Student Experience Report

2020
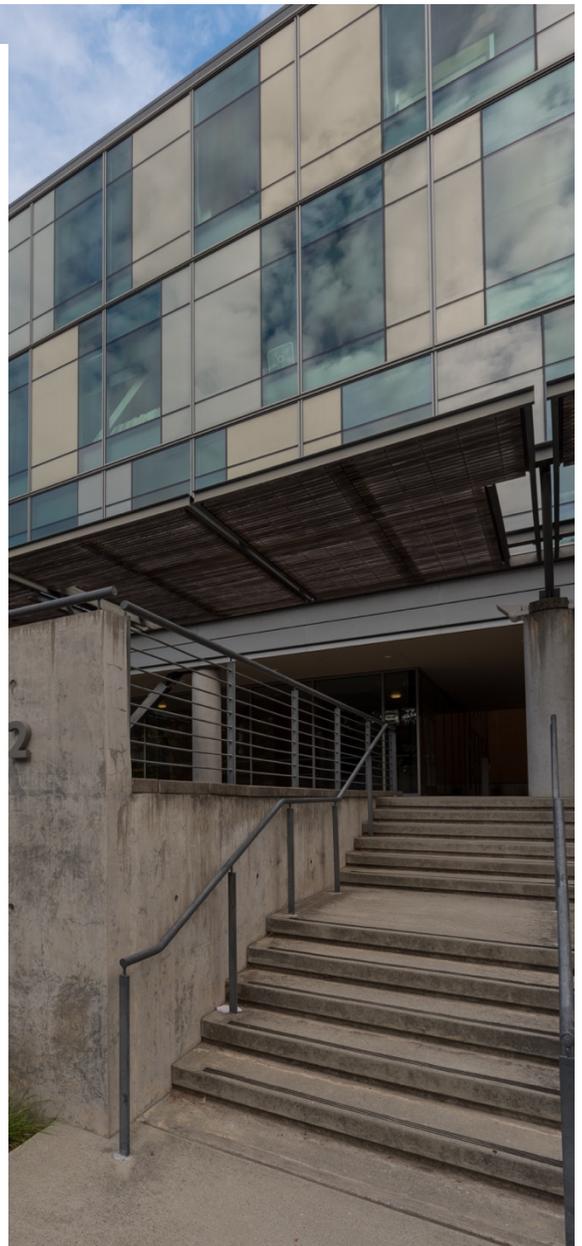
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UCSC, Baskin Engineering

Baskin
Engineering
UC SANTA CRUZ

Student Experience Study
Summary

Background

Engineering has been an historically underrepresented career field and major. The computing field will continue to expand but there are not enough students entering the workforce. The field is especially lacking people of color and women. Diversity opens the door for different ideas and stories in the engineering workforce. Over recent years, the School of Engineering has become more demographically homogeneous, while enrollments of students of color, women, and first-generation students have decreased. Administrators collaborated with the Student Success Equity Research Center (SSERC) in order to discover common challenges engineering students experience. After analyzing the data, we intend to turn these critical points into opportunities for student success. This document serves as a complement to the Student Experience Study, the full report.

Problem

In the next five years, there will be a need for at least 65,000 engineers (Norris, 2019). As Figure 1 illustrates, the Baskin School of Engineering has grown exponentially between 2007 with 700 majors to over 4,500 in 2017. Such rapid growth naturally causes a deficit of resources including staff, faculty, and strategic planning. Due to this we must take stock of the student experience and the equity of our programs. This study informs us of the experiences of our undergraduate population.

