

What's Next? From Analysis to Action

Abstract

This paper describes how data-driven examination of barriers to successful completion of undergraduate engineering degrees amongst female-identifying and under-represented minority (URM) students at Seattle University has shaped the development of new policies and programs within the College of Science and Engineering to better support students from underrepresented or marginalized groups. This study is a continuation of a project in which we first analyzed graduation data to extract characteristics that differentiate students who do or do not successfully complete degrees within engineering. We followed the data analysis with a survey to better understand the experiences of students from underrepresented or marginalized groups.

In Section 1 of this paper, we introduce Seattle University and our previous work. Following, in Section 2, we review relevant literature. In Section 3, we first present the results of focus groups conducted with students from a variety of backgrounds and experiences such as transfer students, female-identifying students, URM women, URM men, international students, and students who have either switched out of an engineering program or have a GPA that put them at risk to not complete an engineering degree. The focus groups confirmed the results of the survey: students from marginalized groups experience bias and microaggressions from other students and faculty.

Combining past analysis and the new focus group results, we identified two primary trends that our programs will be targeting. First, that students from underrepresented and marginalized groups are more likely to seek out opportunities for community within their engineering and computer science programs. Second, that students from these populations reported an overall culture within the engineering and computer science programs that can feel unwelcoming and, at times, hostile.

Section 4 of this paper describes new programs that have been introduced in response to these two themes. To address the need to better introduce students to their STEM community, community building events have been developed for new student summer orientation, along with a summer online community for new students in the College of Science and Engineering.

To address the culture within the college and its departments, training workshops on issues of diversity, equity, and inclusivity have been introduced for both students and faculty/staff. We have hired a team of student Diversity, Equity, and Inclusion (DEI) ambassadors who are developing programs for students, faculty, and staff, beginning with regular college-wide town hall meetings for students, faculty, and staff to have open and informal conversations about students' experiences. We have established a faculty & staff reading group on diversity, equity, and inclusion, with discussions emphasizing how the readings can be turned into actionable changes in how we interact with our students and with one another. We have also developed a model syllabus statement on diversity, equity, and inclusion that has been adopted in several departments, and is currently being discussed for college-wide adoption as a required part of all course syllabi.

Feedback regarding these initiatives has, to this point, been anecdotal, but positive. We describe the aspects that have been particularly noted by students, faculty, and staff to have been helpful. We conclude the paper with a reflection on how we can improve our community building events and the online community and describe our future support services for underrepresented students.

1. Introduction

Seattle University is a small, private, religiously-affiliated and mission-driven institution located in Seattle. Our urban campus is home to eight colleges and schools. One of them is the College of Science and Engineering (CSE) which hosts eight departments. CSE is in the midst of a multi-year project to develop programs and policies to better support students from underrepresented populations in engineering and computer science.

Previous work examined data on undergraduate students who were enrolled in the four engineering majors in the College of Science and Engineering for any part of their time at Seattle University. Our analysis showed that female-identifying students appeared to primarily face barriers to access as they were less likely to pursue engineering degrees, but those who did showed comparable rates of completing those degrees to their male-identifying peers. In contrast, URM-identifying students appeared to face barriers to both access and success. They were also less likely to complete those degrees if they did start them than non-URM students [1].

To gain greater insights into the experiences of engineering and computer science (CS) students in our college, we conducted a student survey. The survey results showed that a significant number of our students experience bias in their time at Seattle University, from both other students and from faculty and staff. Students from underrepresented or marginalized groups were more likely to report having observed incidences of bias and reported feeling less confident about their ability to complete their degree when they started. They were more likely to report that they do not feel able to fully meet the demands of their academic programs. They also reported higher levels of stress, and less satisfaction with their academic work. In addition, we found that underrepresented students engage with academic life in different ways than their peers: they are more likely to be involved in social events and department activities, but less likely to participate in events aimed at individual accomplishment such as hack-a-thons and maker spaces. Furthermore, they are more likely to seek out help such as tutoring, disability services, outside mentors, and talking with friends and family about difficulties with school. They also emphasized community and social aspects of the academic life as being influential in their decisions to continue to pursue their degrees [2].

To further understand the experience of engineering and CS students in our college, we followed the survey with focus groups which are described in detail in Section 3. To provide greater support for students from marginalized groups, we have implemented several initiatives such as workshops on microaggressions and bystander intervention for faculty, staff, and students; community building events during Summer Orientation; summer online community for new students; and a diversity reading group for faculty and staff. We have also created a group of Diversity, Equity, and Inclusion Student Ambassadors and developed a sample statement on

inclusivity for faculty to include in their syllabi. All of these programs are detailed in the subsequent sections of this paper.

2. Literature Review

Despite nationwide efforts over the last 30 years, the participation of women and marginalized students in engineering and CS has increased only slightly [3]. Scholarship on underrepresented minority students in STEM gives us insights into their experiences, challenges they face, and potential ways of increasing their representation and improving their persistence.

Following a review of literature that explores challenges that women experience when pursuing career in the sciences, White and Massiha discuss several general retention theories, propose a conceptual framework for persistence, and raise a number of possible research questions [4]. Blackburn performs a thematic review of the literature regarding status of women in STEM from 2007 to 2017 including journals, trade magazines, theses, and dissertations [5]. The paper focuses on recruitment, retention, barriers to access and success, and faculty issues, as well as stereotypes, biases, campus culture, classroom experiences, identity, and sense of belonging. The author discusses areas for further research and gives recommendation for support services and initiatives that can potentially improve the experience of women in engineering. In [6], May and Chubin analyze literature about factors contributing to the success of minority students in engineering. They correlate their success to pre-college preparation, recruitment programs, admission policies, financial assistance, and academic intervention programs. The authors suggest that the underrepresentation of minority students can be solved given appropriate resources and a collective national will.

Estrada et al. conduct longitudinal study on how quality mentorship and research experience contribute to the integration of underrepresented minority students into the STEM academic community [7]. They use the Kelman's tripartite integration model of social influence (TIMSI) with three key variables of science efficacy, identity, and values as a predictor of URM persistence in STEM. They demonstrate that mentorship and research experience were positively related to students' efficacy, identity, and values. They also show that past experiences of efficacy may not be sufficient for longer-term persistence but science identity and values correlate to STEM persistence of up to 4 years. In [8], Pawley et al. study the dominant themes and patterns in the structure of the research published in the Journal of Engineering Education (JEE). The authors found that articles they analyzed are mostly quantitative studies. The papers did refer to theories of gender but these theories were not used later in the research presented in the articles. The authors recommend that there is a need for greater diversity of theories and designs in research on gender and engineering and they suggest additional topics of research in these areas.

It is essential to study the experience of intersectional groups. Foor et al., for example, focus on a story of a single engineering student who belongs to three marginalized groups – the student is female, multi-minority, and from a socio-economically disadvantaged background [9]. They highlight her perseverance through challenges such as weak high school preparation, lack of familiarity with engineering culture, and a feeling of being an outsider in engineering. The

authors point out that it is important to use narrative as a research methodology because relying only on large samples and statistically significant quantitative results can itself lead to marginalization of some experiences. Goodwin et al. use an intersectional lens to explore the attitudes of belongingness, motivation and STEM identities with a focus on women of color in chemical engineering [10]. They found that women were less likely to feel a sense of belonging in chemical engineering. Both majority and minority women displayed low levels of confidence in their success as engineering students. Women also showed lower levels of expectations for success than their peers. The authors also found that women identified themselves as engineers in the future but not when they were students. They were also less confident in understanding engineering and performing well in their classes while achieving grades that were above their major peers.

