E3 EDUCATIONAL ENVIRONMENT IN ENGINEERING

2019 SURVEY RESULTS

OVERVIEW

The Educational Environment in Engineering (E3) Survey was administered in the UW-Madison College of Engineering in Spring 2019, and over 1000 undergraduate students and 295 graduate students responded. Major survey topics included student attitudes towards and experiences in the College, commitment to their choice of major, students' own confidence in engineering tasks, and future career plans in engineering.

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E3 Executive Summary

The E3 (Educational Environment in Engineering) survey was sent to all UW-Madison College of Engineering (the College, or CoE) enrolled graduate (Grad) and undergraduate (UG) students in Spring 2019. The purpose of the survey is to measure students' attitudes toward key components of the educational environment in the College, including interactions with professors, teaching assistants, and other students; college resources, as well as students' attitudes towards their own abilities in engineering and their future educational and career plans.

A key part of the mission of the College is to be welcoming to all students. One of our goals is to increase the representation of women and students from racial/ethnic and other groups that have been historically underrepresented in both engineering education and the field of engineering. Prior research has suggested that women, racial/ethnic minorities and students who identify as a sexual minority or LGBTQ+ students have lower representation in engineering, and this lower representation may be linked to an unwelcoming educational environment. Thus, our data analysis includes a focus on understanding how members of these group may differ from other students in their evaluation of and attitudes about engineering.

Previous survey data from enrolled undergraduate students were collected and analyzed in 2015. This allows us to compare many of the undergraduate student responses to previous years to get a rough idea of trends in student attitudes. The following are some key takeaways from the 2019 E3 survey and data analysis:

- For undergraduate students, changes since 2015 are small but mostly negative. A slightly higher percentage of students reported experiences of stereotyping and harassment, and students were less positive in their evaluation of their professors, their expectations of the field, their confidence in their engineering academic confidence and their commitment to engineering education.

- Women undergraduate students had significantly lower academic confidence in coursework required for an engineering degree than their male peers, and the largest difference in academic confidence between males and females was their engineering-specific coursework (compared to required coursework in chemistry, physics, math or labs). Female students also reported lower satisfaction with peer interactions than did their male peers, lower feelings of being welcome in the College, and lower ratings on believing their peers listen to and respect their suggestions.

- Of 21 areas of evaluation of the CoE professors, both graduate and undergraduate students give professors their highest ratings on respecting students in the classroom, but their lowest ratings on meeting with them for help with coursework. For undergraduate students, this is consistent with 2015 results.

- While there was a small (but representative) number of graduate student participants who identified as domestic targeted minority students, these students' experiences and attitudes toward their educational experiences in College were consistently more negative than majority or international graduate students. These students reported feeling the least welcome in the College when compared to any other group.

- Graduate students involved in research report trusting relationships with their Principal Investigator (PI)/faculty advisor, but also report they are routinely given more work than is reasonable to complete.

Survey Overview

The E3 (Educational Environment in Engineering) survey was sent to all College of Engineering enrolled graduate and undergraduate students in Spring 2019. Invitations and reminders to complete the E3 survey were sent to 5450 students (1338 Grad; 4112 UG), and yielded usable responses from 1427 students (295, Grad=25.9 response rate; 1132, UG=27.5% response rate). Only students who had taken at least one course in the College of Engineering were eligible to complete the survey. Participants' self-identified demographic information was broadly representative of College enrollment. Both graduate and undergraduate women were slightly over represented, and domestic targeted minority students were slightly underrepresented compared to their enrollment in the College. For the full demographic description of survey respondents and a comparison to College enrollment, see Appendix 1: Survey participant . For additional survey methodology information, see Appendix 5 – Methodology and Psychometrics.

All participants were asked to self-identify their career educational status (undergraduate student or graduate student, and for graduate students: research Masters, coursework Masters, professional school graduate student or Ph.D. student), major or closest department affiliation, sex, gender identification, citizenship, racial/ethnic group, LGBTQ+ identification, disability status, first generation student status, age, student organization affiliation, sources of funding for college, outside work for pay, college and high school cumulative GPA, and future career plans. The survey measured students' quantitative ratings and qualitative (comments) responses in the following content areas:

1. Experiences of stereotyping and harassment and estimates of exclusionary behavior by faculty/other students
2. Experiences with professors and teaching assistants
3. Welcoming by faculty, staff, other students, departments
4. Engineering academic confidence
5. Engineering student interactions
6. Engineering career expectations
7. Commitment to engineering major
8. Evaluation of College resources
9. Environment in research labs/groups (students who work in research labs/groups only, N=389)
10. Engineering research confidence (research Ph.D. & M.S. only, N=263)
11. Engineering teaching training & confidence (teaching assistants only, N=103)
12. Relationship with principal investigator/faculty advisor (research Ph.D. only, N=197)

This data collection is the third in a series of cross-sectional studies. Enrolled undergraduates in the College of Engineering were surveyed on many of the areas above in 2015. In 2019, graduate students were added as participants and new items and scales were added (3, and 9-13 above).

Survey Results

The following sections detail key quantitative results on each section of the E3 survey. Quantitative results tables can be found in Appendix 2: Scale and Item Results. Selected qualitative comments can be found in Appendix 3: Sampling of Qualitative Responses.

Stereotyping, Harassment and Exclusionary Behavior

Undergraduate and graduate student respondents overall

We asked participants about experiences of being singled out in class, hearing stereotypical statements, and being harassed based on gender, racial/ethnic identity and LGBTQ+ identity. We also asked students to estimate the proportion of faculty and their peers who engaged in exclusionary behavior. For undergraduate students and for many of these items, we are able to compare responses to responses our 2015 survey.

Across all undergraduate respondents, there was a small increase from 2015 in the percentage of students who reported experiences of being "singled out" due to their identity, hearing identity-based stereotyping or experiencing identity-based harassment. For example, students reported feeling singled out in class more often by faculty, teaching assistants or other students due to gender (12.8%, up from 9.4%), or race (5.0%, up from 3.2%); a substantial percentage of students reported hearing faculty/instructional staff express gender stereotypes in class (17.9%, up from 14.2%) and stereotypes of race/ethnicity (8.3%, up from 7.1%). Just under half of undergraduate students report hearing other students in class express gender stereotypes (40.5%, up from 38.5%). There was a slightly lower percentage of undergraduate respondents who reported hearing racial stereotypes from other students (34.9%, down from 37.0% in 2015).   [Table 2.0: Stereotyping and harassment]

For the first time in 2019, we asked participants to estimate the proportion of engineering a) faculty/instructors, or b) other students who, at least occasionally, engaged in exclusionary behavior towards women or people of a different race/ethnicity than their own. A substantial minority of all undergraduate students (32.1%) estimated some faculty/instructors engaged exclusionary behaviors towards women, while the remainder thought "None or nearly none" engaged in exclusionary behavior toward women. A similar percentage of undergraduates (27.1%) thought some faculty/instructors engaged in exclusionary behavior towards people with races/ethnicities different from their own. When asked about exclusionary behavior by other engineering students, a majority of undergraduate students (54.6%) thought some of their peers engaged in exclusionary behavior towards women. Finally, a larger percentage of undergraduate respondents (58.2%) thought some engineering students engaged in exclusionary behavior towards people with races different than their own. [Table 2.1: Exclusionary behavior towards women, difference by gender] and [Table 2.2: Exclusionary behavior towards different race/ethnicity, by racial/ethnic/international status].

After responding to items about hearing stereotypes and estimating exclusionary behavior, respondents are asked about more serious experiences of harassment (sexual, racial/ethnic and sexual orientation) from different sources (faculty, teaching assistants, other students). These more serious experiences

were reported by participants at much lower, but unfortunately non-zero levels. There were a total of 39 undergraduate participant responses of experiencing sexual harassment. These experiences were reported to be by faculty (6), teaching assistants (2) or other students (31). This represents both a higher percentage of students identifying these experiences, as well as a higher total number of responses than in 2015. There were a slightly lower number of undergraduate responses identifying experiences of racial/ethnic harassment than in 2015, but again unfortunately this was non-zero. In 2019, there were a total of 17 undergraduate responses of racial/ethnic harassment by faculty (5), teaching assistants (2) or other students (10).[Table 2.0: Stereotyping and harassment]

We surveyed graduate students for the first time in 2019, so we cannot make comparison to previous survey data, however for information purposes we can compare to undergraduate students.[1] Compared to undergraduate students, graduate students reported being "singled out" in class due to gender at lower levels (Grad 9.2%, vs. UG 12.8%), but singled out in class due to race/ethnicity at higher levels (Grad 6.4%, vs. UG 5.0%). Graduate students reported hearing faculty express stereotypes about race (9.9%) and gender (12.6%), and other students express stereotypes about race (25.3%) and gender (25.7%). These proportions are significantly lower than the proportions of undergraduate students on the same items, yet, a substantial percentage of graduate students responded that they had observed or experienced these behaviors. [Table 2.0: Stereotyping and harassment]

Regarding estimates of exclusionary behavior, graduate students were similar to undergraduate students. About a third (33.2%) of all graduate students estimated that some engineering instructors engage in exclusionary behavior towards women, and about half (49.5%) estimated that some other students engage in exclusionary behavior towards women. [Table 2.1: Exclusionary behavior towards women, difference by gender.] Similarly, a third (32.9%) of all graduate students estimated that some engineering instructors engage in exclusionary behavior towards people of different races/ethnicities, and more than half (56.7%) believe some other students engage in such behavior. [Table 2.2: Exclusionary behavior towards different race/ethnicity, by racial/ethnic/international status]

On more serious reports of harassment, no graduate students reported sexual harassment by faculty, but there were reports of sexual harassment by other students (8 respondents, 2.7%) and by a teaching assistant (1 respondent, 0.3%); and reports of racial/ethnic harassment by faculty (2 respondents, 0.7%), and other students (6 respondents, 2.0%). Despite the small number of reports, racial/ethnic harassment, particularly harassment by other students, was reported at higher rates by graduate student participants than undergraduate student participants. [Table 2.0: Stereotyping and harassment]

Group Comparison: female and male respondents

For both undergraduate and graduate students, there were significant differences in how female students responded to items about gender stereotyping and harassment when compared to male students. Both undergraduate and graduate female students reported all items related to gender stereotyping, and exclusionary behavior towards women at significantly higher levels than did undergraduate and graduate male students. Fully one-third (33.2%) of undergraduate women respondents reported hearing gender stereotypes by faculty (vs. about 9.9% of undergraduate men),

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[1] We did not perform statistical significance tests on differences between graduate and undergraduate students because of the large number of potential comparisons.

and two-thirds (60.6%) reported hearing gender stereotypes from other students (vs. about 29.9% of men). Similarly, graduate women reported being singled out in class, hearing other students express gender stereotypes in class, and being sexually harassed by other students at significantly higher rates than their graduate male peers. 15.4% percent of graduate women respondents reported hearing faculty express gender stereotypes, and 41.3% reported hearing gender stereotypes from other students. [Table 2.3: Stereotyping and harassment related to gender, difference by gender]

Women respondents estimated the proportion of faculty and other students who engaged in exclusionary behavior based on gender at higher levels than male students. About 50% of women (Grad 50.0%, UG 49.2%) thought faculty at least occasionally behaved in exclusionary ways towards women, and over two-thirds (Grad 67.0%, UG 75.5%) thought other engineering students at least occasionally behaved in exclusionary ways toward women. [Table 2.1: Exclusionary behavior towards women, difference by gender]

The vast majority of undergraduate and graduate respondents who reported experiencing sexual harassment identified as female (about 90%, not shown in tables).

