate students' perceptions of diversity and inclusion, we interviewed 13 current or past undergraduate ECE students. With nearly 40 percent of the undergraduate ECE students identifying as international students, such a significant international population poses tremendous learning opportunities as well as challenges related to diversity and inclusion. Thus, formal efforts within ECE have been made to bridge cultural differences, develop intercultural competencies, and promote inclusion of internationally and domestically diverse ECE members. However, these efforts have met with mixed results. Our analysis of the interview data suggests that these efforts often were not aligned with literature about how to successfully bridge culture differences in that they lacked an explicit focus on students' understandings of diversity and inclusion, nor did they provide opportunities for students to reflect on their personal and educational experiences.

In what follows, we first examine the framing of scholarship about diversity and inclusion within engineering and then draw upon literature using Kolb's experiential learning models to illuminate the transformational nature that reflection plays within establishing ways of viewing complex social problems. With this combination and reimagining of reflection as a pathway to more deeply understanding diversity and inclusion, we describe our research methods, data analysis, and the findings from our qualitative analysis. Finally, we conclude with a discussion of the tensions pertaining to difference and sameness that emerged through our analysis. Namely, formal efforts within ECE required both scaffolding and intentionality. Without proper facilitation, the central role that diversity and inclusion plays within professional formation appeared forced, created more cultural isolation, or students ignored these efforts altogether to complete assignments. We conclude by offering both theoretical and pragmatic implications for engineering curriculum.

Background

Our study is guided by the bodies of research literature within both diversity and inclusion literature within education and Kolb's experiential learning framework [3]. Within education, diversity and inclusion (D&I) efforts have been strategized in several ways. First, efforts and

interactions focused on D&I have been shown to have positive effects on student learning gains such as “personal/social development, practical competence, and general education” (p. 14) [4]. Other research reported that exposure to D&I during students’ first year at college was influential in students’ continual engagement in D&I experiences throughout their time at college [5]. A final way in which D&I is framed involves representation of diverse peoples with the hope that cultural interactions occur [6]. Roska and colleagues challenged universities to consider “support and resources, not only for providing instruction, but also for adopting inclusive pedagogical practices that can help to improve campus racial climates and facilitate academic success of all students” (p. 136). Put differently, there is a vital need to provide faculty, staff, and students with the tools to create classroom and campus environments that are inclusive and promote learning. An emerging body of literature is beginning to re-examine the impact of embedding experiential learning and opportunities to reflect to deepen students’ understandings of complex social problems [7].

Experiential learning occurs as students process their direct experiences of doing. Drawing on Kolb’s [3] experiential learning framework, for learning to be effective and meaningful, students “must be able to reflect on and observe their experiences from many perspectives” (p. 30). Similarly, Mezirow theorized that critical reflection of experiences can have a transformational effect in learners’ lives [8] [9]. Learning, in this vein, becomes a cyclical process in which new meanings and perspectives are gained. There have been calls to integrate reflection within the engineering education curriculum, which implicate reflection as an essential skill for helping to cultivate a strong sense of professional identity, increase critical thinking, and deepen learning throughout the engineering educational experience [10] [11] [12]; however, these calls have not developed rich insights into how to design, embed, and create reflection activities that encourage different perspectives, assumptions, and corresponding actions. Many times, reflection activities focus on design processes or experiences about degree completion. While these are important, they need to include, embed, and normalize essential processes like understanding diversity and inclusion.

Within engineering, there have been calls for integrating diversity and inclusion as a key part of the undergraduate professional formation process beyond recruitment toward retooling engineering curricula to incorporate socio-technical coursework and socially relevant design processes; however, there are still a significant gap within engineering where diversity and inclusion can be further integrated into engineering cultures and curricula. [13]. To fill one aspect of this gap, our study focused on illuminating students’ experiences, and was guided by a specific research question: How are students’ understandings of diversity, inclusion, and professional formation shaped by cross-cultural interactions in the School of Electrical and Computer Engineering at Purdue University?

Methods

This study is part of a larger three-year National Science Foundation study examining the intractable problems at the convergence of professional identity, formation processes, diversity and inclusion, and engineering cultures. Our study examines electrical and computer engineering (ECE) students’ understandings of and experiences with diversity and inclusion experiences at Purdue University.