Figure 1. Baskin Engineering Historical Student Counts
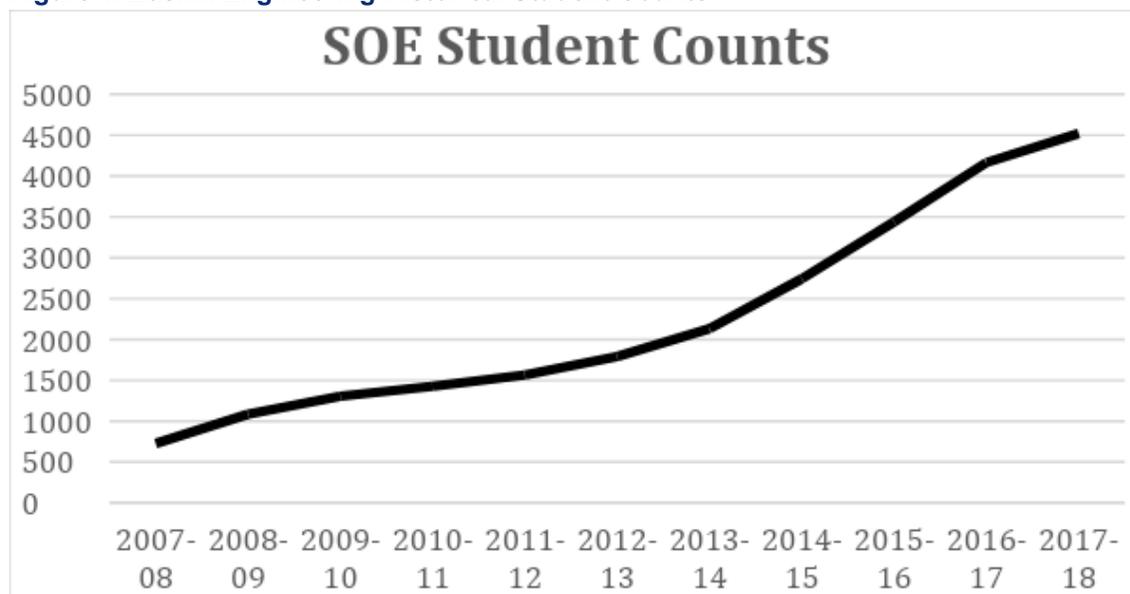
Note: Student Population of School of Engineering students from 2007-2018

Definition of terms

- Matriculation: students moving through major and curriculum
- Retention: Staying in school from year to year
- Graduation: Completion of degree
- Persistence: the act of continuing towards an educational goal
- Sense of belonging: students' perceived social support on campus, a feeling or sensation of connectedness, the experience of mattering or feeling cared about, accepted, respected, valued by, and important to the group (e.g. campus community) or others on campus (e.g. faculty, peers.
- Stereotype threat: the risk of confirming negative stereotypes about an individual's racial, ethnic, gender, or cultural group
- First generation student: student who has one or more parents who have not completed college
- Returning generation student: student who has one or more parents who have completed college

Findings

The study consisted of the analysis of institutional records, focus groups and a survey for the School of Engineering. The major issues revealed in the survey results were surrounding homogeneity of School's demographics, pre-college academic preparation, and the retention and matriculation of underrepresented students.

HOMOGENEITY OF SCHOOL OF ENGINEERING

The relative percentages of African American and Asian students in Baskin Engineering have stayed stable, with African Americans generally being representative of the campus (between -0.6% and 1.1%) and Asians being higher than the campus. Latinx students, however, have consistently become less represented in the School, going from -0.8 to -10.7 relative percent in the past ten years.