Group Comparison: domestic majority, domestic targeted minority, international respondents

The number of graduate and undergraduate participants who self-identify as domestic targeted minority (African American, Latino/a, Southeast Asian, Native American, Alaskan Native, Native Hawaiian) generally reflects the representation of the College (6.2%) but is numerically very low (N=89) in comparison to the size of the domestic majority students (N=1098) or international students (N=231) in the sample. The large difference in group size limits our ability to find statistically significant differences between domestic minority, domestic majority, and international students' responses on these and other items. That is, legitimate differences in response patterns may not reach statistical significance. We report important differences we observe regardless of statistical significance, because of the importance of these gaps in the experience of our underrepresented minority students.

Similar to gender group differences, undergraduate students who identified as a member of a domestic minority group reported racial stereotyping and harassment at higher rates than did majority or international students. A little less than half (44.9%) of domestic minority respondents reported hearing other students express stereotypes in class, and slightly more than one-tenth (11.6%) reported hearing such comments from faculty or teaching assistants in class. [Table 2.4: Stereotyping and harassment of racial/ethnic groups, difference by racial/ethnic/international Status]

Similarly, a larger percentage of undergraduate targeted minority students estimated that some faculty at least occasionally behaved in an exclusionary way towards people of different races/ethnicities than their own, when compared to domestic majority or international students. (TM=42.0%, Maj=26.0%, Intl=28.2%). A much larger percentage of targeted minority students also estimated that other engineering students at least occasionally behaved in an exclusionary way toward people of different races than their own (TM=75.4%, Maj=57.5%, Intl=53.7%). For graduate students, by group, domestic majority students had the largest proportion of students (TM=30.0%, Maj=39.6%, Intl=25.6 %) who estimated some exclusionary behavior by faculty towards people of races/ethnicities different from their own. Domestic graduate students (whether they identified as minority students or majority students) were much more likely to observe exclusionary behavior by fellow students than their

international counterparts (TM=70.0%, Maj=64.9%, Int'l=45.5%). [Table 2.2: Exclusionary behavior towards different race/ethnicity, by racial/ethnic/international status].

Harassment based on race or ethnicity, like sexual harassment, is more serious. We would expect that the individuals who report experiences of racial/ethnic harassment to be underrepresented minority or international students in the College, although some majority students did report this experience in our survey. Of the total number of reports of racial harassment by participants from all sources (N=24), about 35% were from students that identified as domestic targeted minority, 35% from international students, and 25% from majority students. [Data not reported in tables.]

Group Comparison: LGBQT+ and non-LGBQT+ respondents

For the first time in 2019, we asked participants whether they identified as a lesbian, gay, bisexual, queer/questioning, transgender or transsexual or queer/questioning (LGBTQ+) person.[2] 6.8% of participants reported an LGBQT+ identity (Appendix 1). While items related to stereotyping and harassment based on LGBTQ+ identity were very low overall, LBGTQ+ students reported much higher levels of such stereotyping and harassment compared to other students. For example, about 40% of undergraduate and graduate LGBTQ+ respondents reported hearing other student express stereotypes about LGBTQ+ people (UG=38.2%, Grad=42.1%) compared to just 13.7% of non-LGBTQ undergraduates and 8.5% of non-LGBTQ graduate students. All other items of stereotyping and harassment showed similar, statistically significant group differences. [Table 2.5: Stereotyping and harassment based on sexual orientation, difference by LGBTQ+ identity.]

Satisfaction with Professors

I.   Undergraduate Respondents

There are 21 survey items that ask students to evaluate their professors in the College. Broadly, items ask about classroom characteristics, clarity of syllabi and course materials, grading and feedback, office hours, rate of coverage of material, and overall satisfaction. An average value representing an individual participant's evaluation of professors was computed for each participant who responded to 85% or more of the items about professors. The "Professor Satisfaction (PS)" score for professors is thus the average of a group of participants' averages (e.g., the mean of the mean, or the population mean). For a complete list of items on the Professor Satisfaction or other survey scales, refer to Appendix 4– Survey Items by Section/Scale.

Compared to 2015, there was no significant difference in the undergraduate students' PS scores (3.52, vs. 3.54 in 2015). Similar to 2015, in 2019 there were no significant differences between PS ratings by domestic targeted minority students and domestic majority students, however the differences between both of these groups and international students, who rated professors the highest, was significant

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[2] A single question was used ("Do you identify as an LGBTQ+ person?") rather than asking about each separate orientation or gender presentation in order to protect participant identity; and also because no analysis was planned for separate LGBTQ+ identities.

(TM=3.45, Maj=3.51, Int'l=3.65). Female undergraduate students rated professors significantly lower than did male undergraduate students (Fem=3.48 Male=3.54). [Table 2.6 Satisfaction with engineering professors and teaching assistants].

We considered individual items that are part of the PS scale in order to better understand areas of satisfaction and dissatisfaction. Of the 21 items evaluating professors, the highest and lowest ranking items for all undergraduates was:

- HIGHEST: *How often do your Engineering professors treat you with respect in the classroom? (Mean=4.48)*
- LOWEST: *How often do you <u>meet with</u> your Engineering professors for extra help with coursework? (Mean=2.32)*

On individual items related to professors, significant differences emerged between undergraduate <u>international students</u> and other undergraduate student groups (domestic majority and domestic targeted minority). For each item below, international students ranked professors significantly <u>higher</u> than either majority or targeted domestic students.

- *How much do your Engineering Professors care whether or not you learn the material?*
- *How often do your Engineering Professors write helpful comments on the materials and course assignments you turn in?*
- *How comfortable are you asking professors questions in your courses?*
- *How often do you think your Engineering professors think you have lower ability than you have?[3]*
- *How comfortable are you meeting with professors for extra help?*
- *How much do your Engineering professors inspire you to study engineering?*
- *Overall, how satisfied are you with your Engineering professors?*

Graduate Respondents

Graduate students overall rated professors more highly than did undergraduate students (Grad=3.73, vs. UG=3.52). However, the highest and lowest scored Professor items for graduate students were identical to that of undergraduate students:

- HIGHEST: *How often do your Engineering professors treat you with respect in the classroom? (Mean=4.61)*
- LOWEST: *How often do you meet with your Engineering professors for extra help with coursework (Mean=2.66)*

Considering group differences on graduate students' satisfaction with their professors, there was no significant gender difference on the overall PS scale or individual items. However, on the overall scale and on most of the individual scale items, <u>domestic minority graduate students</u> rated their professors significantly lower than did their domestic majority or international peers. [Table 2.6: Satisfaction with engineering professors and teaching assistants.]

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[3] All negatively worded items were reversed coded so values are consistent with other items and a higher score indicates a more positive response.

The largest difference in the averages between these student groups was on the item:

- *How much do your engineering professors <u>inspire</u> you to study engineering?* (Maj=3.85, Int'l Mean=3.95, Domestic Minority Mean=3.10)

In summary, when evaluating their satisfaction with Engineering professors, domestic majority and international student groups had similar response patterns, while <u>domestic targeted minority graduate students had significantly more negative response patterns</u>.

Teaching Assistants

We asked both undergraduate and graduate students who had had a teaching assistant (TA) to respond to items about their experiences with their TAs, creating a scale of "Teaching Assistant Satisfaction" (TAS) similar to the PS scale created for professors. Overall, undergraduate students in 2019 rated their TAs approximately the same as did students in 2015 (Mean=3.59 vs. 3.64). Most graduate student respondents had also had TAs in their courses, and consistent with professor ratings, rated their TAs slightly higher than did undergraduate students (Grad=3.65, vs. UG=3.59).

Also similar to professor ratings, undergraduate students highest and lowest rated items for TAs was:

- HIGHEST: *How knowledgeable are your Engineering Teaching Assistants about the subjects that they teach? (Mean=3.89)*
- LOWEST: *How often do you meet with your Engineering Teaching Assistants for extra help? (Mean=2.52)*

Finally, consistent with professor ratings, domestic targeted minority graduate students evaluated their TAs significantly more negatively (Domestic Targeted Minority Mean=3.37) than did their domestic majority or international peers (Maj Mean=3.63, Int'l Mean=3.72). There was no group difference between male and female graduate students on their ratings of the TAs. [Table 2.6. Satisfaction with engineering professors and teaching assistants]

Feeling Welcomed

In 2019 we added 4 items to measure students' perceptions of being welcomed to the College by different constituencies (professors, TAs, academic department, other students). Together these items made up a scale we called "Feeling Welcomed" (FW). Overall, graduate students indicated more positive experiences of Feeling Welcomed (Grad=3.90) than undergraduate students (UG=3.77). On individual scale items, undergraduate students reported their "academic department" make them feel <u>most</u> welcome (Acad Dept=3.86) while "other students" made them feel <u>least</u> welcome (Other Students=3.68). This pattern was identical for graduate students (Acad Dept=4.00; Other Students=3.70).

Different groups of students had significantly differing averages for the "Feeling Welcomed" total scale. Women undergraduates felt significantly less welcome than their male peers (FW Female=3.70; FW Male=3.81). Women graduate students, however, felt about as welcome as did male graduate students. Domestic targeted minority undergraduate and graduate students feel significantly less welcome than International or Domestic majority students. The difference between targeted minority graduate students and majority graduate students was the largest gap (FW TM=3.49; FW Maj=3.98) and was statistically significant, even though only 20 URM graduate students responded to these items. [Table 2.7: Feeling Welcomed]

Engineering Academic Confidence

Engineering Academic Confidence[4] (EAC) is a 6-item scale that measures how confident students are in their ability to successfully navigate the variety of academic challenges in an engineering course curriculum, including course work (engineering, math, science) and lab work. Items also ask students to compare their engineering academic abilities to those of their peers.

Undergraduate students' average Engineering Academic Confidence is lower EAC UG=3.70), than the average of undergraduate students in 2015 (EAC UG=3.91). Consistent with the majority of historical research in this area, female undergraduate students on average had significantly lower Engineering Academic Confidence (EAC Female=3.61) than the average of male undergraduate students (EAC Male=3.85). Further, the gender difference was evident on all 6 scale items – that is, no single item on the scale appears to strongly drive the overall scale average. Still, the largest difference between male and female undergraduate students was seen in the item asking about their academic confidence in engineering courses, in contrast to foundational courses such as math and science, or lab courses.

As would be expected, for graduate students in engineering, overall Engineering Academic Confidence was high when compared to undergraduates (EAC Grad=3.96). There was no significant difference in Engineering Academic Confidence between male and female graduate students. This result is not surprising as both male and female engineering graduate students have already experienced significant success in their engineering academic coursework, and previous success is a key source of self-efficacy information.

There were no significant differences in Engineering Academic Confidence between domestic targeted minority, domestic majority or international students at the undergraduate level. However, at the graduate level, as was found with other measures, domestic targeted minority students (EAC TM=3.56) were again significantly different than either domestic majority students (EAC Maj=4.05) or international students (EAC Intl=3.92). [Table 2.8: Student Experiences in Engineering, 2015 and 2019.]

