Engineering Inclusion: Understanding Faculty and Student Views

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Abstract
Having an up-to-date understanding of students' and faculty's perceptions of diversity and inclusion within the educational environment is crucial effectively developing and implementing diversity and inclusion initiatives. This study, conducted in the College of Engineering at a mid-size public regional university on the Gulf Coast in the southern United States, aims to assess the current perceptions of diversity among engineering students and faculty members. The study encompasses comprehensive surveys comprising 30 questions that explore various facets of diversity and inclusion within the school, in the engineering curriculum, student organizations, and the engineering workforce. The survey analysis provides valuable insights, which were used to provide recommendations for faculty members, instructors, and other stakeholders in the engineering education sector. These recommendations aim to foster an academic environment where everyone can thrive, contribute, and fulfill their potential regardless of their gender and race.
Keywords: STEM students, faculty members, perception, diversity, inclusion, engineering education, curriculum, instruction

1. Introduction

In recent years, the field of engineering has witnessed a surge in full-time undergraduate enrollment, marking a growing interest in this pivotal discipline [1]. However, within this promising trend, a disheartening reality persists. A significant number of students either transfer out of engineering majors or leave the university before graduation. The dropout rates within engineering programs continue to be a matter of critical concern, with graduation rates stagnating at a persistently low rate (50% in the United States) over the past six decades [2, 3]. This issue highlights a pressing challenge within engineering education that extends beyond high enrollment numbers.

While engineering has the potential to be a transformative and inclusive field, it has struggled to overcome significant disparities in student retention and success. Extensive research in engineering education has revealed a complex web of factors that directly or indirectly influence student success outcomes. These factors include age, gender, race, household income, and family educational background [4]. Specifically, underrepresented students often face considerable hurdles, with performance influenced by race and gender [4, 5]. Additionally, a deeper exploration of the challenges faced by engineering students from underrepresented groups reveals that these students often grapple with feelings of not fitting into the engineering field and experiencing a profound sense of isolation with an inability to integrate into the college campuses [5-7]. Furthermore, they reported a lack of social, cultural, and economic capital compared to their more privileged peers [3, 8].

Aside from these student factors, school-level factors such as school type, student-faculty ratio, and diversity rate have also been found to contribute to engineering students' success [8]. Specifically, diverse courses and faculty members in colleges and universities have been found to predict a broad range of student outcomes in higher education, although the findings are mixed [9, 10]. Additionally, student-faculty interaction has been shown to have positive effects on

student outcomes, but the levels and effects of this interaction may vary by student gender, race, and major field [11]. Furthermore, a school's economic disadvantage status has been found to explain differences in students' effective mathematics engagement [12]. Therefore, understanding the interplay of both student and school-level factors is crucial in developing targeted strategies to support the success of engineering students.

Among these factors, an important theme that stood out is a lack of representation in the curriculum, faculty, and leadership roles within the school expressed by students, which significantly contributes to microaggression. Microaggression is a subtle form of bias, prejudice, and discrimination that impacts women and minority students in engineering. These feelings of isolation and alienation underscore a broader issue. It is a matter of ensuring that all students, regardless of their background, feel a profound sense of belonging within the engineering field. Diverse and inclusive academic environments should provide a sense of shared purpose, where every student feels valued, supported, and empowered to achieve their full potential [5, 13]. The foundation of this transformation is rooted in the core values of diversity, equity, and inclusion (DEI).

While many DEI initiatives have focused on increasing the number of diverse students and student organizations in education institutions, others have placed greater emphasis on recruiting faculty members from different backgrounds and implementing faculty DEI programs to promote inclusive teaching. However, diversity strategies that do not involve the students or that solely prioritize demographic change without taking actions to foster inclusive diversity climates and norms have been insufficient in fully supporting the retention and success of underrepresented students and faculty members [14]. Additionally, DEI in academia needs to encompass the content and perspectives within the curricula and textbooks.

Recognizing this gap, it becomes evident that a comprehensive and multifaceted approach is needed. It emerges from a foundation built on the authentic experiences and perceptions of both students and faculty. By aligning DEI efforts with the realities faced by students and faculty, institutions can create lasting change that enhances the overall diversity, equity, and inclusion within the educational landscape. This approach aims to create a strategic framework that considers all students' and faculty members' experiences and needs, fostering a DEI environment within educational institutions. Such an approach is not only about achieving numerical diversity, but it also entails making every individual, both student and faculty, regardless of race, gender, and background, feel involved, valued, and an integral part of the academic community.

This study aims to bridge that gap by exploring how DEI efforts influence academic life and identifying strategies that foster a more inclusive and equitable educational experience. The university in this study is a mid-size public regional university near the Gulf Coast in the southern United States. The College of Engineering offers six bachelor of science programs, namely Chemical and Biomolecular Engineering; Civil, Coastal, and Environmental Engineering; Electrical Engineering; Computer Engineering; Systems Engineering; and Mechanical, Aerospace, and Biomedical Engineering. In the pursuit of DEI within the university, our report seeks to explore the experiences, challenges, and aspirations of both students and faculty members. By delving into their perceptions, we aim to develop a comprehensive strategy that not only addresses surface-level representation but also ensures that this diversity is

nurtured, celebrated, and ingrained in the very fabric of the university. Our goal is to foster an academic environment where everyone can thrive, contribute, and fulfill their potential regardless of background.

2. Research Methods

The study intends to gain a deep understanding of the attitudes, experiences, and perspectives of both students and faculty members and then use the insights and data collected to formulate recommendations for all stakeholders involved, which will be crucial in promoting inclusivity in engineering education. The goal is to enhance the inclusiveness and supportiveness of the learning environment for every individual.