Participants

Data were collected via in-depth, semi-structured interviews in-person throughout the 2016-2017 school year. Participants initially participated in an online survey about their experiences within the School of ECE at Purdue. Those that indicated an interest in a follow-up interview on the survey were contacted. We interviewed 13 current or past students from the School of ECE. The School of ECE represents 19.6 percentage of the overall College of Engineering, with nearly 40 percent the students within ECE coming from many international locations including China, India, and Korea. Our sample includes ten students from electrical engineering (EE, 77%), and three students from computer engineering (CompE, 23%). Demographically, our sample represented a variety of undergraduate class classifications. Seven of our participants were seniors (54%), three were juniors (23%), one was a sophomore (8%), and we interviewed two recent alumni of the program (15%). Our sample also represented a near gender parity; eight of the participants identified as male (54%), and five identified as female (38%). Finally, our sample included 12 interviews from domestic students and alumni, and only one of our interviews was an international student from India. While our interview study did not collect demographic data outside of gender, major, and grade classification, demographic information about country of origin and hometowns emerged through self-disclosure in the interview process. Interviews lasted about an hour and were transcribed verbatim, cleaned, and any identifiable information was removed to protect participant identity. Additionally, participants were given pseudonyms to protect participant identities. All research was reviewed and approved by our institutional review board with oversight of human subjects research.

Data Analysis

A constructivist paradigm was utilized to analyze the 13 transcribed interviews, which acknowledges researchers' subjectivity within the analytic process. The data were analyzed using a constant-comparative method [14]. The interview transcripts were partitioned by major sections of the interview protocol based on Godrey's cultural dimensions on engineering education [2]. For example, all questions pertaining to students' understanding of diversity and inclusion were included as one file. The files were analyzed using Atlas.Ti software, which created code reports of our primary and secondary coding rounds. Initial codes were aimed at paraphrasing students' responses in vivo. There was little to no interpretation at this step within the process, and coding emerged inductively in that we had no existing framework to generate our coding schema. Our secondary coding began by grouping initial codes together based on conceptually similar "clusters."

To do this, we identified codes and broader categories that emerged from the interview data. The aim was to unpack the various ideas and related meanings that were revealed throughout the interviews. For instance, an idea related to survival in ECE was identified through re-reading interview texts—e.g., "Two more years, and then I can finally go into industry. I just got to survive two more years" or "in order to survive the major, you have to have at least some study group." This process was repeated, and the clusters were further refined to identify the broader themes that emerged with our data.

Themes were created based on recurrence of experiences, phrases, and conceptual meanings. They were reported in narrative form to give voice to our participants' experiences in context.

Finally, to ensure validity of the thematic findings, the themes were also discussed with the research team to verify and refine our claims.

Results

Within ECE, students' experiences pertaining to diversity and inclusion (D&I) occur within both formal and informal settings. Although students would discuss diversity and inclusion in a variety of ways (including gender, race, and perspective), students defined and articulated their experiences in ECE primarily through a cultural lens. In this case, culture means national differences and similarities that become prominent during interactions and other work in engineering. As mentioned, international students represent nearly 40 percent of the total undergraduate population within the School of ECE at Purdue, and references were made throughout the interviews about the large international population in the undergraduate degree programs. These references were domestic students discussing their experiences, interactions, and strategies in working with diverse groups of people within ECE.

The analysis uncovered consistent explicit and implicit references to programs and teaching strategies used by the ECE School aimed at improving both representation and belongingness, or D&I. Although these attempts were mentioned at recurring points throughout the interviews, underlying contradictions emerged regarding the school's intention, its goals, and the efficacy of D&I practices. In other words, there were often inconsistencies between intent and impact of the ECE School's efforts to incorporate D&I within the curriculum. These contradictions often negate but also define each other in their existence within the ECE School. In what follows, we discuss two themes, or recurring semantic patterns, that have contradictions at their core. These two themes pertain to students' understanding of D&I within the ECE school: (1) diversity and inclusion highlighted through cultural interactions while (2) diversity and inclusion minimized to succeed within the ECE curriculum. Whereas the first theme draws upon and acknowledges students' incorporation of D&I vis-à-vis cultural interactions, the second theme encourages students to minimize these differences and treat everyone the same.