Ong et al. analyze research about the experience of women of color while studying engineering [11] in order to find out what influences their experience, participation, and advancement. The authors focus on retention, persistence, and achievement. They study stereotypes, biases, campus culture, classroom experiences, identity, and sense of belonging. They identify challenges and strategies for persistence and give recommendations on how to create interventions that support women of color. The authors call on institutions to generate a sense of belonging and provide social and structural support that increase self-efficacy. While studying experiences of women of color engineering students, Tate and Linn [12] found that students formulate multiple identities to help them persist in engineering studies. Three identities were most prevalent: academic, social, and intellectual. Academic identity is associated with being a student and success is represented through grades. Social identity is related to how a person sees themselves in society. Intellectual identity is associated with the desire to become an engineer. The authors discuss implications of these identities to academic and social support systems.

Significant bodies of research have focused on the masculine culture of engineering and its effects on female-identifying students. Faulkner explores the dichotomous styles of thought present in engineering and their perceived hierarchy and relationship to gender [13]. The two dualisms explored are technical/social and abstract/concrete. The author suggests that the technical/social distinction of engineering maps to masculine instrumentalism and feminine expressiveness. The relationship of abstract/concrete dualism of engineering to gender is more complex. It can be seen as the dualism of the masculine emotional detachment and the theoretical approach to problem solving and the female emotional connectiveness and concrete, empirical, and holistic problem solving. Godfrey studies the culture in a School of Engineering at a large university in New Zealand [14]. The author focused on how welcoming the culture was to female students. It was found that all engineering departments displayed strong culture of masculinity with Chemical and Materials Engineering and Engineering Science being the most friendly to women. Male et al. studied the students' experiences of gendered cultures in the workplace during internships and other industry placements [15]. Female students experienced interactions consistent with gendered workplaces such as actions that demeaned women or drew attention to their gender, requests based on gender, imposed gendered expectations, and marginalization of stereotypically feminine interests. The researchers found that student responses to the gendered culture of the workplace included blocking; leaving the workplace; tolerating and adapting;

justifying the interactions they experienced; denying the gendered culture; and reporting. The students also reported perceived poor fit between work and life, rough culture on site, difficulty asking for support, and lack of respect from tradespeople or technicians. The paper offers recommendations for both faculty and employers on how they can work together to improve the gender inclusivity of engineering workplaces.

Many scholars of engineering education study how students develop their engineering identities. In [16], the authors investigate gender differences in the development of engineering identities and in how their appreciation, confidence, and commitment to engineering change over time. Almost 900 students at four different institutions were part of this study. The authors conclude that there is little difference in the degree of identification as engineers between men and women but men tend to prioritize “building” as a design activity more than women. Men are also more confident than women in their math and science skills and women are perceived to be less competent than men. The authors acknowledge that the interaction of gender and the development of engineering identity is complex and multilayered and that it requires understanding of how women and men develop understanding of what engineering identity is. Jorgenson examines the construction of engineering identities among female students [17] and finds that many of the participants of the study were reluctant to acknowledge that gender relations have any consequences in their career. Women who were interviewed for this study strongly identified themselves with their career but acknowledged the male environment they worked in was challenging. Many mentioned having to prove themselves before they were taken seriously as professionals. However, they strongly associated themselves with the notion of engineering as a gender-neutral field and opposed the need for women-focused groups such as the Society of Women Engineers. They still described the challenges that they had as working mothers in comparison to male engineers but refused to acknowledge that these were related to gender discrimination. Finally, the study participants resisted being positioned as homogenous members of a subordinated group and insisted that there are multiple identities within the research category of a female engineer. The author suggested that the existence of research on women engineers was perceived by the study participants as a challenge to their professional legitimacy.

Stereotype threat is another reason why marginalized groups struggle to persist in engineering. In [18], Logel et al. explore social identity threat and specifically stereotype threat. They show that working in a sexist environment undermines women’s ability to succeed in the field by leading them to underperform. In their studies, women who interacted with sexist men performed worse on an engineering test than women who interacted with nonsexist men. The authors also found that the underperformance did not extend to an English test which is a field in which women are not negatively stereotyped. In [19], the authors investigate if giving women positive information about other women’s achievement would increase their scores on mathematics tests. They conclude that they are some promising methods to improve the performance of stereotyped groups on standardized tests.

Factors that contribute to underrepresented students’ persistence in engineering include mentoring, role models, and supportive learning and social community. However, one has to be

very intentional with the design of supportive services. McLoughlin introduced the concept of “spotlighting” which refers to singling out of women by gender in ways that make them uncomfortable [20]. Their work focuses on one type of spotlighting where women are spotlighted with the intention to help them, for example, through women in engineering (WIE) programs. In the study presented by McLoughlin, students reported that participation in these programs added to their gender-bias difficulties because it marks them as different than male students and in need of help and therefore, less capable. The author recommends changes to WIE programs: offer their benefits to all students or those who are selected based on academics, not demographic criteria or shift the emphasis of WIE programs to pre-emption of unprofessional behavior (for example, include activities on how to conduct yourself in engineering).

In [21], Doerschuk describes a program developed for female computer science students. The program involves multi-faceted mentoring, community building activities, and a research program with significant educational components (work under the mentorship of a female faculty, conference presentation, participation in recruitment and outreach). Reed Rhoads et al. interview students in an engineering program that achieved gender parity [22]. Their studies indicate that the participants valued the cohesive community in the department that provided them emotional support. Students also appreciated the connections that they have made with faculty who are particularly supportive. In [23], Caso et al. describe using learning communities as the underlying concept in first-year and sophomore curricula. The communities implemented such pedagogies as teamwork, active learning, involvement in industry, course cohort, cooperation with industry, technology-enhanced classrooms, and peer teachers. Garrett-Ruffin and Martsolf describe the Science Learning Community (SLC) designed to help minority and first-generation college students succeed in biology, nursing, and chemistry majors [24]. Students who participated in the community had higher retention rates than a control group and expressed high satisfaction rates with the SLC.

Role models are important in supporting marginalized students. In [25], Bauer shows that having a female professor instills higher levels of self confidence in female engineering students. In [26], Downing et al. test the hypothesis that guides help women students pursue the sciences. They define three types of guides: mentors (who provide psychosocial support), sponsors (who provide instrumental support), and role models (who act as examples). Over 90% of interviewed women had a guide, and mentors were the most influential on their pursuit of science. Women typically had more female than male guides.

3. Focus Groups

To better understand the barriers to successful completion of undergraduate engineering degrees amongst female-identifying and URM students in the College of Science and Engineering (CSE) at Seattle University, an external research consultant conducted focus groups and interviews.

In an earlier research, the CSE faculty at Seattle University identified barriers to student degree completion using survey data gathered from undergraduate students who were enrolled in the four engineering majors for any part of their time at Seattle University.

They identified the following barriers to students' successfully completing degrees in these programs, including

- the impacts of transfer versus first-time-in-college status,
- students' prior mathematics and science background, and
- pressures related to differing levels of unmet financial need.

A key research question for this study was therefore:

- RQ1: How are transfer, students' prior mathematics and science background, and pressures related to financial need acting as barriers to success?

Additionally, the study sought to qualitatively investigate the following research questions.

- RQ2: How are students identifying as members of under-represented minority groups experiencing their engineering and computer science programs? What barriers to success do they describe?
- RQ3: How are students identifying as female experiencing their engineering and computer science programs? What barriers to success do they describe?
- RQ4: How are international students experiencing their engineering and computer science programs? What barriers to success do they describe?

3.1 Methods

The goal for this study was to better understand the experience of under-represented minority, female, and international engineering and CS students at Seattle University. Gathering data through interviews and focus groups best matched this goal because it allowed students to speak directly about their experiences. Focus groups were the primary method of data gathering. This was chosen as a methodology in order to both gain detailed information about students' experience in CSE, and also to create a dialogue between participants [27] [28]. Talking to students directly also allowed to privilege student voice [29] [30], and this study includes direct quotations from students wherever possible.

3.2 Participant Recruitment & Sampling

In order to best explore this topic, we recruited a sample of participants through purposive sampling [31] [32] [33] [34] focusing on recruiting members of specific groups instead of randomly sampling students. In order to answer the questions that we had set forth, we needed a sample from the College of Science and Engineering that included female-identifying students, students from under-represented minority groups, international students, transfer students, and students who were struggling or had left the program. As a secondary consideration, we wanted a mix of students from Computer Science (CS), Civil and Environmental Engineering (CEE), Electrical and Computer Engineering (ECE), and Mechanical Engineering (ME).