2.1 Participants

The participants in this study consist of engineering students and faculty members within the College of Engineering at a mid-size public regional university located near the Gulf Coast in the southern United States. The research utilized a comprehensive survey administered through Google Forms, which was distributed to all the students and faculty members in the College of Engineering via email. Participation in the survey was entirely voluntary, and participants were provided with information about the study's purpose, their rights as participants, and the confidentiality of their responses. To enhance participation rates, a gift card incentive was offered to those taking part in the survey. The total student population is about 700, and the faculty consists of about 50 members. Ultimately, 73 responses were received from students, and 17 responses were collected from faculty members. The response rate from students is about 10%, while the response rate from faculty is about 34%.

2.2 Survey Description

A descriptive survey methodology was used to gather insights into engineering students' perceptions and attitudes towards diversity and inclusion. The survey consists of 30 questions, which have been thoughtfully designed to elicit responses from students and are organized into four distinct sections: Engineering Student Diversity, Student Organization and Involvement, Diversity in the Workplace, and Demographic Information. Each section sections aims to collect comprehensive data on students' experiences and opinions related to diversity in engineering education and the workplace. The Engineering Student Diversity section assesses the diversity within the university's engineering student population. It includes six Likert-type questions about diversity, two multiple-choice, and three yes/no questions, some with frequency options. Two open-ended questions that allowed students to provide short recommendations were also included. Questions such as "If you were the instructor, what would you do to promote diversity in Engineering?" and "If you were to give a score about your overall impression of the status of diversity in the university, which score would you give?" were among some of the questions in this section.

The Student Organization and Involvement section explores students' views on the representation of minority and underserved students in student organizations. This section includes nine questions: three Likert-type questions on diversity and inclusiveness, three

multiple-choice questions, two yes/no questions, and one open-ended question asking about the student organizations they belong to. The Diversity in Workplace section gathers students' experiences with discrimination and uncomfortable work environments in engineering workplaces. It includes seven questions, such as Likert-type, yes/no, and multiple-choice, focusing on students' internships or work experiences in the industry. This section aims to understand how these experiences have shaped their perceptions of diversity and inclusion in the workplace. In addition, the survey also collected demographic data such as age, gender, race/ethnicity, place of birth, and academic major. To ensure the convenience of data collection, the survey was administered using Google Forms, an online survey development tool, and shared to all engineering students at the university via email.

A similar survey was administered to faculty members, with four sections: Engineering Faculty Diversity, Student Organization and Involvement, Diversity in the Workplace, and Demographic Information. While the questions in both surveys were similar, the faculty survey was tailored to reflect faculty roles, such as advising student organizations. The faculty survey contained fewer questions in the demographic section and was specifically focused on faculty experiences. It is worth noting that while the survey included a larger number of questions for students compared to faculty members, this report specifically focuses on the analysis of the responses common to both groups. The comprehensive analysis of the broader student survey has been documented in a separate report [15].

2.3 Analytical Procedure

The survey results were systematically coded and organized. Responses from students and faculty were aggregated, and percentages were calculated to explore attitudes and perceptions. Additionally, comparative analyses were conducted, employing the Mann-Whitney U test to identify potential significant differences in responses based on gender and ethnicity. The null hypothesis typically indicates no significant difference between the two groups perceptions and attitudes on the surveyed questions. The alternative hypothesis implies a statistically significant difference in the responses. If the p-value exceeds our chosen significance level (typically set at 0.05), we accept the null hypothesis. Otherwise, we accept the alternative hypothesis.

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3. Results and Discussion

3.1 Demographic Information of Respondents

Descriptive statistics were collected to summarize participants' self-identified demographic information (**Table A1, Appendix A)**. The survey included 73 students and 17 faculty members, highlighting the diverse composition. Among students, 56% are majoring in Civil, Coastal, and Environmental Engineering, followed by Mechanical Engineering (37%), while some departments are not represented. In contrast, faculty representation was more evenly distributed, with Electrical Engineering being the most common, which makes up 18% of the faculty sample. Gender distribution shows that a higher proportion are male 70%, while among faculty members, 47% are males and 24% are females. Ethnicity-wise, Caucasians constituted the majority of students and faculty members, making up 67% and 41%, respectively, with the faculty exhibiting greater diversity. Additionally, students were more likely to be first-generation (30%) compared to faculty (12%). The religious affiliations among students were primarily skewed towards

Catholicism/Christianity (70%), while faculty exhibited more diverse religious beliefs. The political views among the participants also varied, with 30% of students identified as slightly conservative (30%), whereas faculty opinions were more evenly spread across a range of political views.

3.2 Perception of Diversity

3.2.1 General Perception of the College and University

Engineering students and faculty shared their perceptions regarding diversity and inclusion, offering insights into their sense of belonging, understanding of diversity, experiences with discrimination, and their views on the university's diversity. A comparison of their responses reveals both shared viewpoints and differences. **Figure 1** illustrates the collective sense of belonging among both engineering students and faculty. A substantial majority (83.5%) of engineering students feel a sense of belonging to the College of Engineering, with 41% agreeing and 42% strongly agreeing with this statement. Only a small fraction (9%) expresses disagreement, and even fewer (6%) take a neutral stance. Faculty members exhibit similar sentiments, with 82% indicating a sense of belonging. Among those, 35% strongly agree, and 47% agree. In contrast, 12% of faculty moderately or strongly disagree, and 6% remain neutral. The high levels of agreement among both groups suggest a strong connection to their academic community. However, a notable discrepancy was observed, with a higher percentage of female and non-white students expressing disconnection or neutrality. This may be due to the perceived lack of cultural and gender representation or subtle microaggressions. Addressing this discrepancy is crucial to ensuring that all members of the academic community feel fully integrated.