Diversity and Inclusion Highlighted through Cultural Interactions

Cultural interactions occurred in a variety of programming efforts throughout ECE: some students participated in formal study abroad programs, some gained cultural understanding in international service-learning programs, and others worked with one another to complete homework assignments in their ECE courses. Perhaps more important, though, a central site for many cultural interactions were lab spaces. Formally, the ECE curriculum often paired laboratory courses with lectures, which offered students an opportunity to practice and apply many course concepts and theories. Within ECE, lab courses are coordinated by faculty, but are led by teaching assistants (TAs) within the ECE graduate program. Informally, though, labs spaces are used in a variety of ways: completing assignments, projects within the courses, and social support. A common practice shared by students was to "go to lab and then see who [they] know who's there and then…sit next to them and…start working." Labs are also a space that facilitate interactions between students and are noted for being a space that students spend a large amount of time in weekly.

When considering what the labs offered to students, they often noted that labs were crucial sites

of learning in two ways. First, despite some criticism on the outdated concepts within lecture and technologies within the labs, they provided an important experiential component to apply theoretical concepts from lecture courses. Second, labs offered a space for social interactions for the students. Charlotte, a junior in CompE, described this in the following way: “it's always in lab that we all talk and get on a certain GroupMe if we need help with a certain class or whatever.” Other students noted that other students in the labs are “pretty helpful to each other.” Moreover, labs emerged as a space in which many experiences pertaining to D&I were illuminated in two main ways. First, they offered a key way through which the ECE students often interacted with one another socially. Second, labs enabled participants to interact with one another to solve homework and course-related issues, but also provided a space that fostered cultural interactions.

For most labs, students work in pairs. Pairing strategies often varied based on class and instructor; however, in EE, there are no required project (design) courses until Senior Design. There are more opportunities for design and project-based learning in CompE. Lab partnering strategies were a recurring experience shared throughout the interviews. Students were required to work with different groups of people in the lab setting. Carlton, a junior in EE described this instance in the following way:

> A lot of people didn't like this, and personally this didn't apply to me, but my friend, he took a course last semester [omitted], and they did this program where they all got assigned to their lab partner was assigned from a different culture, or something like that. I don't know if they still do that because I'm taking the same course and we just pick our lab partner. But basically your lab partner was from a different region than you. So, his lab partner was from, I don't know, Taiwan or something. Honestly, I think that's a good program to bring back.

Speaking hypothetically, Carlton argued that the lab partnering strategies created opportunities to learn how to work with students from different cultures. Although students like Carlton contended that the pairings were a positive experience that fostered learning, others offered a more critical perspective. Some questioned why this occurred while others did not directly acknowledge the importance of cross-cultural communication that occurred with these partnering strategies. Eamon, one of the lab coordinators and an alumnus of the ECE school, explained that the professor overseeing labs mandated intercultural pairings as an attempt to increase cultural communication and interactions; however, oftentimes, these pairings were poorly executed by the instructional staff, who were given little instruction and support from the coordinating faculty member on how to best facilitate the pairing activity:

> I was a TA for a lab course when I was just a student for a long time, and almost always the teams that joined not to single anything out but say an Indian and an American, the communication barrier there really slowed them down or really made it struggling to learn the material they're supposed to be learning.

To Eamon, these pairings within lab courses had an adverse impact. Instead of trying to learn to work with diverse partners, the pairings often increased conflict and miscommunication. At times, some of the participants expressed their frustration regarding lab partners. These frustrations were recollections of negative experiences of lab partners from different cultures and

the inability to effectively communicate. Carlton described one way that his teaching assistant tried to mitigate the language barrier issue: “they did make a ‘No Chinese; rule in the lab itself. No Chinese speaking.” This rule was also an attempt at bridging language gaps. Claire, a senior in EE, recalled instances where international students would try and take advantage of language barriers to get out of work:

> Knowing how to work well with certain people and knowing that they're not like you. It's just accepting that fact, in the beginning, is a good thing to do, but then at the same time, it's good to know when not to accept certain things as just cultural differences because I know some people do take advantage of that sometimes where you still have to treat everyone like they're a team member. They still have to contribute a certain amount of work to the team, and if they're not doing that, then that's not a cultural thing that you learn over a year. It's like, okay, by your third year, you should know to contribute this amount of work to your team.

In a program that students described as rigorous, the added pressure of trying to mitigate language barriers added another layer of stress to complete assignments and labs.