Figure 2. Race and Ethnicity of Baskin Engineering Students

SOE Race/Ethnicity Relative Percentages
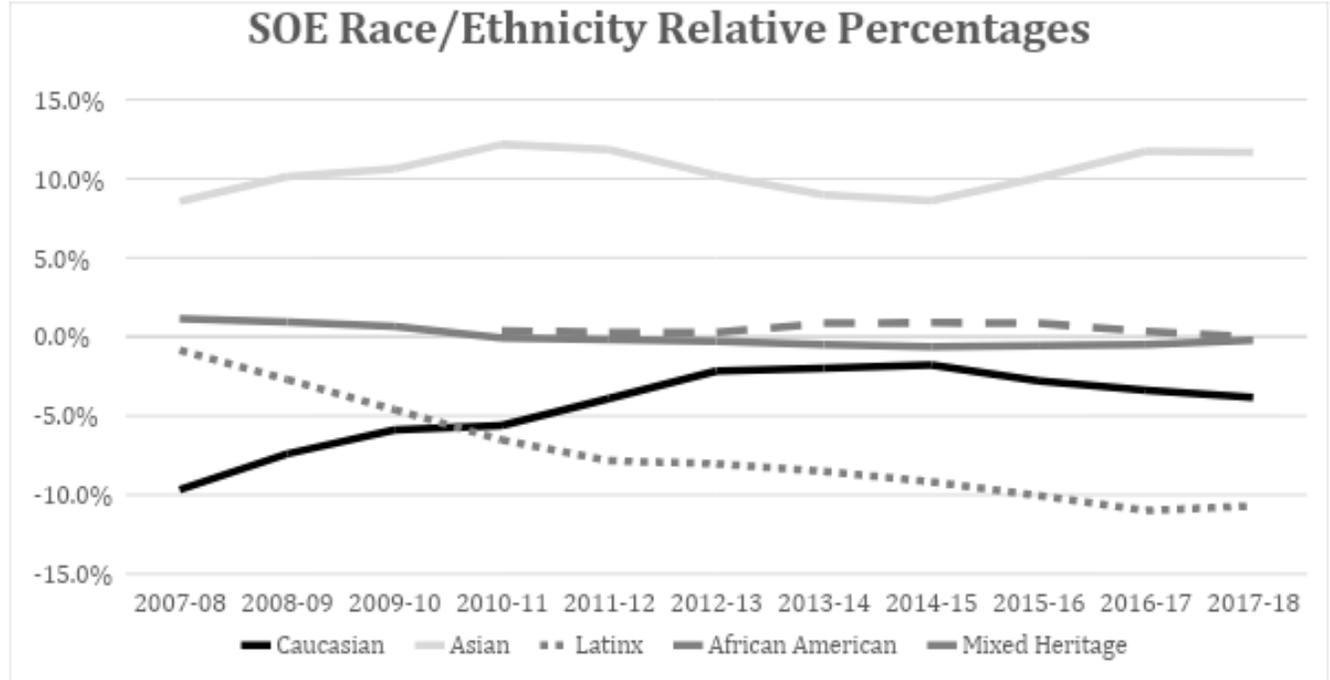
Note: Based on data from 2007-2018.

For women, representation has gradually increased over time, but gender remains the largest demographic disparity in engineering. The relative percentage of women as compared with the campus was -40.6% in 2007 and then -28.4% in 2017. So, despite being one of the largest changes over time women remain markedly underrepresented.

"One thing I wish I would have known, is how to prepare myself to be an engineer. Cause I've definitely noticed some of the younger guys here—or girls—who maybe their parents are engineers as well, they've been groomed to think like engineers and all that all their lives. And they have guidance and all that, where me, I'm just winging it. So, I'm just on my own trying to figure stuff out." [Student Focus group, 2019]

The need for mentorship and role modeling is apparent for students in the School. The presence of faculty who are women and absence of faculty who are African American or Latinx conspicuously aligns with our survey findings for engineering identification. When we asked students about the degree to which they see themselves (and feel externally affirmed) as engineers, we detected a significant difference for ethnicity but not for gender. Underrepresented ethnic minority students reported lower levels of engineering identification than non-underrepresented ethnic minority students. On the other hand, women and men had

similar levels, as did first- and returning-generation students. Although this study was not tightly controlled enough to ascertain causation, there is an interesting pattern where the same faculty demographic groups that have no representation in the BSOE are also the same undergraduate demographic groups that are less likely to identify as engineers themselves.

A negligible number of first-generation students indicated having mentorship from a parent that is an engineer whereas twenty-five percent of returning-generation students did. This question was phrased in terms of their kindergarten through twelfth grade academic experiences, but presumably the mentorship continues into college.

"There's really not many people that are like this out here asking African American students how they feel, or how they feel on a mental level, or if they're feeling comfortable at all. 'Cause I guarantee you a lot of them will say no." [Student Focus group, 2019]

Several students were adamant that the university and the stakeholders that represent it are callous and unconcerned about their academic success or socioemotional state, though some students did not believe that there was malicious intent. Findings suggest that sense of belonging to the Baskin School varies primarily across ethnicity, whereas gender is more central to belonging in math, and cultural mismatch is both a socioeconomic and ethnic issue. Several students mentioned finding their sense of belonging in spaces such as Learning Support Services, Baskin student organizations and MESA Engineering Program (MEP).

ACADEMIC PREPARATION

"I didn't know what computer science meant before I came to college. And I learned more about it in my intro class, and then even when I took the programming classes, I was like what is Java? … I had no idea what programming languages were, so I think my big mistake was going into an accelerated class." [Student Focus group, 2019]

Students in both the surveys and focus group sessions discussed their fears regarding the disparities of academic preparation for engineering. Our scales measuring a holistic sense of pre-college academic support identified numerous statistically significant differences between demographic groups. Returning-generation students reported statistically significantly higher levels of high school support, and parental support for college while underrepresented students reported having statistically significantly lower levels.