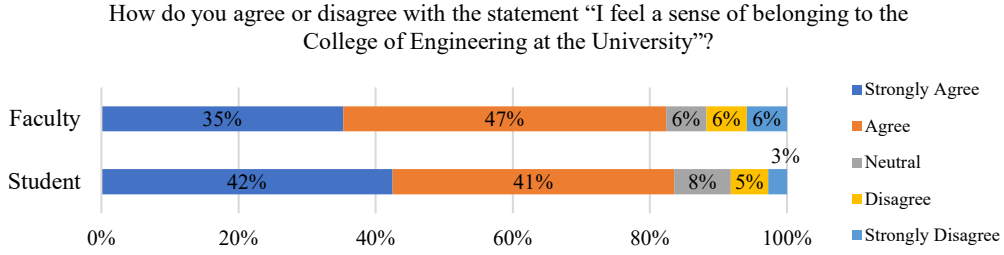


Figure 1. Chart showing the sense of belonging among both students and faculty members.

In terms of understanding the importance of diversity in engineering (**Figure B1, Appendix B**), Most engineering students (72%) affirm their understanding of diversity and its importance to engineering. When asked about the role of diversity in engineering, 45% strongly agree that diversity can provide benefits to the field, and an additional 22% agree. In contrast, 21% of students strongly disagree, and 12% hold a neutral perspective. Faculty members also demonstrate a comprehensive understanding of diversity (82.3%), while 59% indicated that it means a lot, and 77% agreed on its importance in engineering. Specifically, 47% strongly agree, 29% agree, 18% strongly disagree, and 6% remain neutral (**Figure 2**).

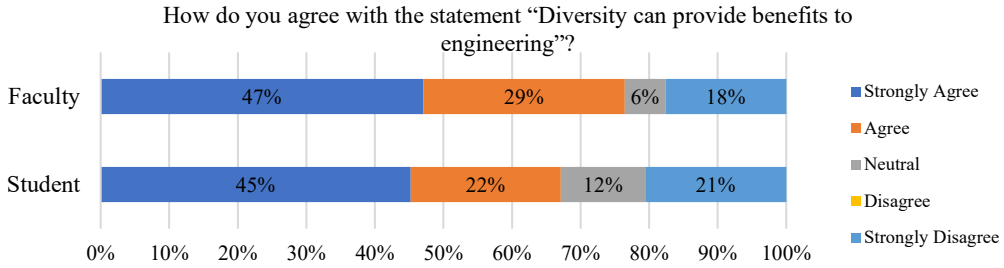


Figure 2. Results of perceived benefits of diversity to engineering.

Upon being provided with the definition of diversity as "the presence of differences in any sense such as gender, age, ethnicity, nationality, religion, and sex orientation," and asked to indicate the degree to which they agree to the statement affirming the importance of diversity to engineering. The results (**Figure B2, Appendix B)** show an improvement from 45%, 62% of engineering students now consider diversity to be very important in engineering, and 23% find it moderately important. A smaller percentage disagrees, with 4% stating that it is not important and 5% considering it not important at all. Faculty members' perceptions did not really change, with 44% now deeming it very important and 38% moderately important. Only 19% find it not important at all. The shift among students suggests that some students may not have initially considered diversity beyond a limited scope, indicating potential gaps in awareness.

When asked about their experiences with discrimination or uncomfortable learning environments based on race, gender, or other reasons, 38% of the students reported experiencing such issues during their engineering education (**Figure 3**). Of these, 5% experienced it frequently, 11% sometimes, and 22% rarely. In contrast, 62% of students reported no such experiences. Faculty responses differed significantly, with 77% reporting instances of discrimination or uncomfortable environment. This difference is supported by the very low p-value (0.002) from the Mann-Whitney U test. Within this group, 24% faced such situations frequently, while 24% encountered them occasionally. Additionally, 29% reported rare occurrences of this discrimination. It should be noted that among both female students and faculty, as well as non-Caucasian individuals, a higher ratio reported experiencing discrimination compared to their male and Caucasian counterparts, respectively. One possible explanation for this is that faculty members, having spent more time in academia, may be more aware of systemic discrimination and biases in hiring, promotions, and departmental interactions. Higher reports of discrimination among female and underrepresented faculty highlight the need for stronger institutional efforts to foster inclusivity not just for students but also for faculties. Additionally, faculty members can use their experiences to help create more inclusive learning environments for students.

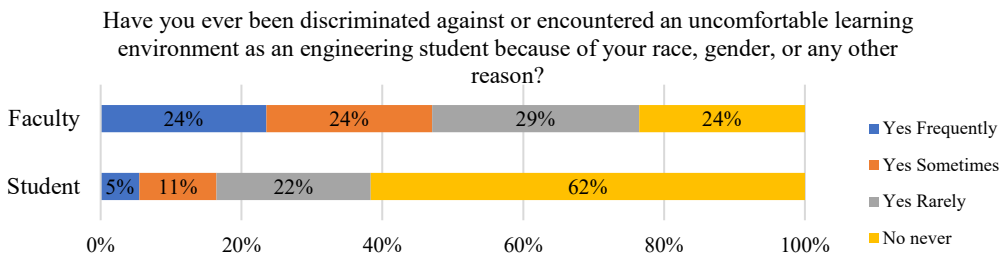


Figure 3. Chart showing respondents' uncomfortable and discriminatory experience.