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[4] In psychology research literature, this construct is called "self-efficacy" (Bandara, 1977) which is defined as an individual's belief in their ability to successfully execute tasks in a particular domain, such as engineering academic course work. We have chosen to use the more common lay term "confidence".

Engineering Student Interaction

Students' satisfaction with their peer interaction in the College of Engineering is measured with 7 items, which ask students about their experiences working on group projects and in study groups, and how much they feel other students compete or collaborate with them. We combine these items into a scale called "Engineering Student Interaction" (ESI). Undergraduate students' ratings of their interactions with other engineering students was nearly identical in 2019 (UG=3.57) to students in 2015 (UG=3.55). Further, 2019 graduate students had an identical level of satisfaction with peer interaction as undergraduate students (Grad=3.57). [Table 2.8: Student Experiences in Engineering, 2015 and 2019]

At the undergraduate level, there were differences on the ESI scale between racial/ethnic/citizenship status groups, with domestic minority students and international students having significantly less positive evaluations of student interactions than domestic majority students (ESI UG TM =3.43, ESI UG Int'l=3.46, ESI UG Maj ESI=3.58). There were no significant differences on the ESI scales based on gender. However, several individual scale items had significantly different averages responses between male and female respondents. The largest gender difference was on the individual scale item:

- *How seriously do other students take your comments or suggestions in class or on group projects? (Male UG=3.67, Female UG=3.51)*

At the graduate level, there were no significant differences in ESI by racial/ethnic or international student status, or by gender.

Engineering Career Expectations

Research on career behavior has established that students' expectations about what occupational benefits (salary, life flexibility, social status, etc.) they will derive from education or career choices is strongly related to their persistence in the field. Indeed, results from our 2015 survey indicated that students' expectations about working in an engineering field was the single largest factor in predicting their commitment to completing their degree. In the E3 survey, 12 items measure students' expectations about a career in the field of engineering. Together these items make up the "Engineering Career Expectations" (ECE) scale.

Compared to student respondents in 2015, on average undergraduate students had less positive Engineering Career Expectations (UG=3.68 in 2019, vs. UG=3.86 in 2015). Graduate students had less positive expectations of a career in engineering than did undergraduates (Grad=3.59). [Table 2.8: Student Experiences in Engineering, 2015 and 2019]

There were no significant differences by sex or racial/ethnic/international status at the undergraduate or graduate level on the overall scale measuring Engineering Career Expectations. However, individual scale items that measured expectations of flexibility and work/life balance demonstrated significant

gender differences for both undergraduate students and graduate students. Female graduate students were the most pessimistic on these items.

- *How flexible do you think Engineering is in allowing people to leave and come back to their careers? (Male UG=3.00, Female UG=2.81, Male Grad=2.92, Female Grad=2.72)*
- *Compared to other fields, how supportive is Engineering …in allowing people to combine personal and family responsibilities with work? (Male UG=3.00, Female UG=2.91; Male Grad=3.04, Female Grad=2.70)*

Commitment to Engineering Education

Students' "Commitment to Engineering Education" (CEE) is a scale with 9 items, intended to measure students' commitment to remaining in Engineering through degree. On average, undergraduate students who responded to the 2019 E3 survey reported slightly lower Commitment to Engineering Education (UG=3.94) than did students responding in 2015 (UG=4.12). Unexpectedly, graduate students on average reported the same Commitment to Engineering Education as did undergraduates (Grad=3.95); we would have expected graduate students to have a higher commitment than undergraduates, given their engagement in additional Engineering education. [Table 2.8: Student Experiences in Engineering, 2015 and 2019]

There were no significant differences by sex or racial/ethnic/international status on the CEE scale at the undergraduate or graduate level.

Engineering Research Groups/Labs

In 2019, we tested a new set of 6 items that were intended to measure students' experiences volunteering or working in Engineering research groups or research labs. Of undergraduate respondents, 206 undergraduates (18.2% of UG respondents) and 180 graduate students (61.0% of Grad respondents) reported that they had volunteered or worked in an Engineering Research Group and responded to these items.

Interestingly, among our respondents, domestic targeted minority students were more likely to have the experience of working in a research groups, (26.0% of domestic targeted minority undergraduate and 80.0% graduate student respondents), while domestic majority students were the least likely (17.3% domestic majority undergraduate and 73.0% graduate student respondents). Male and female undergraduate students were approximately equal in their participation in research groups (18.2% and 18.0% respectively), while a slightly larger percentage of female graduate student respondents work or volunteer in research groups (65.4% of female graduate students vs. 60.0% of male graduate students). [Table 1.0 Undergraduate student participants.] and [Table 1.1 Graduate student participants.]

The six new items were used to create the "Research Group Experience" (RGE) scale. Measured by this scale, undergraduate and graduate students reported very similar levels of overall satisfaction with their experiences working in a research group (RGE UG=3.71, RGE Grad=3.78) [Table 2.9: Student Experiences in Engineering, 2019]. For students working in engineering research labs, the single highest and two lowest rated items were:

- HIGHEST: *How often is the environment in your research group welcoming to you? (UG Mean = 4.31, Grad Mean=4.30)*
- LOWEST: *How often are you mentored by the research group leader or PI? (UG Mean=3.37, Grad Mean=3.72)*
- LOWEST: *How often do you receive feedback on your skills as a researcher? (UG Mean=3.29, Grad Mean=3.41)*

The only item on the scale that demonstrated significant differences between undergraduate and graduate students was *"How often are you mentored by the research group leader or PI?"* Since many research groups are organized hierarchically, it is not surprising that graduate students reported more frequent mentoring by the research group leader (RGE Grad=3.72) than did undergraduate students (RGE UG=3.37).

To maximize power, we grouped graduate and undergraduate students together to investigate differences between groups based on sex and race/ethnicity/international status. However, no significant between group differences were found.

In collaboration with Dr. Angela Byars-Winston, Professor, Division of General Internal Medicine and faculty lead in the Center for the Improvement of Mentored Experiences in Research, we added 10 items for graduate students earning a research Master's degree or a Ph.D. in an engineering major intended to evaluate students' experiences and relationship with their PI or faculty advisor [5]. Broadly, we asked whether the participant trusts their PI, whether their PI supports their research and networking within their field of study, the amount feedback/mentoring they receive from their PI, and the availability of their PI. We called this scale "Relationship with PI" (RPI). The overall scale mean for all graduate school participants was 4.00. [Table 2.9: Experiences in Engineering, 2019]

The highest item on the scale was:

- HIGHEST: *How much do you trust your PI/faculty advisor? (Mean=4.35)*

One item had zero or very low correlation with other items on the scale, and was also the lowest (most negative) item:

- LOWEST: *How often does your PI/faculty advisor give you more work than you can reasonably complete? (Mean=3.32)*[6]

The fact that this item was uncorrelated with other items on the scale indicates that graduate students' evaluation of their relationship with their PI may be unrelated to the amount of work that they are given. However, it may contribute to students' overall satisfaction with their educational experience.

There were no significant group differences by gender on the overall RPI mean or any of the individual scale items. However, there were differences on both the overall RPI scale and individual items for targeted domestic minority students. On the overall scale, domestic targeted minority respondents' group mean (RPI TM=3.57) was significantly lower than either domestic majority students (RPI Maj=3.98), or International (RPI Intl=4.00) students. Three items showed the largest differences between these groups:

- *How much does your PI/faculty advisor help you with career opportunities? (TM=2.92, Maj=3.84, Intl=3.91)*
- *How much does your PI/faculty advisor help you with networking in your field? (TM=2.92, Maj=3.90, Intl=3.76)*
- *How often does your PI/faculty advisor give you career opportunities such as additional research or conference presentations (TM=3.54, Maj=4.00, Intl=3.86)*

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[5] Participants were first asked if their PI and faculty advisor were the same individual. If they were not, we asked them to consider the individual who was most influential on their graduate research.

[6] Because of the low correlation of the lowest scale item, this was not included in the computation of the scale mean.

As with Engineering Academic Confidence, graduate students involved in engineering research and teaching were asked about their training and confidence in these activities. Regarding research, items asked students involved in research (N=263) about their confidence in contributing to and conducting their own research and publication ("Research Confidence" (RC)). For teaching, we asked graduate students who have been Teaching Assistants (N=103) about their preparation and support for teaching tasks ("Teaching Assistant Training" (TT)), and their confidence in contributing to teaching a course, developing curriculum and classroom management ("Teaching Assistant Teaching Confidence" (TC)). Of these three scales, respondents had higher confidence in their teaching (TC=3.91), than research (RC=3.77); however, they rated their training in components of teaching (lecturing, grading, etc.) comparatively low (TT=3.00). [Table 2.9: Student Experiences in Engineering, 2019.] The highest and lowest rated items on these scales were as follows:

Research Confidence

- *HIGHEST: How confident are you in your ability to succeed in conducting the research associated with your program? (RC Highest Mean=3.98)*
- LOWEST: *Compared to other students in your department, do you think your abilities as an Engineering researcher are (much worse =1 -> much better=5?) (RC Lowest Mean=3.44)*

Teaching Assistant Training

- HIGHEST: *How often do you receive guidance from faculty on the courses you are teaching? (TT Highest Mean=3.59)*
  LOWEST: *How effective is the training you have received on how to grade assignments? (TT Lowest Mean=2.58)*

Teaching Assistant Teaching Confidence

- HIGHEST (tie): *How confident are you in your ability to contribute to teaching an engineering course (TC Highest Mean=4.00)* and *How often do you feel respected by the students in the courses you teach? (TC Highest Mean=4.01).*
- LOWEST: *How confident are you in your ability to lead the teaching of an engineering course (TC Lowest Mean=3.77)*

There were differences between male and female graduate students on these measures, but the differences were statistically not significant. Women reported lower research confidence (RC Fem=3.66) than men (RC Male=3.81), and higher teaching confidence (TC Fem=4.00; Male=3.87). Women were less satisfied with the training they had received in teaching (TT Fem=2.89) than were men (TC Male=3.16).