"My experience in the very beginning was very difficult because I felt like I was going into a field that I had no experience with. We were co-mingling with all the other robotics majors and things like that. And I realized, like holy crap, I have no idea why

I'm here. I don't feel qualified to be here because a lot of people I was meeting, they were like, oh yeah, I was president of my robotics team in high school and I learned a lot of code and all this stuff. And this other guy was like, oh yeah I did an internship at NASA." [Student Focus group, 2019]

Survey findings corroborate interview findings. Twenty-three percent of returning-generation students self-reported attending a summer coding camp that their parents paid for, whereas only 4% of first-generation students reported this opportunity. Alternatively, we saw no statistically significant differences for diversity- or merit-based summer programs. Six percent of returning-generation students reported to have received private STEM-related tutoring though no first-generation students indicated this support. This difference was statistically significant. When comparing ethnic groups, we saw no statistically significant differences across both paid and diversity- or merit-based summer programs, but again detected a significant difference for tutoring.

Through discussions with students it became apparent that the academic preparation gap comes from AP computer science and we began to see a pre-college preparation gap emerge. Availability of AP CS was significantly lower among first-generation (44%) and underrepresented ethnic minority (42%) students than returning-generation (63%, p=.001) and non-underrepresented ethnic minority (61%, p=.005) students. For first-generation students, we likewise saw lower levels of participation in programming language classes (FG=25%, RG=44%, p=.001), computer science clubs (FG=29%, RG=47%, p=.001), and robotics clubs (FG=44%, RG=58%, p=.016).

RETENTION AND MATRICULATION OF UNDERREPRESENTED STUDENTS

To discover why the division has become more ethnically and socioeconomically homogenous, we conducted analyses of GPAs that could point to whether students leave because they are failing courses or because they are simply choosing other majors. The analyses revealed that women earn better grades than men, Caucasian and Asian students earn better grades than Latinx students in Baskin, and returning-generation and non-EOP students earn better grades than first-generation and EOP students in the School.

There is a consistent GPA gap between first- and returning generation students, irrespective of GPA type, stayed versus left, or cohort. Our analysis indicates that STEM course performance specifically, as opposed to overall academic performance, may be contributing to higher major attrition of first-generation students.

Unlike all other underrepresented groups in the BSOE, women out earn their more represented male peers, as shown in Table X. Women who leave the BSOE have better grades than men who leave the BSOE (e.g., SOE GPA: Women=2.74, Men=2.56). Women who stay in the BSOE have better grades than men who stay in the BSOE (e.g., STEM GPA: Women=3.12, Men=3.07). The gaps between men and women are the largest among those

who leave and for total GPA, but they appear consistently across all GPA types and both those who do and do not declare.

Socioeconomic and ethnic groups appear to leave the School at greater rates because of their academic performance, except for women. Something other than course performance is contributing to attrition of women in the School. We also see that GPA gaps are not reliably changing between EOP/Non-EOP and men/women, but the gaps between Latinx/Caucasian and first- and returning-generation students are reliably increasing as time goes on. Not only are gaps between ethnic and parental education groups growing, our models suggest that Caucasian and returning-generation students' GPAs are improving as Latinx and first-generation students' GPAs are stagnating or collapsing. As with declaration rate gaps, this trend has inflected in recent years. Finally, the academic performance gaps are shored up disproportionately in STEM classes and are greater among those who leave the division.

Conclusion and Recommendations

The student experience study was commissioned to understand the climate of our School as experienced by our students. The study triangulated data by collecting institutional data, conducting focus groups, and administering surveys. We found the following issues relating to the homogeneity of students, differential academic preparation, and the retention and matriculation of students. While the School has grown exponentially in the past ten years, the diversity in the population has decreased. Our students of color do not find the School or campus as welcoming to those who differ from the dominant culture. Based on the data in the study, perception is reality. The data showed attrition of female students at a higher rate than males despite having a higher-grade point average. Underrepresented students are forced to leave the School of Engineering due to academic performance. One cause is based on pre-college backgrounds. Returning generation, dominant group students reported having an engineer in their families, having a wide network of connections, and attended coding/programming camps or classes. This is a privilege not afforded to some students and explains the struggles that many students experience.