In response to encountering uncomfortable learning environments due to factors such as race, gender, or other unfair reasons, as observed in **Figure B3**, both students and faculty members demonstrate a shared commitment to addressing these challenges. Approximately 18% of students and 14% of faculty members would discuss the issue with instructors or superiors, while 23% of students and 25% of faculty would seek support from close friends or family. Around 18% of students and 11% of faculty express their willingness to engage with classmates, and 13% of students and 17% of faculty members would report such matters to school authorities, emphasizing low interest in formal channels for resolution. A small percentage of students (5%) and faculty (6%) would choose not to take any action in response to uncomfortable learning environments while 4% of students and 3% of faculty remain uncertain about their response. This reflects a general reluctance to engage in formal complaint processes which may be due to fear of retaliation, lack of trust in institutional responses, or uncertainty about reporting procedures.

Additionally, respondents were asked to rate the university's level of diversity. As represented in **Figure B4**, students and faculty had somewhat varying perspective. Engineering students rated the university "High" (42%) or "Very High" (27%), while faculty members were more distributed, with 29% perceiving "High" and 12% deeming it "Very High". The discrepancy becomes more evident when assessing it as "Average," with 35% of faculty leaning in this direction, compared to 18% of students. In contrast, students displayed a lower inclination towards "Low" (10%) and "Very Low" (3%) ratings. At the same time, faculty members appeared to be more critical, with 18% ranking the university's diversity as "Low" and 6% as "Very Low." This divergence is further buttressed by the p-value from the Mann-Whitney U test (0.034), which is lower than the significant level (0.05), indicating a significant difference between students' and faculty's ratings. This may be connected to the lack of awareness of the university's Office of Diversity, Equity, and Inclusion. As revealed in **Figure B5**, 47% of students do not know much about the office. Only a few (37% of students and 42% of faculty) indicated knowledge of the office's existence, while the majority claimed to know very little about its function (34% of students and 47% of faculty). A minority (15% of students) admitted they had never heard of it. This gap in awareness suggests that the university's diversity initiatives are not well-communicated, leading to underutilization of available resources, emphasizing the need for interventions to increase visibility and understanding of the DEI office and its support functions.

When assessing the relevance of some key aspects of diversity in engineering (**Figures B6** and **B7),** both groups strongly agreed that engineers should be diverse (85% of students, 76% of faculty) and possess strong interpersonal skills (91% of students, 77% of faculty), with students placing slightly more emphasis on teamwork (38% rated it "Very Relevant") than faculty members (24%). This could be due to students' frequent exposure to group projects, where collaboration is essential, whereas faculty may focus more on individual research and teaching responsibilities. Additionally, most students (96%) and faculty (88%) recognized the importance of working with diverse clients. There was also broad agreement that engineering solutions should consider technical, cost, environmental, and societal factors (92% of students, 83% of faculty). Both groups (86% Students and 76% faculty) also viewed equal promotion and salary opportunities as relevant to diversity. Regarding organizations like the Society of Women Engineers and the National Society of Black Engineers, students (82%) and faculty (77%) saw

their participation as important, though students placed greater emphasis on their "Very Relevance" (49%) compared to faculty members (24%). This suggests students may see these organizations as more central to diversity in engineering education, while faculty may see them as supplementary rather than essential. Encouraging stronger faculty involvement in these organizations could bridge this perception gap and provide more mentorship opportunities for underrepresented students.

3.2.2 Diversity in Textbooks and Curriculum

An essential aspect of pursuing diversity and inclusion in engineering education involves integrating diversity-related components into engineering courses and textbooks. This section assesses the responses from both students and faculty regarding their observations of diversity components in engineering courses and textbooks used.

When recognizing diversity components in engineering courses, students and faculty respondents have somewhat similar perspectives (**Figure 4**). Among students, 43% acknowledge the presence of diversity components in their engineering courses, 33% are uncertain, and 24% have not identified any. For faculty, 33% have diversity components in their engineering courses, 28% express uncertainty, and 39% believe these components are absent in their courses. It is noteworthy that a significant portion of faculty members, compared to students, feel that diversity components may be lacking. This discrepancy may be a result of differences in how diversity in courses is perceived. Students may consider informal discussions or project topics as diversity-related, whereas faculty may focus on structured curriculum content.

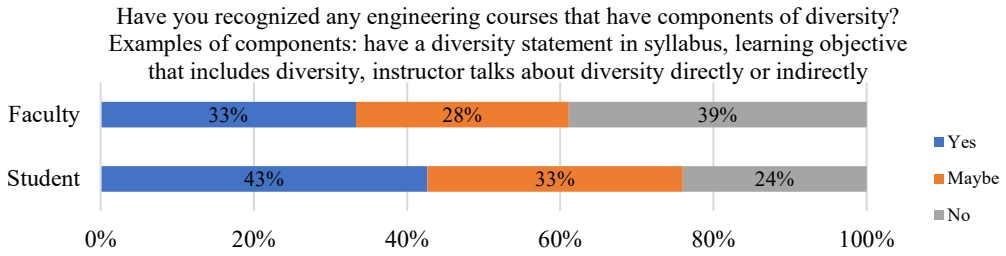


Figure 4. Chart showing students' and Faculty members' perception of the presence of components of diversity in engineering courses.