Similarly, the contradictory nature of lab pairings was also echoed by some faculty and staff. A commonly held belief focused on the foregrounding of technical skills and concepts, although acknowledging a need to foster cross-cultural interactions. Eamon described this contradiction, “[As] the TA, that's sort of like not really my job to make sure that you can interact culturally well. That's not the point of university, or at least kind of my opinion. At the same time, you would like to encourage it if they want to.” These pedagogical practices often lacked various forms of institutional support to engage with and reflect on the role D&I play within professional formation. Moreover, this instance from Eamon highlights a critical aspect missing from the curriculum: opportunities to facilitate and reflect on the social experiences within the labs as an additional aspect of professional formation. According to Eamon, despite being important for professional success, the university should not “force” diversity and inclusion issues as its university mission is defined and focused on learning.

Students noted, though, that there were times when they were isolated from one another. Many students described cultural divides that existed—particularly within lab spaces regarding international students. Almost all of the domestic students acknowledged that international students often self-selected into cultural cliques within the labs spaces. Some students, however, others embraced their multicultural environment, and empathized with these groups. For instance, Claire described her senior design lab in the following way:

> …You'll hear Mandarin, and there's Indian people over in this corner, and then there's white people over in this corner. There's definitely lines that you notice, but they're going to be natural because I studied abroad and I understand that completely…[They’re] talking because they need to communicate in their own way, and maybe they don't know how to say that in a way that we understand. It doesn't mean that it's not inclusion. I think a lot of other people have difficulties understanding that.

While these observations were commonplace within ECE, students who had outside experiences (e.g., study abroad, coming from a diverse high school, internship experiences) often understood

and empathized with their international student classmates. Several students revealed experiences where they felt like an outsider in other cultures and tried to understand international students' experiences. Despite these acknowledgements and attempts at empathizing with these students, there were rarely recollections of experiences that domestic students attempted to bridge the cultural groups within lab. Several students noted that there is a natural curiosity and openness to working with others within the early years of the engineering program. However, as they matriculated through the ECE program, they began sticking more to groups and students that they were familiar with or worked well with previously. To that end, the only times that students attempted to bridge cultural groups were within the context of ECE coursework.

Diversity and Inclusion Minimized to Succeed within the ECE Curriculum

When communication with their lab partners occurred, students tried to minimize cultural differences to complete the assignments. This minimization of difference and focus on goals may be due to the heavy workload of the ECE undergraduate curriculum. Students often stressed the rigor that exists within the ECE curriculum. The focus on cultural interactions within lab courses added an additional layer of complexity, and these moments were minimized to complete assignments and get the work done. In other words, the work itself and the urgency of task completion overrode efforts to engage in more inclusionary interactions and team work. In referring to the ECE program, students characterized their experience in terms of "survival." One student called himself and his peers "veterans of ECE," while others described the student culture as "stressed." Christopher, a sophomore in CompE, recalled his strategy for coping with the rigor of ECE:

> Because it's hard, but trying to avoid burn out the only way to do is to follow the plan of study. What's better to do is learn when you are going to burn out and pick a time when you can afford it. If you can do it before the finals, do it right before the finals, because you don't want to do it the week of the exams, because you want to study at that time. Because I planned my burnouts. Like last semester, burnt out right at the beginning of dead week, at the beginning of finals week.

These feelings of stress, coping, and urgency were associated with perceptions about a heavy workload and the timing of assignments. As such there were material and temporal factors that prevented students' willingness to participate in inclusionary activities. Moreover, the students' understandings of the ECE culture was rooted in struggle. They needed to struggle to get the work done; they needed to be strategic about interactions so that they could meet deadlines and project goals; they could not add more to their schedules or them might not succeed in their courses and engineering program. Additionally, students also described feeling as if they should always be working, or "in lab" completing work. To that end, a lack of time to engage in non-ECE-related programs and tasks was a challenge as it "requires people to take time out of their schedule." These struggles with focusing on their goals, balancing workload, and attending to outside programs also was manifested in additional formal programming from ECE on diversity and inclusion.

When asked about formal programming that occurs outside of the classroom and was related to school and college diversity and inclusion efforts, students offered mixed experiences and responses. A repeated example that many shared were emails from one office within ECE about

weekly events. This formal programming, though, was characterized as “international student events.” Clint expressed a skepticism regarding these programs’ effectiveness in the following interview interaction:

> Clint: I have seen an email or two about a diversity event, but it's all from one guy and it's not even from the department, it's from one guy that's spearheading it, from what I can tell.
>
> [INTERVIEWER]: Like a faculty or like a staff member?
>
> Clint: Yeah. He's of Asian descent, so I think he might just find it important in himself and is taking the initiative. In terms of the department, no formal event.