The Department Chair for ECE emailed current students in the ECE, ME, CEE, and CS departments and pre-engineers. In her email, the chair explained the purpose of the focus groups

and let the students know that participation was voluntary and that the data would be aggregated before being shared with any faculty or staff in CSE.

Interested students completed a brief survey asking with which gender and ethnicity they identified with, asking if they identified as an international student, and asking which focus groups they would be comfortable participating in. We were also able to determine from the survey structure if students had left the program or considered themselves to be struggling. Twenty students completed the survey, and we were able to conduct focus groups and interviews with 14 of those students (70%).

The identifiers collected through this survey have been used as a part of data analysis. In this way, the demographic characteristics of participants have been included without referencing these categories directly during the focus groups and interviews.

3.3 Participants

Students were purposively recruited into the following focus groups:

- students in under-represented minority groups, both male and female,
- all female-identifying students,
- all male-identifying students. This group was composed of black, indigenous and people of color (BIPOC) students, with three out of four students identifying as members of under-represented minority groups.

A total of 14 students participated in focus groups and interviews. While the sample is small, it is diverse and represents multiple members of all groups that the CSE faculty were most interested in learning from. The sample included three transfer students, four international students, six students who identified as struggling, and one student who had left the program. Eighty-six percent of participants were BIPOC, and 64 percent were members of an under-represented minority group. Of the eight male students, all students were BIPOC, and 75 percent of male students were members of under-represented minority groups. Of the six female participants making up 43 percent of the sample, two-thirds were BIPOC, and 50% were members of an under-represented minority group.

3.4 Data Gathering

Focus groups were conducted by two Masters' students in non-STEM programs at Seattle University. One student was a female-identifying student of color, and the other was a male-identifying white student. Both students were closer in age to participants, allowing for a more comfortable environment for discussion.

Interviews and focus groups were analyzed using thematic analysis [27] [35] [36] [37] in order to better understand participants' experience in the program. Interviews and focus groups were transcribed in order to stay close to the text, and coded using MAXQDA software. The thematic coding consisted of both etic coding (themes identified in previous stages of this project) and emic coding (themes that surfaced with analysis).

3.5 Data Analysis

Thematic analysis of the data [35] [38] was selected in order to better understand participants' talk. Interviews and focus groups were transcribed using the site rev.com which has explicit policies regarding confidentiality and privacy. The coding software MAXQDA was used to conduct the analysis.

The focus groups facilitator was interested in participants' discussions of barriers for students who identified as under-represented minority, female, and international and in learning about the impact of transfer, unmet financial aid, and students' prior math and science experience. For this reason, coding started with these as etic codes [32].

After creating etic codes and coding for these areas of interest, the facilitator began looking for emic or emerging codes through thematic analysis [32] [38]. The facilitator read through each transcript looking for themes and patterns. In this way, patterns emerged organically from the data. Once a theme was identified in one focus group or interview, the facilitator checked for those themes in other interviews and focus groups. Themes that occurred in multiple instances of student talk were included in the thematic findings.

The emic themes largely emerged in two categories: different barriers that students encountered, and supports that students used to persist in their programs. Some of these themes that emerged include student discussion of the importance of support from both faculty and fellow students, their reluctance to ask questions or ask for help, and the need for faculty to work with students more effectively around mental health issues. In the below report of the findings, direct quotations from participants are used as often as possible to prioritize their voice and shared experience [38].

3.6 Thematic Findings: Barriers to Student Success

The findings presented here are not meant to be seen as causes of academic difficulty or success for engineering and CS students at Seattle University. Instead, the themes presented here are meant to give voice to students who themselves see issues that need to be addressed. Students identifying as female, international students, and under-represented minority students identified difficulties that they experienced because of their identities. While students did not specifically state that these difficulties were barriers to their success, these difficulties may be seen as having that effect.

RQ1: Discussion of barriers identified in student surveys.

This study seeks to answer the question, How are transfer, students' prior mathematics and science background, and pressures related to financial need acting as barriers to success? In the thematic coding of students' focus groups and interviews, additional information on both barriers related to transfer and students' prior knowledge were described.

Students found themselves at a disadvantage because of differences in their previous math and science background. Differences in students' previous math and science background can contribute to this feeling of not being 'good' at engineering and computer science. In their descriptions of students who were 'naturally good' in these subjects, many of them had more

prior knowledge coming into the program. This was especially true for computer science students who did not have prior coding experience when they entered the program.

Yeah, the friend I take most of my classes with, he can show up to like half the classes throughout the quarter and do better on the exams than I do. And I feel like he's got this baseline of knowledge that's a lot larger than I have, and there's a just a lot of stuff that he understands that I didn't even know I needed to know about. And it may just be that he's more passionate about it so he learns more about it in his free time and stuff like that. I don't know. But that definitely, that dichotomy makes me feel less capable. And like I mentioned earlier, exams overall make me feel less capable. So yeah.

-student identifying as male and URM

Impact of finances and financial aid is mixed. Several students talked about their financial situation, as a reason to continue in their degree. For one student, this was because of the sunk cost of the loans that she had taken out to study at Seattle University. For another, it was a time constraint on his scholarship that made it impractical to change majors. A third student talked about the scholarship that she had as allowing her to complete her degree, while faculty asked for small things like printing that she could not afford. A final student, the only student to no longer be studying in CSE, described the amount he was working in his first semester, and how that impacted his academic outcomes.

Then I had this class that you had to use engineering paper for it. I didn't have it at the time. I was like, why would I need to buy just for this class? At the beginning, I will do the assignments in regular paper and I got some points subtracted because of that. For example, sometimes I couldn't print the homework and it was an Excel spreadsheet. I wrote it down and drew the graph because you have to pay to print stuff.

-student identifying as female, URM and international

Some students had difficulty transitioning after transfer. Of the four transfer students who participated in this study, each described differences that they needed to manage when they started at Seattle University. For one student, it was leaving an environment where the community college faculty was supportive and pushed him to succeed. For two students, it was learning new systems and becoming accustomed to a more fast-paced environment. For another student it was training on computer science software that is not used at Seattle University.

If there's something that I wanted to change about my department, would be how they introduce transfer students, especially coming from a community college when they come here as a junior, because I remember last quarter, I had a lot of softwares, like the students that were here before knew about it, and I had to catch up really quickly. Yeah, I had to catch up with them, because I just didn't know about that.

-student identifying as female, URM, and international

RQ2, RQ3, RQ4: Barriers discussed across groups

Because of intersectionality within the student sample, there is not always a clear delineation between the barriers facing students because of their gender, ethnicity and international status. For example, an international student who identifies as female and member of an URM group may experience inter-related barriers based on each of these identities. Where possible, barriers have been categorized by student identity group, and in other places barriers that affect all groups are presented together. Additionally, examples of student discourse are labeled with students' identifying characteristics to demonstrate this intersectionality.

[RQ2, RQ3, RQ4] Students identifying as female, international students, and under-represented minority students described problematic interactions with faculty or fellow students around their identity. While many students described negative interactions as 'well-intentioned', most students could point to at least one incident that made them feel uncomfortable or that they found 'awkward.' These micro-aggressions— instances of indirect, subtle and most often unintentional bias against a marginalized group [39] were described by students across groups. Respondents stated that these incidents highlighted for them the fact that they were not a part of the majority of students.

(RQ2) Multiple students identifying as members of an under-represented minority group described interactions with faculty where their race or ethnicity were put into question.

One of our teachers is awkward and doesn't get the social cue of it, but he's a good teacher. I knew him for a while after this, but he said "Where are you from?" and I said, "Milwaukee." And he's like, "No, no, no but like, where are your parents from?" "Milwaukee." He's like, "Wisconsin?" And I'm like, "Wisconsin." He meant it in such a nice way, he tried to say it nicely but it didn't come off that way. I thought it was really funny, and I think it's how people perceived it too. But also, that's just really mean of them, that's not fun.