Regarding engineering textbooks (**Figure B8**), only 4% of students believe they contain a substantial number of diversity-related components, while 15% acknowledge some components, 49% see slight components, and 32% feel there are none. In contrast, faculty members view engineering textbooks differently, with none indicating that textbooks contain many diversity components. 12% see some, and a significant 65% perceive their textbooks as lacking diversity-related content. This discrepancy between students and faculty is further highlighted by the p-value from the Mann-Whitney U test (0.025), which indicates a significant difference between students' and Faculty members' perspectives on this subject, which might be due to faculty's greater familiarity with textbook selection and content development processes.

Respondents were also asked to indicate the level of importance they give to some practices promoting diversity in engineering courses (**Figures B9 and B10).** Both students and faculty strongly valued instructors caring about students' learning (95% of students, 89% of faculty), clear grading policies (96% of students, 88% of faculty), and fostering active learning (92% of students, 83% of faculty), with over 70% in both groups considering these "Very Important" or "Important".

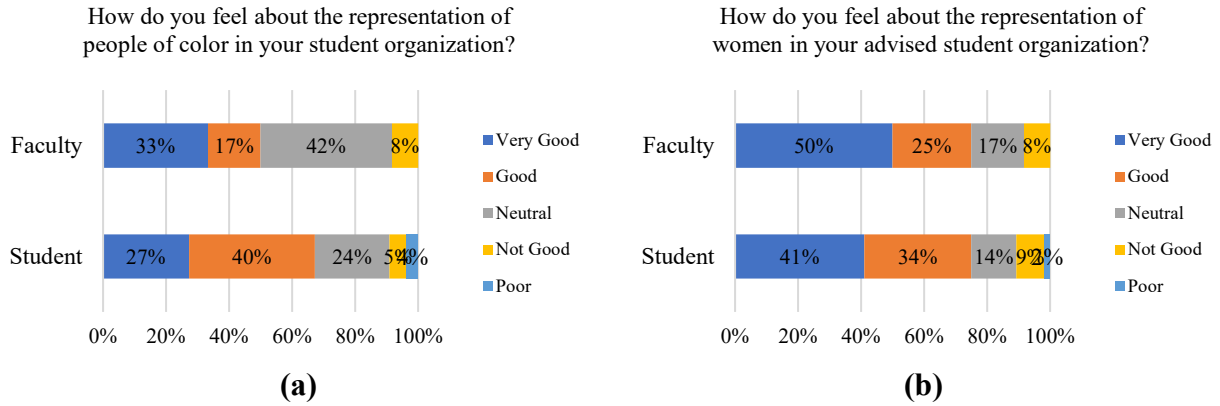
However, there are some areas where faculty members and students differ in their perspectives. Students placed more importance on instructors remembering names and building personal connections, a gap confirmed by the Mann-Whitney U test ($p = 0.006$). Faculty could consider incorporating more opportunities for more engagement with students to create a more supportive learning environment, fostering greater student success. They also valued diversity statements in syllabi (57% compared to 41% of faculty). This suggests that students are more eager for explicit representation of diverse voices in coursework, whereas faculty may either underestimate its impact or prioritize traditional subject matter. Furthermore, when it comes to instructors embracing practices related to the inclusion of more diverse examples in textbooks, designing assignments that incorporate diversity and inclusion, embracing diversity and inviting guest technical speakers who have diverse backgrounds, and leading field trips related to diversity and inclusion, there is a subtle difference in the perceived importance of these practices. Students tend to attribute slightly higher importance to these practices than faculty members, with about a 10-30% difference in their "very important" perception level. This suggests that students value diverse perspectives and that faculty may need to adjust teaching methods to meet these expectations.

Finally, respondents shared their thoughts on promoting diversity in engineering education through responses provided on an open-ended question "As an instructor, what would you do to promote diversity in Engineering?". From the responses, it is evident that respondents have a diverse range of opinions on how to promote diversity in engineering classrooms. Some students emphasized fostering an inclusive classroom, discussing equality, using diverse course materials, and promoting organizations like NSBE and SWE. Others preferred a neutral approach, advocating equal treatment without special emphasis on diversity. Faculty responses varied similarly to the students, some supported active engagement, while others preferred equal opportunities without explicit promotion. A few faculty members viewed diversity as encompassing political affiliation, and some expressed skepticism about student organizations like NSBE, believing it fosters division. This division in perspectives may be influenced by generational differences, past academic experiences, or concerns about maintaining academic neutrality, thus requiring further research.

3.3 Student Organization and Involvement

This section of the survey examines respondents' participation in student organizations, their perception of the organization in promoting diversity initiatives within the university, and their suggestions for promoting diversity in student organizations. The data highlights that a significant proportion of both students (68.5%) and faculty (52.9%) have been or are currently involved in student organizations, underscoring the role of these groups in fostering a sense of community and supporting inclusiveness and diversity on campus.

These groups shared their perception of the representation of people of color and women within their respective student organizations, the results of which are expressed in **Figures 5(a) and b**. Regarding representation, 67% of students rated the presence of people of color in their organizations as "Good" or "Very Good," while 9% found it "Not Good" or "Poor." Faculty responses were more mixed, with 50% viewing representation positively but 42% remaining neutral. Women's representation received more favorable ratings, with 75% of students and faculty considering it "Good" or "Very Good." Neutral responses were lower (14% for students and 17% for faculty), and negative perceptions were minimal. These findings indicate a stronger representation of women than people of color in student organizations and the need for improvement in promoting more inclusive representation.



(a) **(b)**

Figure 5. Chart showing Students' and Faculty members' perception on the representation of (a) people of color and (b) women in student organizations.