This uncertainty between the ECE school’s formal support and value of diversity and inclusion programming was also met with mixed evaluation from the students. Most students shared that the high number of international students, the presence of consistent assessments and surveys, and lab interactions was proof of institutional support; however, a recurring element throughout the interviews that mitigated against effectiveness was the heavy workload within ECE. While students acknowledged the presence of some programming, the reality of heavy workloads, time spent in labs, and survival in the undergraduate programs in ECE often meant that there was limited time to invest in outside activities.

This sentiment was also echoed by student’s perception of the value of nontechnical courses during their collegiate experience. While all ECE students are required to take 24 credit hours of general education courses, these often include requirements from the university’s core curriculum that all students across the university take. Additional electives within both programs are minimal and reduce students’ opportunities to enroll in multidisciplinary courses. In other words, there were few opportunities for students to enroll in non-technical courses throughout their college career. Outside of the lab pairing and the high international student population, students often recalled diversity-related lectures throughout their first-year engineering program; however, beyond those instances, explicit support was absent. Clint described this presence of lectures and absence of follow-up activities and support in the following way:

> I know it's not required but if you could integrate extra credit into educational programs or extra credit for certain classes, because I know they have Intro to LGBTQ. They have cultural classes here that [UNIVERSITY] actually does, but ECE doesn't push it. So, if a class could provide bonus credit for going to them [pause] Actually, they do that. Who am I kidding? In [first-year engineering course], you do that […] You actually do it in [first-year engineering course]. I definitely forgot about that and therein lies the problem. We did it in freshman year. The end.

Students expressed a desire to learn about diversity and inclusion outside of engineering, but their inability to enroll in courses pertaining to diversity or attend programming often meant that their learning came from external or professional experiences. Some came from diverse backgrounds (e.g., diversity in city living and experiences such as students’ residence or visits to Detroit, MI or Las Vegas, NV), others participated in study abroad programs where they have similar experiences to the international students, and still others were resident assistants within

the university's residential life program that stressed the importance of diversity and practice of inclusion as part of their jobs. These experiences offered an important lens in shaping the students' understanding of diversity and inclusion. Additionally, some students intimated that they also noticed that their outside coursework was a primary site for learning about diversity and inclusion—not within the ECE coursework explicitly. Others expressed a desire for more flexibility within their coursework to take classes outside of ECE that would help enrich their experiences.

Discussion

Our study examines the contradictions that exist for students as they reflect on their own experiences pertaining to diversity and inclusion (D&I) within the School of Electrical and Computer Engineering (ECE) at Purdue University. Our findings from the analysis of interview data suggest that students' experiences pertaining to diversity and inclusion programming were often contradictory. The difficulty and rigor of the ECE undergraduate programs both facilitated interactions between students (these were often framed as a need for survival, which helped to develop a common identity within ECE) and became a barrier (as students recalled experiences working with and communicating across cultures that added complexity and difficulty to finish projects, labs, and homework). Formal efforts within ECE (including lab partnering experiments) required scaffolding and additional time to be effective; without these necessary components, these formal efforts seemed forced, they reinforced negative stereotypes, or are ignored as the students do not have the time to truly take advantage of diverse team compositions.

Although some engineering education literature has examined and stressed the importance of integrating diversity and inclusion within engineering cultures and curricula, absent from this literature is the necessary role of reflection to increase cultural competencies. As Eamon described in his interview, TAs were not given adequate training within the labs, nor do they assume that their role is to foster students' understandings related to diversity and inclusion. Moreover, students rarely described moments outside of the first-year engineering program that centered diversity and inclusion within engineering education. In describing their interactions with others, students described experiences such as internships and study abroad as pivotal in understanding and practicing diversity and inclusion within engineering. Scholarship examining study abroad programs on college campuses often center reflection activities as an important part of increasing students' understanding of cultural competence [15] [16] [17]. Vande Berg and colleagues described the cumulative effect on students' cultural competency when faculty are trained to engage their students in intentional mentoring about their study abroad experiences [18]. These findings were echoed by Jackson; who surmised that education is most effective in research-driven, student-centered environments that allow for reflection and scaffolding classroom activities that deepen students' intercultural competence [19]. While there have been efforts within engineering to promote D&I, most often, the central role in providing both students and instructors with tools to engage in reflection about their experiences is overlooked.