Domestic targeted minority respondents had significantly lower research confidence (RC TM=3.26) than did international (RC Intl=3.85) or domestic majority (RC Maj=3.76) respondents. They also evaluated their training in teaching lowest (TT TM=2.60), however their teaching confidence was not significantly

different than domestic majority or international students. [Table 2.9: Student Experiences in Engineering, 2019]

College Resources

Students were asked whether they had used various student services resources (Undergraduate Learning Center, Academic Advisors, Faculty Advisors, Career Services, Career Fairs, Diversity Affairs Office, International Engineering/Study Abroad, Academic Dept. Services, and CAE Labs), and if they had used these resources they were asked to rate how helpful they were. The most used resource among undergraduates who responded to the survey was CAE labs (N=911), and the least used was Diversity Affairs Office (N=74).   All student services had an average rating of > 3.5 (1=not helpful; 5=very helpful), with Diversity Affairs Office rated highest by students who used it, and non-Faculty Academic Advising rated the lowest. Note that the role of the academic advisor requires giving students difficult news (regarding academic challenges, progression, course enrollment, etc.) it is not unusual that academic advising can be considered a less positive experiences for some students. [Table 2.10: Satisfaction with College Resources: undergraduate students]

Graduate students also rated College Resources, although services targeted at undergraduates (such as the Undergraduate Learning Center, and the Diversity Affairs Office) had very small usage by graduate students, however these units are primarily charged with serving undergraduate students. Graduate students gave the highest ratings to the resources available in their academic department, including their department administration and chair (Mean=4.01, N=165) and their lowest rating to College Career Fairs (Mean=3.36, N=127). [Table 2.11: Satisfaction with College Resources: graduate students]

E3 EDUCATIONAL ENVIRONMENT IN ENGINEERING

Appendix 1: Survey participant demographic breakdown

Table 1.0 Undergraduate student participants

Demographic Category	Survey Respondents N	College Enrollment N	Survey Respondents %	College Enrollment %
Male	739	3059	65.3%	74.4%
Female	389	1053	34.4%	25.6%
Domestic Targeted Minority*	69	304	6.1%	7.4%
Domestic Majority or Not Specified	949	3304	83.8%	80.4%
International	109	504	9.6%	12.3%
First Generation	146	-	12.9%	-
LGBQT+ Identity	77	-	6.8%	-
Volunteer/Work in Research Lab	206	-	18.2%	-
-Domestic targeted minority	18		26.0%	
- Majority students	164		17.3%	
All	1132	4112		

* African American, Hispanic, Native American/Alaskan Native, Native Hawaiian, Southeast Asian
** Participants with missing data on demographic questions are not included in totals or percentages.
-No data available.

Table 1.1 Graduate student participants

Demographic Category	Survey Respondents N	College Enrollment N	Survey Respondents %	College Enrollment %
Male	187	1003	64.3%	75.0%
Female	104	335	35.3%	25.0%
Domestic Targeted Minority*	20	102	6.7%	7.6%
Domestic Majority or Not Specified	149	653	50.5%	48.8%
International	122	583	41.3%	43.5%
First Generation	51	-	17.8%	-
LGBQT+ Identity	19	-	6.6%	-
Volunteer/Work in Research Lab	180		61.0%	
- Domestic targeted minority	16		80.0%	
- Majority students	109		73.0%	
- Female	68		65.4%	
- Male	112		60.0%	
All	295	1338		

* African American, Hispanic, Native American/Alaskan Native, Native Hawaiian, Southeast Asian
** Participants with missing data on demographic questions are not included in totals or percentages.
-No data available.

Figure 1.0: Undergraduate survey participants by major, as compared to enrollment in Spring 2019
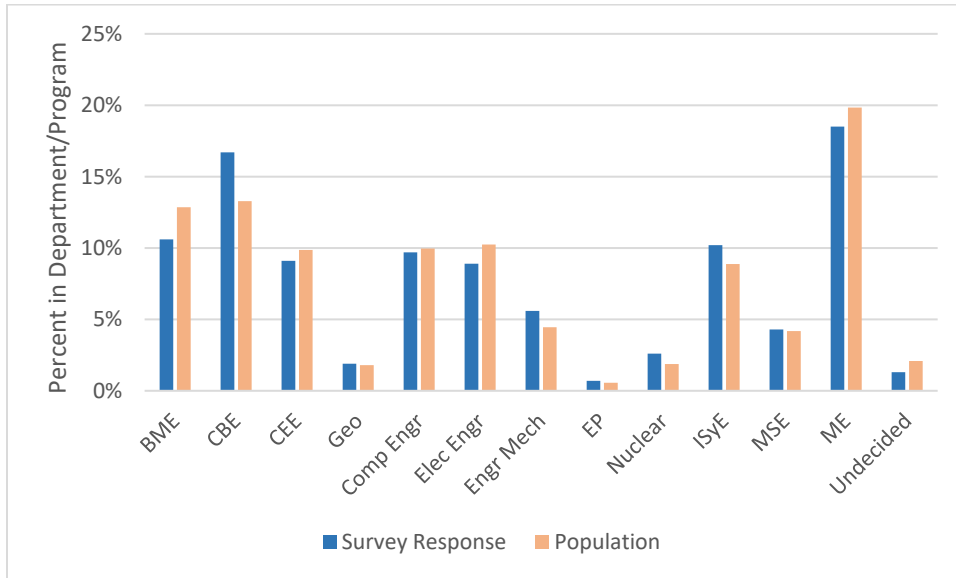
Data from UW Data Warehouse/InfoAccess, enrollment queried for survey invitations

Figure 1.1: Graduate student participants by department, as compared to enrollment in Spring 2019
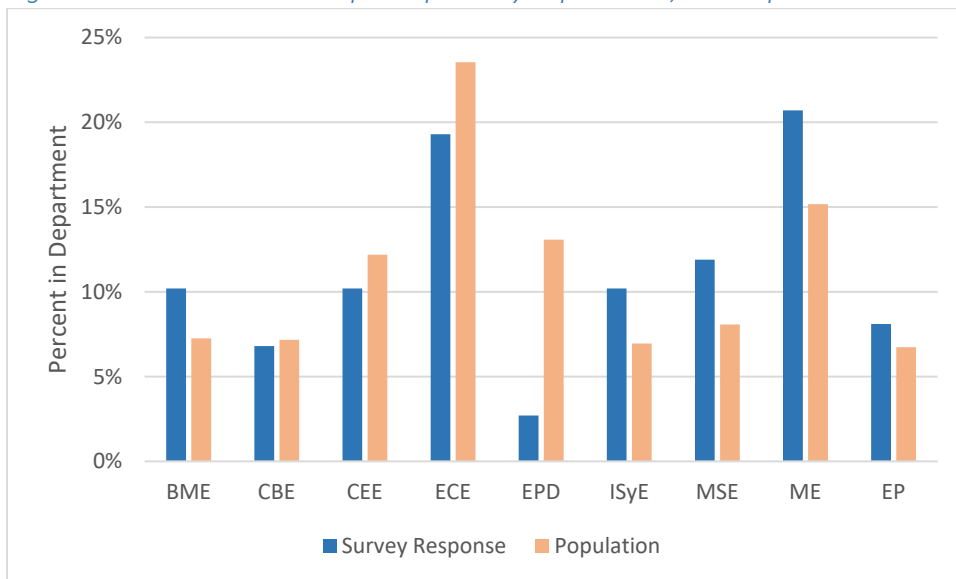
Data from UW Data Warehouse/InfoAccess, enrollment queried for survey invitations

Appendix 2: Scale and Item Results

Selected results are shown in the tables below. Differences shown over time (from 2015 to 2019 for undergraduate students), and differences between undergraduate and graduate student groups were not tested for statistical significance and are shown for comparison information.

Table 2.0: Stereotyping and harassment

| Item	Percent responding "YES"		
	UG 2015 N=1036	UG 2019 N=1132	Grad 2019 N=295
Singled out due to identity			
Singled out unfairly because of gender. (Faculty, TA or other student)	9.4	12.8	9.2
Singled out unfairly because of my race. (Faculty, TA, or other student)	3.2	5.0	6.4
Singled out unfairly because of sexual orientation. (Faculty, TA or other student)	0.4	1.7	1.7
Faculty express stereotypes			
In class, engineering faculty express stereotypes about men and women.	14.2	17.9	12.6
In class, engineering faculty express stereotypes about racial groups.	7.1	8.3	9.9
In class, engineering faculty express stereotypes about LGBTQ people.	3.5	2.6	2.4
TAs express stereotypes			
In class, TAs express stereotypes about men and women.	-	5.9	3.8
In class, TAs express stereotypes about racial groups	-	3.0	2.0
In class, TAs express stereotypes about LGBTQ people.	-	0.9	1.0
Students express stereotypes			
Engineering students express stereotypes about men and women.	38.5	40.5	25.7
Engineering students express stereotypes about racial groups.	37.0	34.9	25.3
Engineering students express stereotypes about LGBTQ people.	6.9	15.5	10.6
Harassment by faculty			
I have been sexually harassed by an engineering faculty member.	0.3 (N=3)	0.5 (N=6)	0.0 (N=0)
I have been harassed by an engineering faculty member because of race.	0.5 (N=5)	0.4 (N=5)	0.7 (N=2)
I have been harassed by engineering faculty member because of my sexual orientation.	0.2 (N=2)	0.3 (N=3)	0.3 (N=1)
Harassment by TAs			
I have been sexually harassed by a TA.	-	0.1 (N=2)	0.3 (N=1)
I have been harassed by a TA because of race.	-	0.1 (N=2)	0
I have been harassed by engineering TA because of my sexual orientation.	-	0	0
Harassment by students			
I have been sexually harassed by an engineering student.	1.0 (N=10)	2.8 (N=31)	2.7 (N=8)
I have been harassed by engineering student because of my race.	1.3 (N=13)	0.9 (N=10)	2.0 (N=6)
I have been harassed by engineering student because of my sexual orientation.	0.1 (N=1)	0.4 (N=4)	0.7 (N=2)

N=Number of reports; - = Question not asked in 2015

Table 2.1: Exclusionary behavior towards women, difference by gender

Item	Percent of each group responding > 1 (e.g. more than "None/Nearly None") Mean (M) on 1-5 scale, where 1=None/Nearly None, 5=All/Nearly All					
	UG Male N=734	UG Fem N=388	UG All N=1122	Grad Male N=186	Grad Fem N=104	Grad All N=292
In your opinion, what proportion of engineering <u>instructors</u> engage at least occasionally in exclusive behavior towards women?	23.0% M=1.32	49.2% M=1.71**	32.1% M=1.45	24.1% M=1.33	50.0% M=1.75**	33.2% M=1.48
	N=733	N=387	N=1120	N=186	N=103	N=291
In your opinion, what proportion of engineering <u>students</u> engage at least occasionally in exclusive behavior towards women?	43.5% M=1.56	75.5% M=2.10**	54.6% M=1.79	40.3% M=1.55	67.0% M=2.11**	49.5% M=1.74

*=significantly different from comparison group to *p<.05*

**=significantly different from comparison group to *p<.01*

Note: Groups may not sum to total. Some respondents answered items but did not identify their group

Table 2.2: Exclusionary behavior towards different race/ethnicity, by racial/ethnic/international status

Item	Percent of each group responding > None or Nearly None; Mean (M) on 1-5 scale, where 1=None/Nearly None, 5=All/Nearly All							
	UG Maj N=946	UG TM N=68	UG Intl N=108	UG All N=1122	Grad Maj N=149	Grad TM N=20	Grad Intl N=121	Grad All N=292
In your opinion, what proportion of engineering <u>instructors</u> engage at least occasionally in exclusive behavior towards people from races or ethnicities different from their own?	26.0% M=1.37	42.0% M=1.56	28.2% M=1.38	27.1% M=1.38	39.6% M=1.57	30.0% M=1.60	25.6% M=1.33*	32.9% M=1.47
	N=942	N=69	N=108	N=1119	N=148	N=20	N=121	N=291
In your opinion, what proportion of engineering <u>students</u> engage at least occasionally in exclusive behavior towards people from races or ethnicities different from their own?	57.5% M=1.77	75.4% M=2.21**	53.7% M=1.73	58.2% M=1.80	64.9% M=1.99	70.0% M=2.25	45.5% M=1.51**	56.7% M=1.80

*=significantly different from one or more other groups to *p<.05*

**=significantly different from one or more other groups to *p<.01*

Note: Participants in each group may not sum to total. Some respondents answered items but did not identify their group.