Some similarities were observed regarding the presence of diversity-promoting policies or statements in their respective student organizations **(Figures B11 and B12)**. While 36% of students affirmed their existence, only 18% of faculty did, with 45% of faculty uncertain. With regards to the diversity activities conducted by the university, most students (77%) and faculty (70%) acknowledged some or significant progress. However, faculty were more critical, with 18% believing the school had done little, compared to only 7% of students. While the majority of students and faculty recognize the university's efforts in promoting diversity, there is a sense that more can be done, highlighting the importance of continued initiatives and communication to address diversity concerns.

Participants were then asked to rate their level of agreement with four proposed activities aimed at promoting diversity in engineering through student organizations **(Figures B13 and B14)**. Both groups supported increasing minority representation (38% of students and 24% of faculty strongly agreed, while 33% and 35% agreed, respectively). Expanding engineering scholarships for minorities also received strong support (37% of students and 35% of faculty strongly agreed, with 23% and 29% agreeing). Faculty expressed slightly stronger support for dedicated funding resources for minority students (32% strongly agreed, 32% agreed) compared to students (34% strongly agreed, 23% agreed). A major difference in views is on 1-on-1 peer programs to encourage interaction among engineering students. Students strongly favored this initiative (45% strongly agreed, 36% agreed), while faculty showed lower support (29% strongly agreed, 29%

agreed). This suggests that students recognize the value of peer mentorship in fostering inclusion and networking, whereas faculty may prioritize more formal institutional measures such as scholarships and funding. The faculty's lower support could also stem from concerns about feasibility, effectiveness, or additional administrative burdens associated with such programs.

3.4 Diversity in the Engineering Workplace

Among faculty, 58.8% have professional experience in engineering firms or agencies, compared to 41.1% of students. This is likely due to their roles as educators and prior industry experience Additionally, when examining the size and nature of these engineering workplaces, distinctions emerge (**Figure B15)**. 80% of faculty with experience worked in firms with over 100 employees, while only 57% of students did. Smaller firms (under 50 employees) were more common for students (23%) than faculty (10%) most likely due to students securing internships or early-career roles in smaller firms, while faculty, given their advanced career stages, may have been employed by larger organizations. Both groups reported experience across various company types, including local, regional, family-owned, domestic, international, profit-driven, and non-profit organizations **(Figure B16)**.

Engineering companies' diversity initiatives were evaluated by asking both students and faculty about their experiences working for such companies. From the responses **(Figure B17)**, 50% of students reported their companies had a dedicated diversity division, specialist, and policy, compared to 30% of faculty. This may be attributed to the fact that students are more likely to engage with companies recently adopting formal DEI policies, whereas some faculty members' past experiences in industry may have preceded the widespread implementation of such initiatives. This survey also explored the respondents' encounters with discrimination or uncomfortable work environments stemming from their gender, race, or other factors. From the responses (**Figure 6**), it was observed that 9% of students reported frequent experiences, 11% sometimes, and 23% rarely, while 57% never faced discrimination. Faculty reported higher occurrences, with 23% frequently, 15% sometimes, and 31% rarely experiencing discrimination, leaving only 31% who never encountered it. Higher reports of discrimination among faculty may be as a result of their prolonged workplace exposure, increasing their likelihood of experiencing or recognizing systemic biases. Underrepresented faculty may also face barriers in hiring, promotion, or leadership, amplifying their perception of discrimination. This result highlights the need for continued efforts to eliminate discrimination and promote inclusive workplaces.

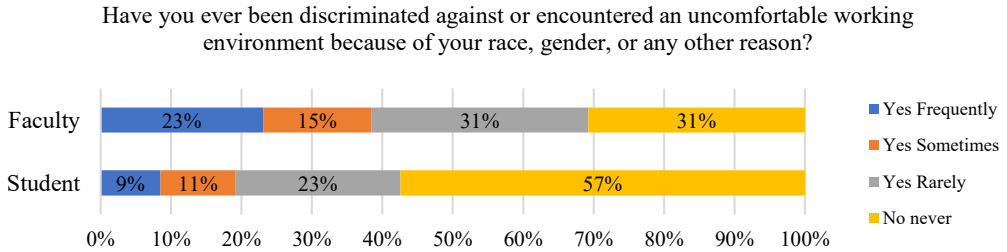


Figure 6. Chart showing the frequency of workplace discrimination experienced by students and faculty members.

In an attempt to access the respondents' beliefs about unequal opportunities in engineering careers, the survey inquired about perceptions of opportunities for women and people of color in

the field. Results (**Figure B18)** showed that among students, 13% believed women and people of color had fewer opportunities, while 39% thought both groups faced disadvantages. Faculty responses were similar, with 17% seeing fewer opportunities for women, 13% for people of color, and 42% believing both groups faced challenges. Meanwhile, 36% of students and 29% of faculty believed opportunities were equal. The higher percentages of correspondents who indicated that minorities have unequal opportunities suggest a broad recognition of systemic inequalities within engineering, reinforcing the need for structural changes in hiring, career advancement, and workplace culture to ensure fair opportunities for all.