-student identifying as female and URM

In this example, the faculty member asked the student about her country of origin in front of other students, and did not immediately accept the student's answer. In another example, a student who is mixed-race described meeting with a faculty member of color to discuss a scholarship specifically for URM students. In that interaction, the faculty member questioned his URM status. The student described the interaction as making him feel "humiliated."

(RQ3) One female student described an interaction with another student where she was made to feel that she did not belong.

I don't think I've had any experiences with faculty, but I remember a time when a student, he was a guy and we were talking about CS, and he was like, 'wow, it's rare for a woman to be in CS'. Or, I talked about an interest in gaming, and he was like, 'good luck'.

-student identifying as female and Asian

Another female student described an interaction with a faculty member that revolved around her gender and sexuality.

Can I add something? I definitely think sometimes my teachers don't take me as seriously because one time they thought I was flirting with someone, but I was just talking with them. That's pretty weird.

-student identifying as female and white

(RQ4) International students described multiple problematic encounters with faculty and other students around their international status. One student described an instructor telling them in front of the class that they didn't understand a problem because "you don't speak English." Another student described the curiosity that she perceived from other students when she spoke with an accent. A third student described a time when they felt underestimated by faculty because she was from another country.

And I remembered a bad example, not a good one. I remember it was last quarter, and I was working with both of my men friends on homework. And then, one faculty came and he talked to one of, I think one guy and myself were international students, of course we have an accent and stuff like that. He and the other one were like a native from here, a person from here, and he said, oh, it's so good that you're helping the two of them. And then I was like, oh, we're actually all helping each other. So yeah, they was, the only bad example I had.

-student identifying as female, URM, and international

In addition, students spoke about the diversity of both the student body and the faculty. When students did not see themselves represented, they described feeling a lack of confidence and belonging. They described positive feelings when being able to interact with faculty who were like them.

I feel more like what you were saying in terms of I don't see a bigger population that is representative of my background so that sort of makes me feel like I'm not in the right place. It creates a lot of self-doubt. I don't see a lot of representation in terms of our faculty so that's also sort of challenging in a way. I struggle to find people that I can relate to in terms of "This is what I'm going through. You get it.

-student identifying as male, URM, and international

[RQ2, RQ3, RQ4] Students across groups also talked about a reluctance to ask questions and to ask for help. Students second-guessed questions that they wanted to ask in class for fear of appearing dumb or asking a dumb question. More than one student described incidents where faculty responded to their questions negatively.

I would say that as a freshman, new to programming I wasn't really sure where to turn. I felt really dumb, going to my professor that I was retaking the class from, asking "I really don't know what's in computer science." ... I don't know if they are trying to enforce that engineering mindset where, "Hey! You need to go do this on your own and learn about

this on your own" or they're trying to be helpful and support us because it's very, very confusing and I think teachers have conflicting opinions on what they should do.

-student identifying as male and URM

When I had a question in class, if I thought it was a reasonable one that wouldn't push back the class, I just don't want it to take longer because I'm not understanding it. I will ask in class. Otherwise, I would just write it down and go to office hours and tell him, Hey, I did understand this. Can you explain this to me?

-student identifying as female, URM, and international

One student described a distinction between faculty who saw their jobs as educating and supporting students, and faculty who saw their jobs as evaluating student performance with an expectation that students should be in charge of their own learning. The majority of respondents across all groups favored faculty who were more supportive.

[RQ2, RQ3, RQ4] Many students compared themselves to other students who they saw as 'naturally good' at engineering. Several students talked about their own beliefs about students' innate capabilities, while others stated that they perceived faculty to have this belief, with the implication that some students were more suited to engineering and computer science than others. Comparisons took the form of observing other students in class, working with students on group projects, and being able to see their grades along with the grades of their classmates.

I feel like this is something that a lot of classes or professors or the curriculum science and engineering do: they are trying to weed out people because they have this idea of a model student who was born with the ability to understand math and science but it's difficult to fight against that current. I got really lucky when I was in community college that I found professors that pushed me and that actually guided me. I was struggling but they were supporting me to have a better understanding. It's not that they were holding my hand, I had to do a lot of work myself but I think in order to have the support from professors rather than... Saying, "I am giving you the tools to succeed" rather than trying to get you out of the way so that other people can go through. I know it's competitive but I don't think it should be that kind of competition or cutthroat

-student identifying as male, URM, and international

[RQ4] International students discussed issues specific to their status as international students that acted as barriers to their success. These included needing to adapt to a new culture, and having to learn content in a second or sometimes third language. One student who identified as undocumented, also discussed the additional difficulties and stresses involved in living as a student without documentation.

It's just like yeah, because English is my third language, so just moving from my first language and second language then my third language... what I have to do is maybe write it down and go search it somewhere.

-student identifying as male, URM, and international

Students discussed ways in which fellow students and faculty made these barriers more or less impactful. One student for whom English was a second language compared working with two groups, one that adjusted to her pace and made sure that she understood, and another that moved on quickly without her. In this case, an understanding faculty member helped her to find a group that supported her learning.

I remember it was last quarter, and I was working with both of my men friends on homework. And then, one faculty came and he talked to one of them. I think one guy and myself were international students, of course we have an accent and stuff like that. He and the other student were like a native from here, a person from here, and [the instructor] said to him, 'oh, it's so good that you're helping the two of them'. And then I was like, oh, we're actually all helping each other. So yeah, that was, the only bad example I had.

- student identifying as female, URM, and international

Additional Thematic Findings: Mental and physical health barriers

Students described barriers related to mental health. Multiple respondents described their mental health as a barrier to completing assignments. They specified that they found their interactions with faculty around their mental health as problematic. Another student talked about other health concerns that he had, and not wanting to ask for help. He did not tell anyone in CSE that he was having problems until he was asked to leave the program. After describing his issues, he was reinstated. Students were not aware of what services were available to them or what policies CSE programs around accommodations for students.

I'm not trying to victimize myself, but as a foreign [student], we go through more challenges that might affect your mental health. Then my only issue was that I've been medically diagnosed with anxiety. I take pills on a daily basis. Spring quarter was really tough on me because I was taking 18 credits. One of those included biochemistry. One day it was almost near finals and I had a major anxiety attack. It's one of the worst anxiety attacks I ever had. The next day, we had a homework in this class.

Their comment was like, a lot of people asked me this before and I don't think it will be fair to make any exceptions. You have one and a half hour until the class. Why don't you try to do it? Again, because I was with my anxiety, I couldn't defend myself. I was just already started to cry and I just left. I feel like they're not aware of how anxiety works and how really you rarely can think when you are having anxiety.

-student identifying as female, URM, and international

Additional Thematic Findings: What keeps students going

When students were struggling or considering leaving CSE, they found a variety of supports that kept them going. Some of these were their love of the content and the desire to work in that field.

Students described an enthusiasm for engineering and computer science that kept them going even when they were struggling. This passion made students continue in the face of difficulties with coursework.

I've had professor be like, "You're doing really well in these other classes maybe you should switch to that." But I've told them I'm either going to get expelled as a computer science major or... [pause]. Because that's what I want to do.

-student identifying as male and URM

I was really lucky to find that structural engineering as a career and then focusing on building bridges because I'm very passionate about bridges

-student identifying as male, URM, and international

Other students described a support network of fellow students. Some of these networks encompassed an entire department, while others included a few close friends.

Even when I hang out with my friends now, we don't hang out really with many people outside of our major just because our personalities are always so similar. It definitely makes you want to keep doing this together. If one person's sick, and the teacher mentions it... Like, I've had people come up to me and say, "Hey, are you okay because you weren't in class." We're not friends, but that's really nice of you. Being in a cohort setting motivates you a lot

-student identifying as female and URM

I think I just have a small group of friends who are in CS. I think we have a good competitive, but encouraging vibe between each other. And I think that really helps.