Table 2.3: Stereotyping and harassment related to gender, difference by gender

Item	Percent responding "YES"			
	UG Female N=388	UG Male N=733	Gr Female N=104	Gr Male N=187
In class, singled out unfairly because of gender by faculty/instructors	9.0%**	0.8%	3.8%**	0.5%
In class, engineering faculty express stereotypes about men and women.	33.2%**	9.9%	15.4%	11.2%
In class, engineering students express stereotypes about men and women.	60.6%**	29.9%	41.3%**	17.2%
I have been sexually harassed by an engineering faculty member.	1.0%	0.3%	0.0	0.0
I have been sexually harassed by an engineering student.	7.3%**	0.4%	6.8%**	0.5%

**=significantly different from comparison group *p<.01*

Table 2.4: Stereotyping and harassment of racial/ethnic groups, difference by racial/ethnic/international Status

Item	Percent responding "YES"					
	UG Maj N=945	UG TM N=69	UG Intl N=108	Grad Maj N=149	Grad TM N=20	Grad Intl N=122
In class, (faculty, instructor or TA) singled out unfairly because of my race.	0.6%	7.2%**	3.8%	0.7%	10.0*	0.0%
In class, engineering (faculty, instructor or TA) express stereotypes about racial groups.	10.6%	11.6%	9.3%	14.1%	27.8%	7.4%
In class, engineering students express stereotypes about racial groups.	34.5%	44.9%	31.5%	32.9%	40.0%**	13.4%
I have been harassed by an engineering faculty member because of race.	0.1%	1.4%	2.8%**	0.7%	0.0%	0.8%
I have been harassed by engineering student because of my race.	0.2%	8.7%**	1.9%	1.3%	10.0*	1.6%

*=significantly different from one or more other groups to *p<.05*

**=significantly different from one or more other groups to *p<.01*

Table 2.5: Stereotyping and harassment based on sexual orientation, difference by LGBTQ+ identity

Item	Percent responding "YES"			
	UG LGTBTQ N=76	UG non-LGBTQ N=1045	Grad LGTBTQ N=19	Grad non-LGBTQ N=271
In class, (faculty or TA) singled out unfairly because of my sexual orientation.	15.8%**	0.7%	21.1%**	0.4%
In class, engineering faculty express stereotypes about LGBTQ+ people.	9.2%**	2.0%	10.5%*	1.8%
In class, engineering students express stereotypes about LGBTQ+ people.	38.2%**	13.7%	42.1%**	8.5%
I have been harassed by an engineering faculty member because of sexual orientation.	1.3%	0.2%	5.3%**	0.0%
I have been harassed by engineering student because of my sexual orientation.	5.3%**	0.0%	5.3%*	0.4%

*=significantly different from one or more other groups to *p<.05*

**=significantly different from one or more other groups to *p<.01*

Table 2.6. Satisfaction with engineering professors and teaching assistants

Rating Scale (1=most negative - 5=most positive)	2015 UG	2019 UG N=1132	2019 Grad N=294
Professor Satisfaction (PS) (21 items)	3.54	3.52	3.73
- Domestic targeted minority students		3.45* (N=69)	3.37* (N=20)
- Domestic majority students		3.51 (N=949)	3.79 (N-149)
- International students		3.65 (N=109)	3.73 (N=122)
- Female students		3.48* (N=386)	3.73 (N=104)
- Male students		3.54 (N=739)	3.73 (N=187)
		N=1065	N=203
Teaching Assistant Satisfaction (TAS) (8 items)	3.64	3.59	3.65 (N=203)
- Domestic targeted minority students		3.57 (N=69)	3.37* (N=14)
- Domestic majority students		3.58 (N=891)	3.63 (N=111)
- International students		3.66 (N=102)	3.72 (N=75)
- Female students		3.59 (N=362)	3.71 (N=75)
- Male students		3.58 (N=701)	3.61 (N=125)

* significant difference from comparison group *p<.05*

Note: Not all students reported having Teaching Assistants in their courses.

Table 2.7: Feeling Welcomed

Feeling Welcomed (FW) Rating Scale (1=most negative - 5=most positive)	2019 UG N=1046	2019 Grad N=290
Feeling Welcomed (4 items)	3.77	3.90
- Domestic targeted minority students	3.53** (N=69)	3.49** (N=20)
- Domestic majority students	3.76 (N=948)	3.98 (N=148)
- International students	3.79 (N=109)	3.89 (N=122)
- Female students	3.70** (N=363)	3.89 (N=103)
- Male students	3.81 (N=701)	3.91 (N=187)

NS=non-significant, * significant difference from comparison group *p<.05*, ** *p<.01*

Table 2.8: Student Experiences in Engineering, 2015 and 2019

Rating Scale (1=most negative - 5=most positive)	2015 UG N=1032	2019 UG N=1126	2019 Grad N=295
Engineering Academic Confidence (EAC) (6 items)	3.91	3.70	3.96
- Domestic targeted minority students		3.70 (N=69)	3.56** (N=20)
- Domestic majority students		3.78 (N=948)	4.05 (N=145)
- International students		3.79 (N=107)	3.92 (N=122)
- Male students		3.85 (N=736)	3.99 (N=187)
- Female students		3.61** (N=389)	3.90 (N=101)
Engineering Student Interaction (ESI) (7 items)	3.55	3.57	3.57
- Domestic targeted minority		3.43* (N=67)	3.28 (N=20)
- Domestic majority students		3.58 (N=945)	3.57 (N=148)
- International students		3.46* (N=109)	3.61 (N=119)
- Male students		3.57 (N=734)	3.57 (N=184)
- Female students		3.53 (N=388)	3.56 (N=103)
Engineering Career Expectations (ECE) (12 items)	3.86	3.68	3.59
- Domestic targeted minority		3.64 (N=69)	3.52 (N=20)_
- Domestic majority students		3.69 (N=947)	3.66 (N=149)
- International students		3.60 (N=108)	3.54 (N=121)
- Male students		3.69 (N=736)	3.58 (N=186)
- Female students		3.66 (N-389)	3.62 (N=104)
Commitment to Engineering Education (CEE) (9 items)	4.12[+]	3.94	3.95
- Domestic targeted minority		3.93 (N=69)	3.86 (N=20)
- Domestic majority students		3.95 (N=948)	4.12 (N=148)
- International students		3.88 (N=107)	4.04 (N=121)
- Male students		3.98 (N=736)	4.0 (N=186)
- Female students		3.88* (N=389)	4.1 (N=103)

* significant difference from comparison group *p<.05*, ** *p<.01*

+ Based on fewer items than 2015 and 2019 measures

Table 2.9: Student Experiences in Engineering, 2019

Rating Scale (1=most negative - 5=most positive)	2019 UG N=1126	2019 Grad N=295
Research Group Experience (RGE)+ (6 items)	3.71 (N=207)	3.78 (N=180)
Relationship with PI (RPI)++ (10 items)	-	4.00 (N=194)
- Domestic targeted minority students		3.57* (N=13)
- Domestic majority students		3.98 (N=88)
- International students		4.00 (N=93)
- Female students		4.00 (N=73)
- Male students		4.01 (N=121)
Research Confidence (RC)++ (5 items)	-	3.77 (N=263)
- Domestic targeted minority students		3.26** (N=20)
- Domestic majority students		3.76 (N=125)
- International students		3.85 (N=115)
- Female students		3.66* (N=94)
- Male students		3.81 (N=166)
Teaching Assistant Teaching Confidence (TC)+++ (4 items)	-	3.91 (N=103)
- Domestic targeted minority students		3.89 (N=11)
- Domestic majority students		3.88 (N=49)
- International students		3.96 (N=43)
- Female students		4.0 (N=94)
- Male students		3.87 (N=166)
Teaching Assistant Training (TT)+++ (6 items)	-	3.00 (N=103)
- Domestic targeted minority students		2.60* (N=11)
- Domestic majority students		2.88 (N=49)
- International students		3.34 (N=43)
- Female students		2.9* (N=94)
- Male students		3.1 (N=166)

+All UG and Grad respondents working in research groups/labs

++Research Grad respondents only

+++TAs only

*Significant difference *p<.05* **Significant difference *p<.01*

Table 2.10: Satisfaction with College Resources: undergraduate students

	How satisfied are you with…									
	UG Learning Center?	Academic Advisors (non-faculty)?	Faculty Academic Advisors?	Engineering Career Services?	Career Fairs?	Diversity Affairs Office services?	International Engineering Studies (study abroad)?	Your academic department?	Computer Engineering Labs?	Size of your Engineering classes (# of students)?
N	681	610	690	602	849	74	219	505	911	1129
Mean	4.06	3.58	3.69	3.70	3.66	4.20	3.83	3.66	4.06	3.69
Std. Deviation	.885	1.027	.968	.906	.985	.810	1.037	.819	.724	.860

Table 2.11: Satisfaction with College Resources: graduate students

	How satisfied are you with…									
	UG Learning Center?	Academic Advisors (non-faculty)?	Faculty Academic Advisors?	Engineering Career Services?	Career Fairs?	Diversity Affairs Office services?	International Engineering Studies (study abroad)?	Your academic department?	Computer Engineering Labs?	Size of your Engineering classes (# of students)?
N	24	55	137	113	127	9	22	165	216	293
Mean	3.83	3.74	3.81	3.64	3.36	3.66	3.90	4.01	3.90	3.94
Std. Deviation	.916	.927	.935	.962	.981	.707	.811	.815	.826	.728

Appendix 3 - Sampling of Qualitative Responses

I. Stereotyping, Harassment and Exclusionary Behavior

Undergraduate Students – about 7% of respondents made relevant comments in this section.