As part of the survey, respondents were asked to share their views on four statements regarding promoting workplace diversity by indicating their level of agreement or disagreement. These statements focused on the importance of diversity in fostering a strong and cohesive engineering profession, preferences for employers that prioritize diversity, perceived responsibilities for promoting diversity, and expectations for fair treatment in companies that emphasize diversity, equity, and inclusion. The results (**Figures B19 and B20)** indicated that a majority acknowledged the significance of DEI in engineering, with 55% of students and 47% of faculty strongly agreeing that it fosters a stronger profession. Additionally, 42% of students and 47% of faculty preferred working for employers with clear DEI policies. Regarding personal responsibility, 54% of students and 71% of faculty disagreed with the notion that promoting DEI is not their duty, suggesting a collective commitment to fostering a more inclusive engineering environment. This shared belief underscores the growing recognition that diversity is a shared responsibility across all levels of the profession. Furthermore, 42% of students and 41% of faculty strongly agreed that workplaces prioritizing DEI are more likely to ensure fair treatment for all employees. These responses align with a broader societal shift toward recognizing diversity as a key factor in organizational success and employee well-being [16].

4. Conclusions

The study provides valuable insights into the current perceptions and practices related to diversity in the University College of Engineering. Key findings include:

- The majority of both students and faculty report a strong sense of belonging, but some still feel disconnected. Faculty, especially from underrepresented backgrounds, experience significantly more discrimination while limited awareness of diversity initiatives by the university and reluctance to report discrimination all indicate the need for stronger institutional efforts to address bias and foster inclusivity, and raise awareness of diversity initiatives.
- While both students and faculty recognize the importance of diversity in engineering education, students expect more explicit integration of diverse perspectives in courses and textbooks, whereas faculty are less likely to prioritize these elements. This disconnect suggests a need for greater alignment in curriculum design through faculty development and training, as well as collaboration with publishers.

- Both students and faculty are actively involved in student organizations, though opinions vary on the representation of diversity within these groups indicating a need for better communication and targeted efforts to enhance inclusion. While there is a general

commitment to increasing minority representation and scholarships, the importance of the 1-on-1 friend program, particularly among students indicate the need for a balanced approach that integrates both peer-driven and institutional initiatives.

- Discrimination remains a concern, especially among faculty, indicating ongoing challenges in the engineering workforce. While students are more likely to encounter structured DEI efforts in modern workplaces, faculty have experienced environments with fewer formal diversity policies. Both groups overwhelmingly support DEI efforts, emphasizing the shared responsibility of individuals and organizations in fostering inclusive work environments.

5. Recommendations

The survey has highlighted the importance of diversity and inclusion in engineering education in ensuring that all students have access to quality learning experiences. As such disparities in perceptions and efforts to promote diversity were evident. In response, a comprehensive set of recommendations has been formulated for the university, faculty members, textbooks authors and other institutional organizations to advance diversity and inclusion.

5.1 Institution

The university should

1. Optimize its support system by strengthening the Office of Diversity and Inclusion with trained staff and conducting regular surveys to identify discrimination patterns. Clear reporting procedures, support groups, and forums should encourage open communication. Ongoing campus campaigns can raise awareness of the office among students and faculty.
2. Create materials that highlight diverse engineers' success stories and organize events that demonstrate how diversity strengthens the engineering field. This will help students and faculty see the practical value of diverse perspectives in the profession. Additionally, they can introduce mandatory diversity and inclusion training for faculty that covers unconscious bias, inclusive teaching strategies, and how to incorporate diversity into course content. This will better equip faculty to create inclusive learning environments.
3. Set up a committee to review and update engineering course materials, ensuring that diverse perspectives, case studies, and examples are integrated into the curriculum. This will help ensure that students are exposed to a broader range of viewpoints.
4. Assist student organizations with resources and guidance on fostering inclusivity. Support student leaders in promoting diverse representation and creating spaces where all students feel welcome and have opportunities to lead.

5.2 Faculty Members

Faculty members should

1. Foster an environment where all students feel valued and respected, ensuring that students from diverse backgrounds can engage comfortably in discussions on diversity.
2. Integrate diverse real-world examples and case studies into their teaching to reflect a variety of perspectives and align with students' expectations for inclusive content.

3. Encourage group work and collaborative assignments that bring diverse perspectives together. Assignments should also include diverse examples and adhere to inclusive grading policies.
4. Actively engage with students, offering mentorship and personalized support to inspire academic and professional growth. This is consistent with McCarthy et al. [17]. recommendation for promoting an inclusive educational environment and aligns with the student's desire for more personalized support and mentorship.

5.3 Textbooks Authors

Textbook authors should

1. Include diverse case studies that represent a wide range of backgrounds and experiences to meet students' desire for inclusive educational materials.
2. Work with faculty and curriculum committees to ensure textbooks align with the needs of engineering programs and promote diversity. They should also establish channels for feedback from educators and students to ensure that diversity-related content is effectively incorporated into textbooks.

5.4 Engineering Industry Organization

1. Companies should invest in diversity initiatives, such as specialized divisions and hiring diversity specialists. Regular reviews should ensure that these initiatives remain effective.
2. They should ensure that all employees, regardless of gender, race, or background, have equal opportunities. Hiring and promotion decisions should be made fairly, demonstrating the company's commitment to diversity.
3. must develop and enforce zero-tolerance policies against discrimination, harassment, and microaggressions to address the concerns raised by students and faculty.

Acknowledgment

The research was conducted during 2022 and 2023. The research team expressed gratitude to support from the university and college. The team appreciated the participation of students and faculty who took part in the anonymous survey.