-student identifying as female and white

Some students described a mission bigger than themselves. This included wanting to make their family proud and wanting to serve as a role model for young people in their community.

And, I really want to, especially for the girls back in my country, I really want to be a role model of someone who actually did something and worked in science and engineering. So, that's what keeps me going.

-student identifying as female, URM, and international

Every student who took part in this study wanted to complete an engineering or computer science degree, and more specifically they wanted to become engineers and computer scientists. Even the student who was asked to leave the program, wanted to stay. These are some of the strategies that students describe using to support themselves in this endeavor.

Students identifying as female, members of an under-represented minority group, and international students spoke of the importance of having diverse faculty. Students described the ways in which they benefited from working with diverse faculty. They described being able to relate to members of their own gender and ethnic group more easily, and also the benefit of

seeing someone like them succeed. In addition, many students described female faculty as more supportive in general, and felt that having more female faculty would be beneficial for that reason. International students spoke about feeling more comfortable with international faculty, and being able to more easily learn from them.

And for the ethnicity, it does have an effect because like last week we had the National Society of Black Engineers meeting, and we had for the first time one faculty member who is an IT professor here, who just came, he just heard about the club. And, he was just here for the meeting, to know what we were going to talk about. But then, the whole meeting just ended up us asking him questions because we were so happy to see someone who actually looked like us.

-student identifying as female, URM, and international

I really like having female teachers in our department and not because of anything but the way that they teach and the way that they go about things. They care about the students, I've noticed, rather than just teaching for teaching. It makes it a lot more compassionate and welcoming place to learn. Not just being a female student but I've noticed for all students, and a lot more students like the female teachers because of it.

-student identifying as female and URM

3.7 Implications & Recommendations from Student Focus Group

Based on the barriers that students across study groups are identifying, it is important to encourage a sense of belonging for students identifying as female, members of under-represented minority groups, and international students. Students in these groups are experiencing micro-aggressions based on their identities, frequently not seeing themselves represented in classes by students or faculty, and express a fear that they will be perceived as unintelligent if they make a mistake or ask an inappropriate question. In order to address these barriers, the focus groups facilitator recommended that faculty encourage a growth mindset in students, work to address micro-aggressions within the department, continue to recruit a diverse student and faculty population, make mental health services more readily available to students, and continue the work that they have begun in supporting these students. Below are details of the recommendations.

Dispel the idea that there are students who are natural engineers and students who are not. When students have this idea, it is harmful to their sense of agency and may lead them to hide areas where they lack understanding. One student who had this idea, described feeling that she needed to come to terms with being 'dumb' in order to ask for help. When faculty are perceived as having this idea, it can lead students to believe that faculty see some students as worthy of their attention. Students feeling the need to present themselves as fully competent may be less likely to ask for help and less likely to ask questions.

Encouraging a growth mindset [40] [41] among both faculty and students will help to alleviate this barrier to student improvement. With a growth mindset, the message of the department can be that everyone is able to learn, and that there are no born engineers. Emphasizing persistence,

growth, and the idea that mistakes are how people improve can give students permission to ask for help and to struggle in their learning without judging themselves as not belonging.

Consider having faculty professional development on microaggressions. While overall respondents in this study found faculty and students to be well-meaning, a majority of students also described at least one incident where their race or gender was referred to in a problematic manner. These microaggressions— instances of indirect, subtle and most often unintentional bias against a marginalized group [39] can be harmful to student self-esteem [42]. Providing faculty training on racial and gendered microaggressions will help to prevent instances like this in the future [39]. With more training on micro-aggressions, faculty will be able to monitor their own interactions with students. They will also be able to recognize microaggressions if they hear them in their classrooms in order to create a safer environment for students identifying as female, international, and members of an under-represented minority creating a more positive climate for students and eliminating barriers to their success [42] [43].

Continue to hire diverse faculty and to recruit a diverse student body in terms of both gender and ethnicity. Students who identify as female, international students, and members of an under-represented minority all described the importance of seeing others like them in order to feel a sense of belonging. Several students positively described the diversity that is already present among the CSE faculty at Seattle University.

Make students aware of the services that are available to them on campus. This is especially important for international and transfer students as well as students with a documented disability (anxiety, depression, ADHD). Students in this study described not wanting to ask for help or not knowing what kind of help was available until it was too late. New students should be informed of all available services, and made to feel that there is no stigma in seeking help. Some students described their understanding that they should be able to figure out things on their own. Whether this is a message that they receive directly or one that they are inferring, it should be replaced with a message that everyone needs help sometimes.

Have faculty-wide discussions about how best to support all students and in what circumstances differentiated treatment is warranted. Based on the descriptions of students in this study, they are not aware of college-wide policies on when to allow for differentiated treatment. For example, students should know when and how to ask for extensions or other accommodations based on medical necessity or disability. Additionally, the college faculty and staff should discuss what additional supports could be made available to students. For instance, transcriptions of classes which are often provided for deaf and hard of hearing students might benefit students who are learning in their second or third language. Providing PowerPoint slides for sessions to international students prior to class might be another accommodation that would assist those learning in a second or third language.

4. New Programs & Initiatives

Based on both the focus group work and the previous surveys, we identified two primary themes that should be addressed.

First, we need to improve community-building for students from marginalized and underrepresented groups. This includes helping them to feel more connected to classmates, faculty, and staff, as well as developing their sense of identification as members of their academic and professional community (seeing themselves as engineers and computer scientists). This is consistent with many findings in previous studies, such as the previously discussed [7], [10], [22], [24].

Second, we need to improve the culture and climate within our college. In both the surveys and the focus groups, students identified a number negative experiences or interactions with faculty and staff. Students noted that these interactions did not necessarily seem to be born of malicious intent, but that their impact still caused harm. Students from marginalized and underrepresented groups also indicated a hesitation or lack of comfort in seeking out existing resources (such as office hours, tutoring, or disability services) or asking for support. Authors of reference [15] discussed how an unwelcoming climate can lead to people feeling less comfortable or safe about asking for support.

There is clearly overlap and connection between these two themes, but each represents a distinct need, with distinct ways they could be addressed.

4.1 Community

In this section, we describe initiatives undertaken to build supportive learning communities for engineering and CS students.

4.1.1 Summer Orientation Events

Each July, a majority of incoming first-year students, along with their families and supporters, visit our campus to attend one of four 2-day orientation events. Over the two days, students engage with a mostly separate agenda from their families and supporters. On the first day, students connect with their assigned Orientation Advisor (OA), a current student serving in the role of Seattle University ambassador and peer mentor. The student agenda allows for individual exploration where students choose their own adventure (picking among sessions hosted by campus units such as Study Abroad, Health & Wellness, Career Engagement, etc.) and also includes times when they share and learn with their assigned OA and student group. Students stay overnight in one of our student dorms and attend a few sessions with their families and supporters. Seventy minutes on the first day is reserved for School or College Presentations where students are brought together according to their intended major.

In 2019, our team revised those 70 minutes for the College of Science and Engineering's students to incorporate activities meant to enhance community building while still retaining the overall goal of introducing students to what would soon be their new Science and Engineering academic home. Stipends were awarded to two 9-month contract faculty members for them to join a senior academic advisor, who was on a 12-month contract, to develop and facilitate the

new vision for this part of the orientation agenda. The three organizers met several times to brainstorm and shape the activities to satisfy our goals of encouraging students to (1) make meaningful connections with students in their major/area of focus, (2) start to build community with other incoming first-years, and (3) find department spaces that will be important to their academic life in the coming years. Activities were chosen to promote cooperation rather than competition.

In addition to the four July orientation events, our university holds one event remotely for students in Hawaii, and one one-day orientation event in September. Students who attended the summer orientation event in Hawaii did not participate in these activities and those who attended the one-day orientation event in September participated in a scaled-down version of the activities.