- *Everyone is very focused on coursework.*
- *I don't expect my voice to be heard from this survey but I sure hope someone steps up and addresses the situation.*
- *I feel like for the most part, the CoE is a safe environment for me.*
- *I feel like CoE tries to implement policies inclusive to women, yet I have only ever heard of one female engineering professor. If the college wants to see more women applying to engineering, they should hire more women professors.*
- *I have had a male student say to me "Oh, you're smart?" after looking at my exam grade and then say "I thought you were just looks". I've had male group members complete ignore my ideas, then deny that it was my idea even when I showed them my notebook with the time/date. I've had males refuse to help me when I had a question but would help male counterparts. I've…had TAs that made me feel stupid, uncomfortable and unwelcome when all I wanted to do was learn.*
- *I would experience a lot more singling out and harassment if I didn't hide my gender and sexuality in the CoE. A professor told me I was "unprofessional" and I should get a haircut when growing out my hair to better express my gender identity.*
- *I think it's safe to say many Midwestern students AND faculty have literally never left Wisconsin and their racial and stereotypical biases clearly show this.*
- *I think people here are great. Not sure why these questions are necessary.*
- *I'm a straight white male, so no problem, that's the majority of engineers. The only ethics teaching we get is to "not blow others up"…nothing about how privileged we are to get this education. Start teaching that it's important to engineer the world a better place for everybody, not just to make yourself more money. Also I've heard blatantly racist comments pretty often which is disgusting.*
- *I've experienced and heard more classism from engineers than sexism, racism or anything else.*
- *Microaggression and passiveness happen too often…not straightforward attacks…the passiveness is enough.*
- *Professors have made comments about male vs. female innate abilities for certain activities. I find that pretty aggravating and pointless to talk about.*
- *TAs and Professors by and far behave in a professional manner. However, promoting 'inclusion' to the point of special status/exclusion of other groups is beginning to become a problem. That is not concentrated nor exclusive to faculty nor Engineering faculty however.*
- *The CoE makes it harder for women of color to succeed in these classes and feel comfortable in engineering in general.*
- *There's a reason engineers get double the free mental health visits, you guys already know this is a problem, but you haven't actually changed anything.*

- *Usually, I get a bad comment from students outside classes based on my religion and where I am from.*

- *All the questions here refer to blatant incidents occurring in class. However, most professors are smart enough to not approach any topics to what was asked here in front of their classes. I have, however, experienced multiple issues with professors and advisors outside of class, or in one-on-one meetings, and this is equally, if not more damaging. Additionally, the instances of bias, ignorance, and severe misunderstanding of diversity (or how more diverse student populations "get in") do not have to be mustache-twisting level evil to be inappropriate and requiring of attention. More subtle views, such as who individuals feel get in or receive certain accolades because there "just aren't that many _____ in engineering" get taught, or never untaught, to every student that goes through our program, further intensifying a pathological climate for the College of Engineering. Currently, numerous professors, faculty, and students believe that we should care about diversity because it gets us NSF funding. This understanding is insidious and empty. We need to start seeing bias and misinformation as not just unconscious, but as non-innocent. We can start addressing the core problem by clearly disseminating the message (to all levels!) in our program of why funding agencies have set and care about these diversity goals. What are the values and benefits in having diversity in engineering and science. What types of challenges do different groups systematically and structurally face in getting here? How do we each play into these challenges, willingly or unwillingly, while they are here? What is the history of their challenges, and who historically benefited from these structures existing? Many students are here on merit, while receiving messaging both blatantly and subtly from professors, advisors, and classmates that their accomplishments are not (and will not be) because of their own hard work, due to identifying features out of their control like race, gender, etc.*
- *CoE is on par with other engineering institutions that I have been involved with. Institutionally, it's doing due diligence for members of protected classes. I just find that Wisconsinites (the undergrads namely) are more conservative and more prone to participating in some of these negative behaviors. Hopefully going to UW-Madison is changing them for the better.*
- *Engineering can feel like a "boys club" at times, but I feel as though the people I have met in the UW-Madison engineering department are actively trying to include anyone interested.*
- *Every woman in engineering I have met has a "woman in engineering" story. Usually many stories - me included. It continues to be an issue to be unfairly treated and I welcome any and all potential solves. However, it is up to the male student body to change their behavior and call each other out, because women's opinions are treated worse when it comes to individuals that do not have values centered in fundamental equity.*
- *Good experience.*

- *I feel like all students make jokes just about anything or comments sinply because we are a morbid bunch who really don't care. Any negative things ive heard in terms of race or sex by faculty have been against white men. As a white man I obviously see this as bull shit but hey, thats just me.*
- *It may be easy to think that only white student are exclusive, but this has not been my experience. I notice that Asian students tend to work exclusively among themselves.*

II. Professors

Undergraduate Students – 33% of UG respondents wrote comments regarding professors

- *A couple of my professors have been absolutely stellar, but most have been subpar. Right now in my final semester, I have one professor with unreasonable expectations and another professor who is condescending, unhelpful, disorganized, and sexist.*
- *All my professors have been extremely informative and focused on their job.. I have loved every one*
- *A majority of the material is never applicable to real world engineering jobs. Many of the assignments and concepts would be a far better fit for a masters or doctorate program, not a typical UG class. I work full time in industry as a practicing engineer while still in school, and routinely use very little coursework. I also find many of the "real world" examples posed in classes very seldom reflect actual issues I encounter in industry. Almost all of my professors have no idea what the "real world" is and it shows in their teaching style and course examples. Its frustrating to say the least, and extremely difficult to stay motivated in classes. The material they provide is never adequate to learn the course concepts and it just makes everything worse.*
- *After taking classes in psychology, math, history, statistics, physics, and others, I think the engineering professors are some of the best on campus, very interested in their research and bring it into the classroom to enhance the material, very interested in the material, want every student to succeed, and are always looking to make themselves better professors*
- *Class size and speed of teaching has always been good. Some professors give out assignments that seem like a lot of busy-work that, as a student, I do not gain anything from.*
- *Dedicated teaching staff or Professor who "own"/always teach the same course seem to be the best teachers.*
- *Even though I am only in my first year here, having taken several courses not in the CoE, I have generally gotten the impression that CoE professors actually care about teaching you the material and react to questions with encouragement and interest unlike many others (cough cough math department cough)*
- *Fairly often, the homework seems disconnected form what is covered in lecture and requires a significant amount of time researching on one's own to understand.*
- *Fantastic institution. Great professors who are willing to help, but some can be a little intimidating.*

- *For the most part, the professors in CoE are great instructors. I have had a couple professors that are clearly here just for their research/tenure/etc. and do not place much energy on their teaching. These classes are extremely frustrating and make learning a drag. Other professors are absolute standouts, showing great care for their students and detail in their instruction. These are some of my favorite classes to take, regardless of the course content.*
- *I dont enjoy attending office hours, if i am confused on a topic that is "basic" they can be condescending. I feel this is a reason that i get behind, i am afraid to ask "stupid" questions that they expect us to just know, and that I am just wasting their time*
- *I feel like the professors don't usually take much responsibility for their students learning. They often teach assuming a lot and fail to explain many steps.*
- *I have other friends in the COE who take classes after I do, and it seems after I put some comments in the end of the semester evaluation for the professor, my friends tell me that nothing changes from when I took it based on the comments/suggestions that are made the previous semester.*
- *I often feel belittled and like my ideas don't matter. I have cried at office hours before and have felt like I am stupid and don't belong. I have gone twice and will never go again. I do not feel welcome as a woman.*
- *I think it's just been the negative experience that I've had so far in InterEgr 170. Unfortunately, I've felt throughout the course of the lab that our class has been regularly talked down to, threatened with failure, and dismissed throughout the course. I am sure this is not indicative of the rest of the department, but unfortunately has been my experience this semester.*
- *I think that like is the case with drop in tutoring, professors should especially emphasise their availability to support students of color who are often overwhelmingly in the minority and feel outcasted in the learning experience. If professors atleast show they care then it is encouraging.*
- *I think they all do their best at teaching, just some are better teachers then others.*
- *I've noticed (in the past year) several professors doing surveys mid-semester, addressing student's concerns publicly, and then making modifications to assignment style or lectures accordingly. Sometimes this process can be a bit messy, but I really appreciate it being done. I think I remember it in ISyE 415 and MSE 350. Very transparent and creates more trust.*
- *In comparison to classes in other departments (eg Math or Humanities), I have felt most challenged and engaged in my engineering courses due to my professors' abilities and engagement.*
- *The best professor I ever had here, Professor BH, left because his research wasn't up to par, but everyone I talk to says he was the only instructor we had who actually made an effort to teach structural material so that everyone understood it. This proves to me where Madison's priorities truly lie. I once considered getting my Master's here, but no longer. I'm jumping ship ASAP, before this place brings me down further.*
- *More female/diversity representation in teaching staff!*

- *More real world examples*

Grad Students – About 25% of Grad student respondents included comments about professors

- *Currently, they are good. Hope most of them could provide electronic textbook.*
- *Having done my UG and Grad work here at UW, I've taken many, many courses in the CoE. At the UG level, the engineering professors were very knowledgeable and were interested in students' stories and success. Sometimes, there were issues with professors traveling and them being unable to teach / attend classes; I had one professor who had to miss almost a third of the classes one semester. At the Grad level, engineering professors have been outstanding. They have been very willing to assist with coursework requirements, and are willing to accommodate conflicts (e.g. conferences, personal conflicts, etc.). I've very much enjoyed the courses I've taken thus far.*
- *I feel like out of the 6 courses I have taken so far at UW-Madison in the Engineering department, only 2 of them have been academically satisfying. For the other courses, it feels as though the professors are teaching it as a fulfillment of a requirement or an afterthought. Although my UG degree was at a university that is not nearly as prestigious as UW-Madison, the quality of the courses were largely head-and-shoulders above the courses at UW-Madison so far. This is especially apparent in the UG courses I have taken here. I love the research, but the quality of the courses have really made me question if I really want to continue doing this for another few years.*
- *Instructors generally teach to the 'hot shots', the students with the strongest natural ability and quickest grasp. They thereby are losing the 'middle shots', students who can certainly grasp and master material even to the highest level, but take a little more time or a little more explaining, but are still fully capable.*
- *Professors need to focus more on practical applications of the course material. UW Madison may be a research institution, but I believe students are better off going to Platteville/Milwaukee if they want a more hands on/practical experience. Also, I understand that many professors here are "world-renowned," but they need to realize that students are paying good money to go to school here and the other part of their job (other than research) is being able to teach and relay information to their students.*
- *Would appreciate understanding towards building a more inclusive classroom.*

III. Research Group/Lab Environment – Undergraduate and Grad Responses

- *Been a very positive experience outside of the classroom*
- *Best experience of my UG education*
- *Grad students do more mentoring than PIs and are not compensated for their management of research labs.*
- *I was excluded from my research group as they assumed that since I couldn't do research through the summer, I then wouldn't be returning in fall. I reached out multiple times, but was basically looked over for inclusion in meetings and other group activities from then on.*

- *My mentor told me on multiple occasions that I only got accepted to internships because of my race and gender. Never met my PI. Was expected to work during exams and as late as 4 am.*
- *There are peers that are great to work with and some that are toxic. I don't know how my PI deals with toxic relationships among students and what she does to address it. The toxic lab mate caused me significant stress as she would make up stories about me to my adviser (which I could tell by adviser's attitude towards me). She told me that she didn't get her work done and would blame me at the meeting (even though I sent her the file two weeks prior and she didn't look at it because she was searching for jobs). I ended up seeing a therapist because the stress affected my sleep and I was feeling depressed. I think more training on how to have discussions with people you work with could be beneficial. It would have been helpful if the toxic lab mate and I set clear deadlines. Instead, she would get things done when she could and refuse to set a time to meet (using Outlook calendar like everyone else in the lab) because she wanted to come and go to the lab as she pleased.*

IV. Relationship with PI/Faculty Advisor – Grad research students only

- *He's great!*
- *He's just so busy unfortunately. And I'm still learning the necessary skills / material to be helpful in my field.*
- *It's a shame that he is technically (from an outside perspective) wildly successful as a PI/professor. Regularly I feel that my PI/advisor simultaneously embodies the best and worst of academia. He is brilliant, but regularly uses that brilliance to undermine me or my coworkers. He is fast to criticize and slow to praise. He is so busy (because he performs all of the functions of a professor as best he can) that he is actually kind of mediocre at things that are important to me as a grad student (e.g., being a supportive mentor, a good instructor [yes, I have taken a course taught by him in the past]). I'm asking for the moon and the stars, but I can thank my advisor for encouraging me to a) never pursue a career as a research professor and b) giving me plenty of ammunition to use in discouraging others (or at least offering a more metered opinion) from pursuing Grad level engineering as a profession.*
- *My PI is currently working toward tenure, so at this point our relationship is very symbiotic. I have heard from others students (in the X Department) who have tenured PIs that after they get tenured, PIs are less motivated to provide mentorship, guidance, etc to students. Overall, my PI is absolutely wonderful.*
- *My PI is very poor at mentoring Grad students. Constructive criticism is given, but almost always in a disheartening and condescending manner. They express disappointment and impatience much more often than being proud of any work. And when approached by Grad student trying to communicate better with them, they refuse to try and adjust their behavior and instead put it all onto the Grad student to deal with it and change or leave.*