Our study addresses this gap in two key ways. First, it reinforces the notion that learning about and experiencing D&I within engineering occurs most meaningfully in sustained and consistent interactions with others; however, these interactions are most meaningful when paired with intentional reflective activities. As shown through our analysis of interview data, students shared moments of interactions in labs; however, their lack of ability to reflect on these experiences

stymied potential gains in intercultural competence. Hammer [20] argued, “immersion in the college experience—even at an institution with a culturally diverse student body—does not result in increased intercultural capability (p. 126). Within ECE, students’ creation of the meanings associated with their experiences often were met with frustration and uncertainty. These meanings demonstrate a clear gap between the intention and impact of interactions. As research has called for and demonstrated, reflection is an important skill for increasing learning and understanding for complex concepts and experiences—including cultural experiences. In light of these findings strategies for increasing intercultural competence need to include providing students with opportunities to reflect on the importance of these interactions. Moreover, faculty and staff members need to be provided with resources and training through which to best support student reflection in and outside of the classroom.

Secondly, the addition of reflection to cultural interactions reaffirms the need to center diversity and inclusionary experiences as a core component linking engineering technical education with the professional formation. Instead of professors and lab instructors arguing that their job and responsibility is to solely teach “the technical,” the embeddedness of cultural reflection throughout the curriculum becomes an important part of increasing students’ cultural competence. In considering the importance of professional formation within ECE, experiential learning is an important way that students learn about their professional field. This includes team experiences, hands-on learning within classes and labs, and the informal peer-to-peer interactions that occur throughout their undergraduate experience. It is the convergence of experiential learning and informal interactions that students learn to apply the technical knowledge, create a common language to communication across cultures, and deepen their understanding of what it means to be an Electrical and Computer Engineer.

To make experiential learning most effective, increasing intentionality and integration within the ECE curriculum in needed. Intentionality within the classroom and the curriculum requires faculty to both incorporate high impact learning activities within the classrooms, and continually assess learning outcomes [21]. For example, service learning opportunities that bridge the technical engineering skillset learned in the classroom within a real-world context offer students an opportunity to integrate socio-technical experiences. Additionally, these intentional activities provide resources (i.e. training, support, or financial) to support and create space for opportunities. However, this means making space within both the curriculum and the classroom to reflect on students’ experiences. Integration requires both faculty and students to examine their own experiences and engage in the dual cognitive and learning processes of sensebreaking and sensemaking. In other words, both faculty and students engage in sensemaking when they retroactively assign meaning to their experience; sensebreaking occurs as these meanings challenge their existing cognitive understanding of their experience.

Reflection allows students to learn from their experiences. Ignoring critical reflection can reinforce cultural stereotypes, create hesitation or reluctance to work with others who are different, and/or prevent students from building the skills necessary to do engineering well. Additionally, intentional learning experiences, integration of personal and social learning, and reflection are important to consider for efforts to broaden diversity and inclusionary perspectives within engineering. As mentioned throughout the interviews and analysis, students within ECE often grounded their diversity and inclusion experiences through their interactions with the school’s large, international population. These day-to-day experiences, when coupled with

reflection, offer a unique pathway into expanding how students come to understand notions of diversity and inclusion. This could include providing an intersectional approach that considers the convergence of race, gender, and ethnicity as it pertains to interacting with others, as well as re-conceptualizing engineering identities.

Limitation and Future Scope

Our study is limited in two main ways. First, it lacks international students' experiences and voices. The sample included only one international student. As such, the students' responses in our study perceive diversity and inclusion in response to a heavy international population but lacked a richer portrait of international students' complementary experiences at the university. Next, although the specific cultural lens that we adopted in this paper addresses diversity and inclusion through the interactions between international and domestic students, the women in our study also shared clear experiences that would benefit from future analysis. In other words, adopting a broader definition of interactions would give voice to their experiences within ECE.

Throughout our paper, we have endeavored to showcase the often-contradictory nature of students' experiences with diversity and inclusion. In doing so, our interview study exposed gaps in how students' understanding of how and why diversity and inclusion interactions occur within ECE. Often framed within intercultural terms, students' interactions with a diverse student body are often minimized because of the program's lack of resources and ability to facilitate reflection of these experiences. Experiential learning occurs in both formal and informal settings in ECE; however, the findings from our study concerning the need to pair experiences with reflection can serve as a reminder for educators who adopt, promote, and implement diversity and inclusionary practices within engineering education.

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