The three organizers led students through three main activities, one for “getting to know you,” one for team-building, and one to combine the first two with an exploration of the Science-Engineering complex (two linked buildings). The organizers knew in advance how many students of each major would be in attendance for each session so they could plan how best to group students, considering not just major, but size of group, and also how to include pre-science and pre-engineering majors. The space was prepared in advance by putting up on walls all around the room the name of the major(s) or department along with one large post-it, marker pens, and a pile of smaller post-it notes at each station.

The first ice-breaker activity called for students to form small groups by major and then use provided post-it notes and pens to document individual answers to four prompts. Specifically, students were asked to reflect on and share (1) an accomplishment (2) a source of gratitude, (3) something giving them concern moving into college, and (4) a fun or bizarre fact about them. The organizers walked around the room to help facilitate timely and equal engagement by all students. After completing the first task of introductions and sharing answers to the prompts, the second component directed students to use the large post-it to draw a map on which each student could mark where they call home and also be creative and develop a team name which would later be shared with the larger group. They also placed their individual post-it notes on the map/poster.

The final activity asked the students to visit their soon-to-be classroom and department spaces and as a team find key areas as part of a scavenger hunt. They were provided with location lists in terms of major; for example, mechanical engineering students had to find the machine shop and chemistry students had to find the chemical stockroom. The students also had to find department offices and student lounge spaces to generate some excitement and also highlight department-specific support awaiting them as part of their new community. While they were gone, the facilitators read individual post-it notes to help formulate closing remarks to be made to the entire group. During the scavenger hunt, students took group photo selfies at each spot and as they returned, the facilitators reviewed their success, more for enjoyment than strict verification. An incentive to get all teams back on time was a random drawing to award 4 prizes that were purchased from the university bookstore. When students had first entered the room at the beginning of the session, they were given a Seattle University ballpoint pen with tiny balls

and a maze puzzle to keep as a souvenir, along with a slip of paper for entering their name into the prize drawing jar.

After prizes were awarded, any remaining time was devoted to closing remarks and Q&A. The facilitators often shared more generally some of the common concerns they read while students were out on their scavenger hunts as a means of helping students to know they are not alone both in what they fear and in having a strong support team awaiting them. Some examples were “I won’t transition well to school”, “homesick”, “I won’t be able to scrape up enough money to offset college costs”, “balancing workload”, “time management”, and “finding my people”. The facilitators appreciated the willingness of students to be vulnerable and share out personal items about themselves. A common question was wanting to know more details about their fall course schedules, which were going to be available on day two, when these same students were going to visit the same room, moving through in smaller group advising sessions led by the professional advisor present.

Our assigned timeslot was 70 minutes with a lot of events packed into that time (Table 1 **Error! Reference source not found.**). We were fortunate to have a very large meeting room with rows of moveable chairs occupying only the middle portion of the floor space; thus, students could pick up their chairs and walk to designated spots around the perimeter according to their majors. Each of the four orientation events drew 40-60 STEM majors. The larger groups (e.g., Biology and Computer Science) were divided into 2-3 smaller groups, while the smallest groups (e.g., Math and Physics) were joined together. We observed that the most interactive and productive groups were often those with 4-8 members.

Table 1. Timeline for 70-min orientation session for incoming first-year students in Science & Engineering.

Arrival	Students receive pen to keep and slip of paper to write their name Names go into large beaker for prize drawing later
0:00	Dean welcomes students and provides three pieces of advice
0:05	Facilitators, goals, and activities are introduced
0:10	Small groups form and begin to work sharing information and making maps, while facilitators circulate and answer questions
0:25	Each group shares the meaning behind their team name
0:30	Scavenger hunt: Each group heads out to visit tailored list of places
0:55	Returning groups show their photos from each place they visited Prize drawing occurs
1:00	Q&A
1:05	Director of summer online community explains goals and logistics
1:10	Students depart

Given the relatively short time we had with the students and they had with each other, we were happy that most of them seemed to be having fun and were chatting with others more going out the door than on the way in. It was evident that they were glad to have opportunities to move around and engage with each other and also with their new SU campus. The prize drawing was a

fun, culminating event and helpful in getting students back on time from the scavenger hunt. Had more time been available, the event could have benefited from a more leisurely pace through the activities and also more time to reflect on their initial prompts and perhaps have teams share out more to the larger group.

While some groups took advantage of maps posted inside the buildings where the scavenger hunt took place (all started out in the nearby library), others had a difficult time finding the listed locations. In the future, we might try to recruit a few volunteers to stand in the building lobbies to provide hints and tips as needed; we could potentially make use of the 2 OAs that were on hand during this time. Another possible change going forward might be to have students submit their photos from the scavenger hunt to their departmental office, where the pictures might be posted on a bulletin board or news blog.

In early September, students were reminded of the goals of the STEM portion of their July orientation program and asked to rate the main elements and give suggestions for improvement. Fifty out of approximately 200 students responded to the online survey about their orientation experience. A majority of respondents rated the session as helpful (Figure 1 **Error! Reference source not found.**). The sharing of information in small groups and the scavenger hunt were deemed more valuable than making the map of their hometowns and choosing a team name. When students were asked about what changes we should implement for future sessions, several had suggestions for improving the scavenger hunt and others desired more time for informal conversations; a handful indicated the format did not need adjustments (Table 2 **Error! Reference source not found.**). We did not ask any demographic questions on this survey.

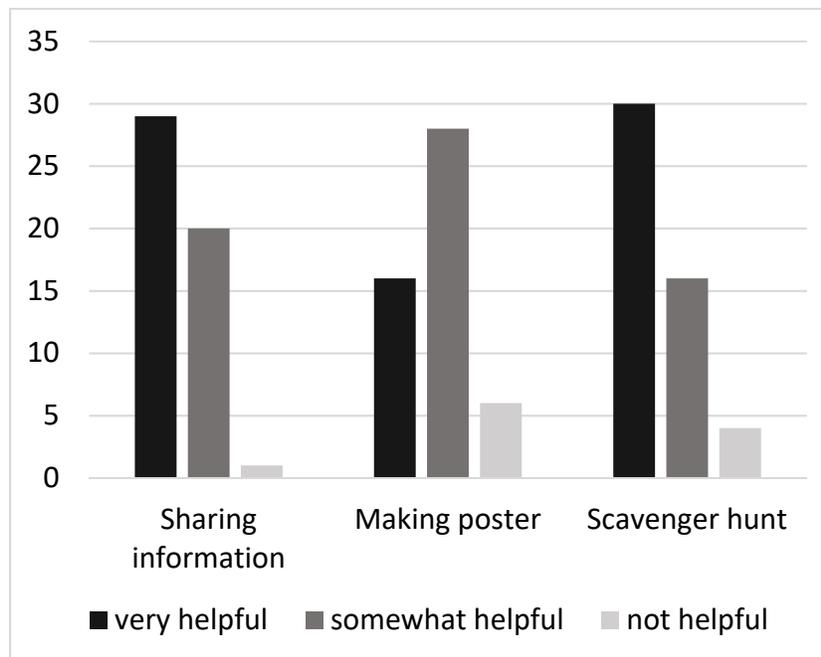


Figure 1. September survey asking July participants whether the three main activities of the community-building session met the stated goals. Fifty students responded.

Table 2. Feedback themes among 28 students who supplied written suggestions “for improving next summer’s event.”

Written comments on survey	# comments
Adjustments to scavenger hunt – mostly requests for more hints or more places to explore	9
More time for informal conversations with other students in their field	7
No changes needed	5
Miscellaneous: more breaks (3), more ice-breakers (2), t-shirts (1), shorten presentations (1)	7

We were satisfied with the level of student engagement in the planned activities and feel this new approach for introducing new students to the College of Science and Engineering assisted their transition to college better than the previous format. Additional orientations at the department level, where students met multiple faculty and staff and toured departmental facilities, occurred during Welcome Week in late September, just prior to the start of fall term. We expect that gaining even a small amount of familiarity with peers and key campus spaces helped students start their first majors’ classes with greater ease.