- *They are knowledgeable, and I am glad to be working under their guidance. They are also intimidating and seem to get frustrated with me and my abilities when the data that I get is not promising, even when I am doing what was asked, working hard, and am proud of the work I put in. I often feel that I am walking on eggshells around them.*

Appendix 4– Survey Items by Section/Scale

(RC)=Reverse Coded

DEMOGRAPHIC
Are you enrolled in a major in the College of Engineering at UW Madison?
How many years have you been enrolled at UW-Madison?
Are you an UG student or a Grad student?
What is your major? (UG)
Have you taken classes in the College of Engineering? (UG)
Have you met your departmental progression requirements? (UG)
Did you transfer to engineering from a major in another UW-Madison school or college?
Did you transfer to UW-Madison from another institution?
What Grad degree are you pursuing? (Grad)
Which engineering department are you most closely associated with? (Grad)
In what type of institution do you expect to be working? - Selected Choice
In what type of institution do you expect to be working? - None of the above, I expect to be working in a : - Text
What position do you expect to hold?
In what position do you expect to be working?
Thinking of your current and long-term educational plans, do you intend to complete a degree with an engineering major?
What is the highest level of engineering degree you would like to obtain?
For how many years do you see yourself working as an engineer?

PROFESSORS
How much do your Engineering professors care whether or not you learn the course materials?
How often do your Engineering professors encourage you to think creatively in class assignments and projects?
How often do you feel your Engineering professors place more value on their own research than on teaching engineering courses? (RC)
How often do your Engineering professors write or provide helpful comments on the materials and course assignments you turn in?
How often do your Engineering professors treat you with respect in the classroom or in office hours?
How often are you able to understand course materials (lecture notes, slides, books, etc.) in your Engineering courses?
How comfortable are you with asking professors questions in your Engineering courses?
How often do you think your Engineering professors think you have a lower ability than you actually have? (RC)
How fairly do your Engineering professors grade your work?
How seriously do your Engineering professors take your suggestions and comments in class?
How comfortable are you meeting with your Engineering professors for academic (coursework) help?
How clear are your Engineering course syllabi?
How clear are your Engineering professors' class expectations for you?
How much do your Engineering professors inspire you to study engineering?
How often do your Engineering professors keep the office hours they set for students?
How often do your Engineering professors encourage you to attend their office hours?
How often do you meet with your Engineering professors for extra help with coursework?
How often do your Engineering professors move through material too quickly? (RC)
How often do you feel overwhelmed by the amount of homework? (RC)

How often do language barriers between you and your Engineering professors make it difficult to understand course material? (RC)
How satisfied are you with your overall teaching experience with your Engineering professors?
Is there anything else you would like to tell us about your experiences with engineering professors as course instructors here at UW-Madison?

TEACHING ASSISTANTS

How effective are your Engineering teaching assistants at teaching?
How effective are your Engineering teaching assistants as communicators?
How knowledgeable are your Engineering teaching assistants about the subjects they teach?
How much have cultural differences made you less likely to meet with Engineering teaching assistants? (RC)
How comfortable are you meeting with your Engineering teaching assistants for academic help?
How satisfied are you with the assistance you receive from Engineering teaching assistants?
How often do you meet with your Engineering teaching assistants for extra help?
How satisfied are you with your overall experience with Engineering teaching assistants?
Overall, how welcome do teaching assistants make you feel in the College of Engineering?
Is there anything else you would like to tell us about your experiences with engineering teaching assistants here at UW-Madison?

OVERALL QUALITY OF INSTRUCTION AT UW-MADISON

Thinking only about Engineering courses you have taken here at UW-Madison, what is the overall quality of teaching you have received?
Thinking only about science courses you have taken here at UW-Madison such as chemistry, physics, computer science, etc. what is the overall quality of teaching you have received?
Thinking only about math courses you have taken here at UW-Madison, what is the overall quality of teaching you have received?
Thinking only about humanities or social science courses you have taken here at UW-Madison, what is the overall quality of teaching you have received?
Is there anything else you would like to tell us about the overall quality of instruction here at UW-Madison?

ENGINEERING LAB COURSES

Have you ever had a lab in any of your engineering courses at the UW-Madison?
How valuable is your Engineering lab work?
How clearly are your Engineering lab experiments explained prior to each lab?
How satisfied are you with the technical communications training you are given in your Engineering lab courses (for example, for writing lab reports, or giving technical presentations)?
For most labs, how fairly is lab work divided up among the group members in your Engineering lab courses?
Is there anything else you would like to tell us about your experiences with Engineering labs here at UW-Madison?

COLLEGE RESOURCES - only participants who reported having used the following resources were asked to rate satisfaction

How helpful is the College of Engineering UG Learning Center?
How helpful are College of Engineering Academic Advisors (non-faculty)?
How helpful are College of Engineering Faculty Academic Advisors?
How satisfied are you with College of Engineering Career Services?
How satisfied are you with College of Engineering Career Fairs?
How satisfied are you with College of Engineering Diversity Affairs Office services?
How satisfied are you with College of Engineering International Engineering Studies and Programs (study abroad)?
How helpful are the resources in your academic department (departmental staff and chair)?
How satisfied are you with College of Engineering Computer Engineering/Computer Labs?
How welcome does your academic department make you feel?

How satisfied are you with the size of your Engineering classes (number of students in class)?
Is there anything else you would like to tell us about your experiences with College of Engineering resources at UW-Madison?
STUDENT INTERACTIONS
How valuable have you found participating in group projects in Engineering?
How much do you like studying with other students in a group in Engineering?
How much do you feel like you are part of an Engineering community in the UW-Madison College of Engineering?
How much do Engineering students at the UW-Madison help each other succeed in class?
How seriously do other students take your comments or suggestions in class or on group projects in the College of Engineering?
How often do students in your Engineering classes compete with each other? (RC)
What other comments do you have about your interactions with other Engineering students?
FEELING WELCOME
Overall, how welcome do Engineering course professors make you feel in the College of Engineering?
Overall, how welcome do teaching assistants make you feel in the College of Engineering?
Overall, how welcome do other Engineering students make you feel in the College of Engineering?
Overall, how welcome does your academic department make you feel?
EXPECTATIONS OF FIELD OF ENGINEERING
Compared to other professions, do you think the pay in Engineering is [Much less than <-> Much more than] other fields?
Compared to other professions, how flexible do you think Engineering is in allowing people to leave and come back to their careers?
Compared to other fields, how supportive is Engineering in allowing people to combine personal and family responsibilities with their work?
How much do you feel society values the work that engineers do?
How flexible is Engineering in allowing engineers to set their own work schedules?
How supportive is Engineering in allowing engineers to achieve a balance between work and personal life?
How interesting is Engineering to you?
How respected by others is Engineering as an occupation?
How important is the work of Engineers in making the world a better place?
How rewarding do you expect Engineering to be as a career?
How easy do you expect it be for you to find a job after earning an Engineering degree?
How prepared will your Engineering education make you for a job in the field of engineering?
How interested are you in declaring a non-Engineering major? (RC)
How confident are you that you prefer an Engineering major over any other possible non-engineering majors?
How much did the opinions of others affect your decision to study Engineering?
How committed are you to completing your Engineering degree?
How much do you enjoy solving Engineering problems?
How interesting do you find the content of your Engineering classes?
Overall, how satisfied are you with your current major?
Overall, how happy are you to be in Engineering?
Is there   anything else you would like to tell us about your major at UW-Madison?
ENGINEERING ACADEMIC CONFIDENCE
How confident are you in your ability to succeed in your Engineering courses at UW Madison?
How confident are you in your ability to succeed in your science courses at UW Madison?

How confident are you in your ability to succeed in your math courses at UW Madison?
How confident are you in your ability to succeed in your laboratory courses at UW Madison?
How confident are you in your overall academic ability?
How confident are you that someone like you can succeed in your chosen Engineering career?
Compared to other students in your Engineering classes, do you think your abilities are [Much lower than <-> Much higher than] your peers?
ENGINEERING RESEARCH CONFIDENCE – Grad students engaged in research only
With continued training, how confident are you in your ability to succeed in conducting the research associated with your major/program?
With continued training, how confident are you in your ability to succeed in executing your own Engineering research?
With continued training, how confident are you in your ability to contribute to Engineering research publications?
With continued training, how confident are you in your ability to author your own Engineering research publications?
Compared to other students in your department/program, do you think your abilities as an Engineering researcher are [Much lower than <-> Much higher than] your peers?
TEACHING SELF-CONFIDENCE – Grad students with Teaching Assistant appointments only
With continued training, how confident are you in your ability to contribute to teaching an Engineering course?
With continued training, how confident are you in your ability to lead the teaching of an Engineering course (including developing course content) in your area of expertise?
Compared to other students in your department/program, do you think your abilities as an Engineering teaching assistant are: (worst <-> better)
How often do you feel respected by students in the courses that you teach?
TEACHING TRAINING – Grad students with Teaching Assistant appointments only
How effective is the training you have received on how to teach or how to be an instructor?
How effective is the training you have received on how to grade assignments?
How helpful is collaboration with other teaching assistants involved in your courses or in your department?
How often do you receive guidance from faculty on the courses you are teaching?
How often do you receive supervision from faculty on the courses you are teaching?
What other comments do you have about your research and teaching preparation?
RELATIONSHIPS WITH PRINCIPAL INVESTIGATOR/FACULTY ADVISOR – Grad students with Research only
How much do you trust your PI/Faculty Advisor?
How much does your PI/Faculty Advisor help you with career opportunities?
How much does your PI/Faculty Advisor help you with networking in your field?
How much feedback does your PI/Faculty Advisor give you on your own research?
How much does your PI/Faculty Advisor value your research?
How clear are the expectations of your PI/Faculty Advisor?
How often does your PI/Faculty Advisor give you more work than you can reasonably complete? (RC)
How often does your PI/Faculty Advisor give you career opportunities such as opportunities to participate in additional research, or to present at a conference?
How available is your PI/Faculty Advisor to meet with you?
How often does your PI/Faculty Advisor provide you with advice or mentoring?
What other comments do you have about your PI/Faculty Advisor?
RESEARCH LAB/GROUP ENVIRONMENT – students who have worked or volunteered in research group/lab only
How often is there collaboration between research group members?
How often are you mentored in research skills by other lab members?
How often is the environment in your research group welcoming to you?