IMPLICATIONS FOR PRACTICE

From the study we recommend several items to be considered by focusing on support for students, staff, and faculty.

Outreach

As previously mentioned, the Baskin School of Engineering has become more homogenous in its demographics. The first step to retaining and graduating diverse populations is recruiting them. Attending diverse conferences such as SACNAS, NSBE, SHPE, etc., will introduce the School to prospective undergraduate and graduate students who are currently interested in engineering. There are also several STEM high schools in the western region of the United States from which we should establish a practice of annual diversity recruiting.

Mentorship

From our study, we discovered that regardless of sex, race, or socioeconomic status our students have not experienced mentorship in a meaningful way. Mentorship can provide multiple pathways for students to envision. They also open new networks for historically underrepresented students in engineering. In the 2020-2021 academic year, there will be a pilot mentorship program that will pair incoming students with industry alumni.

Student travel funds for conferences

Underrepresented students possess the ability and skills in engineering but many times lack a professional network. These networks give advantages to students who have access and disproportionately disadvantages those who do not. Professional conferences are imperative for students to attend in order to have access to large companies, however they are cost prohibitive to our most vulnerable students.

Learning Community and Sense of Belonging

By increasing assistance through the MESA Engineering Program (MEP), a URM academic excellence learning community, we will be able to increase the retention rate of our students as well as STEM graduation rates. Because many students find community and a sense of belonging through student organizations, we propose providing funding for the engineering-oriented organizations. We recommend funding increase for this program and faculty involvement.

Speaker, Career and Graduate series and writing workshops

Another common intellectual experience among students is hearing from those in the engineering field as it is a structured opportunity that involves diverse voices. This past year, through sponsors, the School invited four engineers to speak with our students. The expansion of this program would include industry series and graduate school/research speaker series. Some of these series can be done by collaborating with student organizations within the School of Engineering.

Writing is a key part of the process of graduate school. Per the 2017 UCSC Graduate Student Survey, one in three students reported low/no proficiency in writing articles for publication, and one in two students reported low/no proficiency in writing funding proposals. Writing intensive courses are a high impact practice that we would like to implement with our graduate students. This includes, but is not limited to, meeting basic writing needs for our international students, who make up 48% of our School's graduate population.

Policies

Many policies have the unintended consequence of disproportionately affecting underrepresented groups. It is imperative for policies to be regularly reviewed, and where necessary revised. We recommend creating a faculty committee to review Baskin Engineering divisional and departmental policies.

Inclusive pedagogy, faculty support and research

"My advice is that if you're already asking me for how to catch up right now, it's a starter course. You're not made for this major. You should really just find something else." [Student Focus group, 2019]

The preceding quote came from one of our students recounting an experience with an engineering professor. It is imperative that we support faculty in order for them to support our students. We will look to engaged faculty to assist with integrating and initiating inclusive pedagogy while also implementing our program which will include:

- Mini-grants for faculty research on inclusion in the classroom
- Funding for faculty to attend diversity, inclusion, and pedagogical conferences
- Funding to enculturate inclusivity within the school of engineering including:
  - Faculty speakers
  - Understanding mentorship with first generation, low income, and students of color
  - Hiring tutors for courses which have equity gaps
  - Hiring researchers for conducting inclusive engineering education research and continuing experience studies regularly
  - Organizing diversity, inclusion, and equity workshops for faculty and staff

Student Research

"I wish the School of Engineering department can arrange more events to let students get involved in doing the research/ project." [Student Focus group, 2019]

Research is imperative for students intending to attend graduate school or going into industry. One way to encourage students to present their work at conferences is to provide funds for registration fees for students who have had their papers or posters accepted into conferences. The fees are often cost-prohibitive and providing funds will allow students to focus on research instead. Another approach is to work with the School's departments and work with external agencies to identify Research Experiences for Undergraduates (REUs).

Inclusive Excellence Hub

In order to create a space for learning and support, we recommend creating the Inclusive Excellence Hub. This space can house engineering diversity, equity, and inclusion initiatives and create a community of practice. The Hub will provide resources of information and funding for students and faculty. The Hub will be imperative to creating a climate of inclusivity while focusing on the recruitment, retention, and completion of engineering students.

Our students have shown grit and resilience in the face of challenges. The study has created a benchmark that has shown that we have work to do. By taking the recommendations, Baskin will strive to create a space of anti-racist, supportive inclusive excellence.