4.1.2 Online Summer Community

Following Summer Orientation, an online community using the CANVAS course content management system was organized for the 278 incoming CSE students. The content consisted of an “online course” of activities that were designed to help students form communities and be more familiar with the CANVAS system prior to their arrival to Seattle University. The online community was facilitated by one of the authors of this paper.

The activities included three broad themes – (1) getting to know the academics side of the university, (2) getting to know the city, (3) getting to know their fellow FTIC students, and (4) fun and games. The activities were masked as assignments and students were given a score on completing the “assignment.”

The “academic” activities included learning some of the functionalities of CANVAS such as uploading a headshot and setting up reminders. The facilitator also asked faculty members who typically teach FTIC courses in math, chemistry, and biology how students can better prepare for their courses. The collection of responses became an essay that was posted on CANVAS. Students were asked to write a short reflection about the “adjustment” that one must make when transitioning from high school to a university. The facilitator followed up with a discussion on how the quarter system is a bit quicker paced relative to high school academic calendar system.

The “get to know Seattle” activities included online treasure hunts to make students familiar with locations of mail service, a nearby drug store, art supply store, nurses station, and how to get to the airport from Seattle University. Current senior students were asked to share all the “must go” restaurants and entertainment spots. The goal of these activities was to help FTIC students think about their future life at Seattle University.

The “get to know fellow FTIC students” activities focused on self-introductions. A discussion board was organized by states where students came from, the location of their residence hall assignment, and their intended major of study. Students were asked to go to their home state and resident hall floor and introduce themselves. They were also asked to write emails to three fellow FTIC students and introduce themselves. As a result, students who belonged to specific dorm floors got to know each other and started to plan activities for when they all move in to their rooms. The “fun and games” portion involved quizzes about the city, university, and other topics of interest to students, and photo caption contests.

Of the 278 potential participants, 53% of students participated in at least one activity, 22% of the students participated in over 50% of the activities, and 8% of the students participated in over 90% of the activities. The effectiveness of the online community was evaluated with an online survey during fall quarter. 31 students responded to the survey questions (results are included in parenthesis):

- The online community helped you connect with fellow students and SU campus (61% agree, 6% disagree)
- The online community helped you prepare your first quarter at SU (77% agree, 10% disagree)
- The online community helped promote student cohort (77% agree, 10% disagree).

In written comments, some students made technical suggestions and some lamented that online interactions are not as authentic as in-person. Most students were appreciative of the effort of the facilitator to create a meaningful engagement and connections with peers.

4.2 Climate

In this Section, we describe activities that we have implemented to improve the college climate.

4.2.1 Workshops

We have facilitated a number of workshops on DEI. Part of this has been to leverage outside expertise. We have arranged for faculty and staff to participate in seminars offered by the American Society for Engineering Education (ASEE), with topics such as designing an inclusive classroom and Safe Zone Workshops. The workshops our faculty attended included:

- “Engineering Inclusive Classrooms” by Dr. Tershia Pinder-Grover (University of Michigan) that discussed key principles behind inclusive teaching, and provided attendees with actionable strategies for engineering inclusive classrooms.
- “Safe Zone Ally Training workshops” (Level 1 and 2) that described key LGBTQ+ terminology and concepts, as well as implications of privilege and bias, and offered strategies for being an ally and building an inclusive environment for LGBTQ+ individuals.

Both workshops were very popular with faculty and staff. We organized joint viewing of the first workshop above which allowed the attendees to discuss the material covered and share ideas on how we can create inclusive classrooms in our college.

We have brought in an outside expert to hold workshops for both students and for faculty & staff on microaggressions. We have invited Dr. Emily Affolter from the Center for Evaluation & Research for STEM Equity at the University of Washington to conduct a workshop on identifying and understanding microaggressions for faculty and staff. The workshop was well received with a feedback that attendees would like follow-up workshops that focus on practical advice on how to deal with microaggressions and other bias incidents when they are happening.

In response to this, we have designed a bystander intervention workshop that can be run internally for faculty and staff. This workshop was in part inspired by NCWIT's "Interrupting Bias In Academic Settings" resources [44]. The workshop starts with a short introduction to core DEI concepts. Participants are then divided into small teams of three to five participants each. Each team is given handouts with descriptions of two scenarios in which some sort of microaggression / bias incident occurs in an academic setting. Many of these scenarios were drawn from the free response section of the student survey administered in spring of 2018 [2]. Others were drawn from incidents reported by faculty and staff to members of the DEI committee.

Below are examples of some of the scenarios:

- In a community / study space, you overhear a male student say to a female student "It's going to be easy for you to get a job since you're a girl. You won't need to try."
- In a class activity, you ask students to divide into small groups to work on an activity. Everyone divides into groups, except for one student who is not a native English-speaker, who is not asked by any classmates to be part of their groups.
- A colleague repeatedly refuses to use the correct pronouns for a student, despite having been informed on multiple occasions what this student's pronouns are.
- While chatting outside of class, a female student mentions to you that they have noticed that a particular other faculty member in your department regularly chats with male students before or after class about non-academic subjects (sports, movies, etc), but never with female students.

The groups are instructed to pick one of the scenarios to discuss. The option to pick a scenario was included for several reasons. If participants felt that they already knew how to respond to a particular scenario, we wanted to give them an alternative that they might find more valuable to discuss. We also wanted them to have an opportunity to pick issues that resonated most closely with what they have experienced. And finally, if a particular topic would be upsetting or traumatic for a participant to discuss, we wanted to ensure that they could request a different topic.

Once a group has picked a topic to discuss, they are given time to brainstorm how they might respond in their chosen scenario, and to think about how others would react to their responses. We discuss with participants about how there is not an easy checklist of correct responses to most situations - what responses will be most effective can depend a lot upon context, and upon the individuals involved. We talk with participants about how, in a high-stress moment, we are

not likely to be in the best mental position to come up with the most effective response, and that the object of the workshop is to provide an opportunity to think about how various responses might be received now, when we have the time and mental space to think through the issues more calmly, so that we can then draw on these ideas later when we do find ourselves in the midst of an incident.

The workshop ends with each group reporting about their conversations. Some time is allowed for participants from other groups to ask questions or offer their own thoughts on each group's chosen scenario.

We have run this workshop three times so far, once with the faculty and staff members of our college's Committee for DEI, and twice at meetings for faculty and staff in two of the departments in our college. Future workshops are being scheduled both for department meetings and as stand-alone events for any faculty and staff in the college.

4.2.2 Diversity, Equity, and Inclusion Student Ambassadors

Inspired by the Bias Busters groups created by industry and academia, especially the Bias Busters @ Carnegie Mellon University [45] and the Bias Busters in the Electrical Engineering and Computer Science Department at University of California Berkeley [46], we have created the Diversity, Equity, and Inclusion (DEI) Student Ambassadors program. Because our college includes both engineering/CS and science departments, we invited students from all majors within the college to apply to become ambassadors. We were looking for students with leadership experience or those with a strong desire to gain leadership skills. We welcomed students who have experience in facilitating a brave space and being an advocate for others as well as those who care for others but are not sure how to make an impact. After reviewing applications and interviewing the finalists, we selected a group of five making sure that the students reflect the diversity of our student body and majors.

The students were given broad objectives to improve the college community and educate the student population about diversity, equity, and inclusion. They were charged with organizing meaningful and impactful events for other students as well as providing feedback from students to faculty and staff regarding college climate. Our first meeting was in late February 2020. We discussed organizing a DEI Takeover Week in spring quarter which would have featured DEI topics front and center for an entire week with events, seminars, workshops, conversations, hallway displays, posters, challenges, and opportunities to interact with each other in safe spaces. Unfortunately, soon after our first meeting, the university moved to virtual delivery of courses due to COVID-19. As a result, the DEI ambassadors focused on gathering feedback from students through a virtual Town Hall and office hours. They advocated for the needs of students from underrepresented or minority groups to faculty and staff. Faculty appreciated hearing from students and being able to express their thoughts about virtual teaching.