How often are you mentored by the research group leader or PI?
How clear are the expectations for your work in the research group?
How often do you receive feedback on your skills as a researcher?
What other comments do you have about working in an Engineering research lab or research group?
STEREOTYPING AND HARASSMENT – note frequency questions ("How often"?) ONLY asked if respondent answered YES to "Have you ever…"
In engineering classes, have you ever heard instructors or faculty express stereotypes about racial or ethnic groups?
In engineering classes, have you ever heard instructors or faculty express stereotypes about men and women?
In engineering classes, have you ever heard instructors or faculty express stereotypes about LGBTQ+ people?
How often have you heard instructors or faculty express stereotypes about racial or ethnic groups?
In your opinion, what proportion of engineering instructors engage at least occasionally in exclusive behavior towards people from races or ethnicities different from their own?
How often have you heard instructors or faculty express stereotypes about men and women?
In your opinion, what proportion of engineering instructors engage at least occasionally in exclusive behavior towards women?
How often have you heard instructors or faculty express stereotypes about LGBTQ+ people?
In engineering classes, have you ever heard teaching assistants express stereotypes about racial or ethnic groups?
In engineering classes, have you ever heard teaching assistants express stereotypes about men and women?
In engineering classes, have you ever heard teaching assistants express stereotypes about LGBTQ+ people?
How often have you heard teaching assistants express stereotypes about racial or ethnic groups?
How often have you heard teaching assistants express stereotypes about men and women?
How often have you heard teaching assistants express stereotypes about LGBTQ+ people?
In engineering classes, have you ever heard students express stereotypes about racial or ethnic groups?
In engineering classes, have you ever heard students express stereotypes about men and women?
In engineering classes, have you ever heard students express stereotypes about LGBTQ+ people?
How often have you heard students express stereotypes about racial or ethnic groups?
In your opinion, what proportion of engineering students engage at least occasionally in exclusive behavior towards people from races or ethnicities different from their own?
How often have you heard students express stereotypes about men and women?
In your opinion, what proportion of engineering students engage at least occasionally in exclusive behavior towards women?
How often have you heard students express stereotypes about LGBTQ+ people?
In class, have you ever been singled out unfairly by a faculty member because of your race or ethnicity?
In class, have you ever been singled out unfairly by a faculty member because of your gender?
In class, have you ever been singled out unfairly by a faculty member because of your sexual orientation?
How often have you been singled out unfairly by a faculty member because of your race or ethnicity?
How often have you been singled out unfairly by a faculty member because of your gender?
How often have you been singled out unfairly by a faculty member because of your sexual orientation?
In class, have you ever been singled out unfairly by a teaching assistant because of your race or ethnicity?
In class, have you ever been singled out unfairly by a teaching assistant because of your gender?
In class, have you ever been singled out unfairly by a teaching assistant because of your sexual orientation?
How often have you been singled out unfairly by a teaching assistant because of your race or ethnicity?
How often have you been singled out unfairly by a teaching assistant because of your gender?
How often have you been singled out unfairly by a teaching assistant because of your sexual orientation?
Have you ever been singled out unfairly by another student because of your race or ethnicity?

Have you ever been singled out unfairly by another student because of your gender?
Have you ever been singled out unfairly by another student because of your sexual orientation?
How often have you been singled out unfairly by another student because of your race or ethnicity?
How often have you been singled out unfairly by another student because of your gender?
How often have you been singled out unfairly by another student because of your sexual orientation?
Have you ever been sexually harassed by a faculty member?
Have you ever been harassed by a faculty member because of your race or ethnicity?
Have you ever been harassed by a faculty member because of your sexual orientation?
How often have you been sexually harassed by a faculty member?
How often have you been harassed by a faculty member because of your race or ethnicity?
How often have you harassed by a faculty member because of your sexual orientation?
Have you ever been sexually harassed by a teaching assistant?
Have you ever been harassed by a teaching assistant because of your race or ethnicity?
Have you ever been harassed by a teaching assistant because of your sexual orientation?
How often have you been sexually harassed by a teaching assistant?
How often have you been harassed by a teaching assistant because of your race or ethnicity?
How often have you been harassed by a teaching assistant because of your sexual orientation?
Have you ever been sexually harassed by another student?
Have you ever been harassed by another student because of your race or ethnicity?
Have you ever been harassed by another student because of your sexual orientation?
How often have you been sexually harassed by another student?
How often have you been harassed by another student because of your race or ethnicity?
How often have you been harassed by another student because of your sexual orientation?
What other comments do you have about your experiences in the College of Engineering?
ADDITIONAL DEMOGRAPHIC QUESTIONS
In which if any of the following Engineering Honors Programs have you participated?   Check all that apply. [LIST OF STUDENT ORGANIZATIONS]
Prior to beginning college, did you take any high school engineering courses?
What is your current UW cumulative grade point average (GPA), using a 4 point scale?
What was your approximate High School cumulative grade point average (GPA), using a 4 point scale?
For tuition purposes, are you considered an in-state or out-of-state resident?
Are you a US citizen, permanent resident or international student?
Are you a first generation US citizen?
Do you identify as a person with a disability?
Do you have at least one parent or guardian who raised you who completed a bachelor's degree?
Which of the following have you used to pay for your college education? [LIST OF SOURCES OF FUNDING]
This academic year, about how many hours per week have you worked for pay while taking classes?
What is your age?
What was your sex assigned at birth?
What gender do you identify yourself with now?
Do you identify as a lesbian, gay, bisexual, queer or questioning, transgender or transsexual (LGBTQ+) person?
With which of the following racial or ethnic groups do you identify? [CHECK ALL. LIST OF RACE/ETHNICITIES. If not listed, TEXT.]

Appendix 5 – Methodology and Psychometrics

Survey Development Overview

The original basis of the E3 survey was the PACE (Project to Assess Climate in Engineering) survey developed by the University of Washington and fielded at 22 Schools and Colleges of Engineering across the country, including UW-Madison, in 2008. University of Washington again fielded the PACE survey in 2012 with 12 schools, not including UW Madison. UW-Madison fielded the survey (with University of Washington PI approval) for a second time in 2015. During these data collections, statistical validity of the items and scales was verified by the lead study authors and individual schools collecting data. Thus, except for new items developed in 2019, most items and scales in E3 have been well validated with engineering student populations.

For the 2019 survey deployment, the author worked with several groups to substantially revise the survey. First, at the recommendation of the UW Industrial Engineering faculty member, and Chair of the Equity and Diversity Committee (EDC), Pascal Carayon, we contracted with the UW Survey Center (UWSC) to review the survey content and to manage the fielding/data collection. UWSC reviewed all questions for clarity and to ensure they met the best-practice standards for item-response validity. They recommended minor wording changes to many items to meet best practices in survey research. Changes were primarily: (1) shift from "statement format" where participant is asked to rate level of agreement with statement (2008, 2015) to a format where the participant is asked a question, and (2) change in response format to ensure response choices offered to participants matched the intent and wording of the question. UWSC also recommend removing the "don't know" response option on items asking participants about experiences of stereotyping and harassment, and to add follow-up questions for students who responded "YES" to these items asking them "How often…" they had these experiences. [7] All recommendations were accepted unless they compromised the meaning of the question. Researchers at UWSC estimated the risk of changes introducing problems with comparison with questions from previous data collections to be very small when compared with the benefits of increased question clarity, however we cannot rule out some impact of wording changes when comparing results between 2015 to 2019.

Second, the College wished to include graduate students as participants. To include graduate students, we had to review all the survey questions to ensure that they were appropriate to the experiences of graduate students. With the support of the Equity and Diversity Committee, enrolled engineering graduate students were nominated and invited to participate in a graduate student task force to review and provide input to the survey. The task force was made up of 11 graduate students, and met four times in the Fall 2017 and Spring 2018. Most current survey questions were retained, with minor revisions. The task force also suggested new constructs or areas of interested they wished to include which specifically considered experiences relevant to graduate students' education:

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[7] In 2015, participants were able to answer "Don't know" to these questions. Analysis in 2015 treated "Don't know" responses as missing data. In 2019, respondents could choose only "Yes" or "No" and if "Yes", were asked to rate "how often".

- Engineering Research Lab/Group Environment
- Relationship with Faculty Advisor/Principal Investigator
- Engineering Research Self-Efficacy (Confidence)
- Engineering Teaching Self-Efficacy (Confidence)
- Satisfaction with Teaching Training & Support

In development of <u>new items and scales</u>, the author first consulted vocational psychology and sociology, and the engineering education literature to determine if there were existing measurement items or scales that had been validated with similar populations (engineering undergraduate and graduate students. Unfortunately, we found no published studies that created and tested quantitative items or scales measuring the new constructs of interest. However, published research on the development valid self-efficacy measurements (Lent and Brown, 2006) were utilized for developing new items for Research and Reaching self-efficacy (confidence).

Items were developed by the task force and by this author, and re-reviewed with the task force and the UW Survey center. Additional review and suggestions were provided by Angela Byars-Winston (Relationship with Faculty Advisor/PI), who has substantial expertise in evaluating research mentoring relationships; Jennifer Sheridan, Executive Director for Research for WISELI and former PACE survey leader (2008), Manuela Romero, Associate Dean for UG Affairs, and Laura Albert, former Assistant Dean for Graduate Affairs.   Finally, we worked with Jay Yonker, Program Specialist and researcher on UW Campus Climate study (2020) to verify that demographic questions were consistent with University standards, and to create items on "Feeling Welcomed". Markus Bauer, Professor of Psychology and an experienced researcher on in-group and out-group bias and discrimination, suggested and helped develop questions on exclusionary behavior.[8]

Psychometric Evaluation of New Items and Scales
The distribution of responses for each survey item, whether new or from previous studies, was investigated for response patterns and in cases where scales will be used for predictive analyses, normalcy. Missing data overall was very low. There were no items that had unexpected, excessive or systematic missing data.

For items contributing to a construct or scale, we first ran factor analysis (principal components) to determine if the items had expected inter-correlations and appeared to form a related construct.   A few of the expected constructs were made up of separate, but related, sub-factors. For example, Expectations of Engineering Career contained three sub-constructs: 1) expectations of salary, benefits, 2) interest and social impact, and 3) flexibility and work/life balance. Clearly, these three sub-constructs are closely connected and can be combined to represent career expectations. In some other cases, one or more items clearly did not fit with other items (negative correlations) and in that case the item was a

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[8] Questions asking participants to estimate the proportion of faculty or other students engaging in exclusionary behavior had 5 possible responses, where 1=None, or nearly none, 2= Less than half, but not none, 3=About half, 4=More than half, but not all, 5=All. Larger values on this scale indicate more negative response.

candidate to be excluded from scale computations. Reliability[9] was computed for each group of items we expected to form a scale and are shown below:

Table 5.1: Internal validity of constructs

Scale/Construct Name	Number of Items	Chronbach's α	Scale N
Professors	21	.878	1426
Teaching Assistants	8	.845	1268
Engineering Lab Work	4	.725	1064
Feeling Welcome	4	.768	1268
Engineering Student Interaction	7	.734	1414
Engineering Career Expectations	12	.788	1415
Commitment to Engineering Education/Major	8	.796	1126
Engineering Academic Confidence	7	.862	1412
Engineering Research Confidence	5	.914	263
Engineering Teaching Confidence	4	.826	102
Engineering Teaching Training	5	.729	103
Research Lab/Group Environment	6	.784	386
Relationship with PI/Faculty Advisor	9	.889	196

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[9] Chronbach's α is a measure of the total number and size of inter-item correlation, and has values range from 0 to 1.0. Values > .7 have acceptable inter-item correlation, allowing items to be averaged scale mean for each participant. Participants had to have non-missing values for 80% of items for the scale mean to be computed.