Currently, Seattle University is still in a virtual mode with most faculty, staff, and students asked to work and study from home. This mode will continue through the winter quarter and possibly spring. The DEI Ambassadors are looking into ways to acknowledge and address issues of systemic racism in STEM and continue working on improving the college climate. For example,

they are looking for POC professionals from industry who can talk about being a minority in STEM and how it affects their experience in the workplace.

They also organized another Town Hall in October of 2020 for faculty and students to talk about the experience of students learning virtually, now that everyone had spent more time with virtual learning. Students were able to provide feedback to faculty about what has worked well for them and what has been a challenge with virtual learning. Specific feedback included the observation that many students have living situations that make synchronous participation in virtual classes challenging, and that this was particularly true for students from marginalized and underrepresented groups. They discussed the increased isolation they have been experiencing, and the difficulty in forming community with their classmates, both due to physical separation, and due to screen fatigue causing most students to not have the emotional and mental energy to engage in virtual social events. Based on our previous work, we know that this sense of community is especially important for the success of students from marginalized and underrepresented groups, and so finding ways to address this challenge is particularly important.

The DEI Ambassadors have launched an Instagram account to engage with students on DEI topics. Through their Instagram page, they are both promoting events and resources, as well as engaging in discussion and education on DEI issues.

Finally, the ambassadors are working on mini workshops to be delivered via Zoom in STEM classes that would educate students about microaggressions and raise awareness of the need for bystander interventions. Inspired by [47] and [48], the format of the mini-sessions will involve theatre sketch acted by the students and a follow up discussion.

Because the DEI Student Ambassadors program is very new, we do not have much feedback from faculty, staff, and students about its effectiveness. We are looking forward to the events planned by this group during the next couple of quarters. The one area where we have received feedback has been the town halls. Faculty and staff have said that they find the opportunity to hear directly from students to be extremely helpful. Students have said that they have appreciated having an opportunity to discuss these issues openly with faculty. Students noted that the fact that these town halls have been organized and facilitated by students, rather than staff and faculty, has substantially contributed to their feeling safe and comfortable discussing their concerns.

4.2.3 Diversity Reading Group

In response to a growing faculty and staff interest in better understanding DEI issues, we organized a reading and discussion group starting in the summer of 2020, and continuing during the academic year. Virtual meetings are being held to discuss articles, books, and videos related to DEI, along with online message boards for asynchronous discussion. In these discussions, an emphasis is placed on how the ideas in the readings can be turned into specific actions within the college. In light of current events, the decision was made to focus, for the time being, specifically on issues around race.

The group started with a pair of videos by Jay Smooth on how to frame conversations about race to make them more comfortable, more productive, and more accessible [49] [50]. This was

followed by readings focused on racism in STEM and in the classroom [51] [52] [53], with discussions centered around specific actionable ideas that could be implemented in our classes.

One discussion focused on how to react or respond to bias incidents in the classroom. Participants discussed the importance of centering the experiences of the students being harmed rather than those causing harm, of acknowledging to the class that something inappropriate had been said or done rather than trying to ignore it, but also looking at ways to not turn it into a heated argument in the moment. Faculty and staff in the discussion shared stories of their own classroom experiences and what responses had worked or not worked for them.

Another discussion looked at ways that academic expectations and assessment methods can reinforce white supremacy culture [54]. This led to many faculty starting to rethink their evaluation methods in their courses.

Subsequent conversation looked at how we can create community during COVID-19. We discussed some of our own past research showing that a connection to an academic community is particularly important for URM students [reference redacted]. Current remote learning practices are causing many students to be more isolated. Faculty and staff shared strategies that they had used during remote learning in the spring quarter. This included both community-building efforts in the classroom and outside of the classroom.

Within the classroom, a lot of the discussion was centered around how to divide students into small groups that would work well together. This included the importance of dividing students into groups in such a way that, when possible, students from underrepresented or marginalized populations would not be isolated in their groups. For example, it would be better to have one group with two Latine students and one with none rather than two groups that each have one Latine student. Another idea that was discussed was keeping students assigned to the same small groups throughout the quarter, so that they have a chance to get to know their group members over the course of the quarter. One faculty member shared that, during breakout room work over Zoom, some students preferred to primarily work quietly and individually, while others preferred to be more talkative and interactive. They found that asking students to give a preference on a “quiet” group or a “chatty” group greatly improved students’ engagement.

Outside of the classroom, it was noted that community building seemed to be most effective when done asynchronously - students seemed to largely be uninterested in engaging with synchronous extracurricular activities, presumably due to screen fatigue. Instead, faculty and staff were finding the most student engagement with things like department and club Instagram pages and setting up department-level Discord servers for students. Through these, faculty and staff engaged with students in both academic ways (problem-solving contests, for example) and non-academic ways (such as chatting about what tv shows and books everyone was currently enjoying, or people sharing pictures of their pets).

4.2.4 Syllabus Statement

Drawing on input from a number of faculty in the college, a sample syllabus statement on inclusion was written and made available to faculty. Multiple departments have chosen to make it a standard part of their syllabi, and individual faculty in other departments have included it as well.

The statement first emphasizes the importance of diversity, equity, and inclusion as core values of both the course and the university. It discusses a commitment to fostering a learning environment in which all students are able to learn and succeed.

The statement then encourages students to say something if they feel that any aspects of the course fail to live up to these principles, including if they feel that their instructor has failed to live up to them. Students are told that their instructor welcomes such feedback, and they are given a list of a number of possible avenues for them to discuss any concerns they have, depending on whom they feel comfortable speaking with (the instructor, department chair, faculty advisers, etc.). Finally, the statement also provides information for students on what channels are available if they want to file an official report of a bias incident to the university.

Feedback from faculty has indicated that these last items, encouraging students to raise concerns and providing them with specific information on ways that they could do so, have been particularly well received by students. Students have appreciated the framing around how to take action, rather than just being given another general statement of support for diversity. They described feeling safer and more supported in raising concerns because of this statement.

5. Conclusions

In this paper, we have presented diversity, equity, and inclusion-focused initiatives undertaken to improve the experience of underrepresented and minority students in our college. Our previous research on these students' attitudes and experiences showed us that the climate and community of our college can often feel unwelcoming and at times hostile to them. This has been a major barrier to their success, as they have had difficulties integrating into their academic communities, and have not felt comfortable seeking out support from many of the resources available in our college.

We have followed up on that research with focus group interviews to gain a deeper understanding of our students' experiences. Based on what we have learned, the decision was made to focus DEI efforts on improving the climate and culture in our college to make it a more welcoming and supportive environment for students from underrepresented and marginalized populations, and to develop programs to help students feel a sense of belonging and identity in a community of engineers and computer scientists starting with their earliest interactions with the university.

These efforts have included workshops for faculty, staff, and students, summer orientation events and online summer community for new students, establishing DEI Student Ambassadors program, creating a diversity reading group for faculty and staff, and adding of a DEI statement to the syllabus template. Changing the culture of a large organization can be a slow process, but

feedback we have received anecdotally from faculty, staff, and students has indicated that these efforts have made a notable difference in how students from marginalized and underrepresented groups feel about their place in our college community.

6. Future Work

Our current challenging reality has two interesting consequences. Faculty, staff, and some students are eager to participate in conversations about diversity, equity, and inclusion and call for concrete actions. At the same time, it is difficult to offer many meaningful opportunities for engagement due to the restrictions that the pandemic brought on us. Our immediate work involves finding ways to continue our initiatives in a virtual environment with a sensitivity toward those who were most impacted by COVID-19.

We are looking forward to working with DEI Student Ambassadors on their initiatives especially the theatre-based mini sessions on bystander interventions with a goal of implementing them in a number of courses in spring quarter.

Our feedback on these initiatives has, so far, been anecdotal. Once we have programs more fully in place, students will again be surveyed using the questions described in [reference redacted], so that we can more clearly measure the impacts of these efforts on the college climate and the student experience.

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