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Appendix A: Survey Respondents' Demographics

Table A1. Demographic Information of Survey Respondents

Item	Variables	Students	Faculty
Major	Electrical Engineering	3%	18%
	Computer Engineering	0%	12%
	Chemical and Biomolecular Engineering	4%	6%
	Mechanical Engineering	37%	12%
	Civil, Coastal and Environmental Engineering	56%	18%
	System Engineering	0%	6%
	Prefer not to say	0%	24%
Gender	Male	70%	47%
	Female	30%	24%
	Non-binary	0%	0%
	Prefer to self-describe	0%	29%
Ethnicity	Caucasian	67%	41%
	African-American	10%	0%
	Latino or Hispanic	3%	6%
	Asian	7%	24%
	Native American	1%	0%
	Native Hawaiian or Pacific Islander	0%	0%
	Two or More	11%	6%
	Other/Unknown	1%	12%
	Prefer not to say	0%	12%
First Generation Student	Yes	30%	12%
	No	67%	83%
	Prefer not to say	3%	6%
Religion	Catholicism/Christianity	70%	35%
	Judaism	1%	0%
	Islam	1%	6%
	Buddhism	3%	0%
	I have no religion.	19%	12%
	Others	5%	47%
Political View	Very liberal	11%	6%
	Slightly liberal	21%	29%
	Slightly conservative	30%	18%
	Very conservative	18%	12%
	Prefer not to say	21%	35%

Appendix B: Survey Results

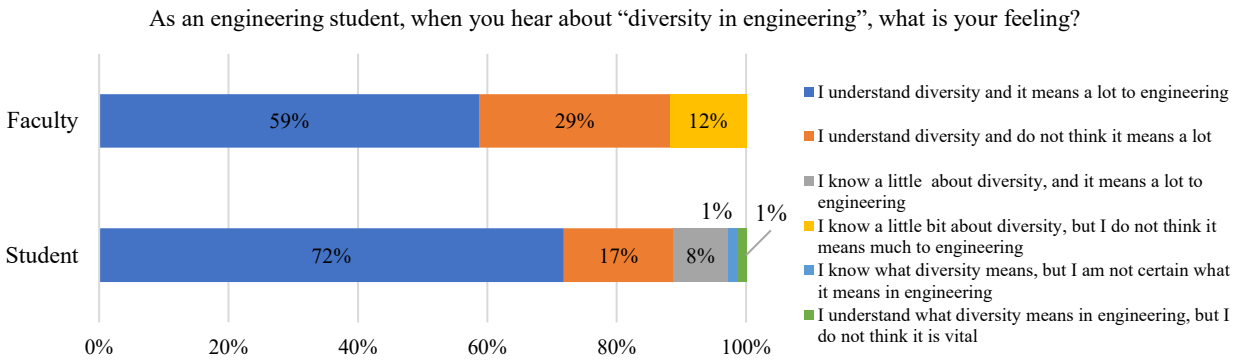

Figure B1. Chart showing the level of understanding of diversity and its importance in engineering.

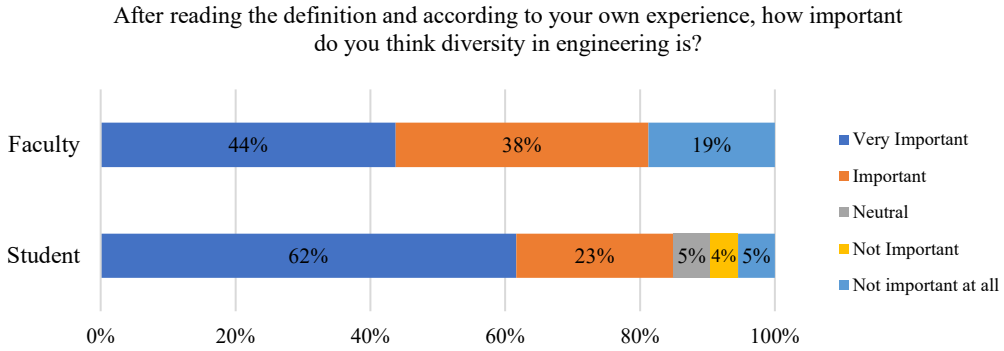

Figure B2. Respondents' perception of the importance of diversity after being provided with the definition of diversity.

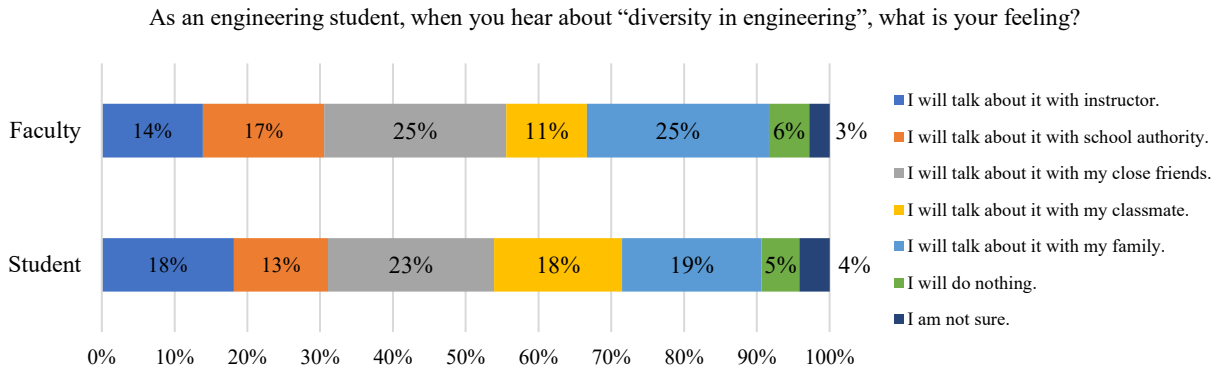

Figure B3. Chart showing how students and faculty members will address being discriminated against.

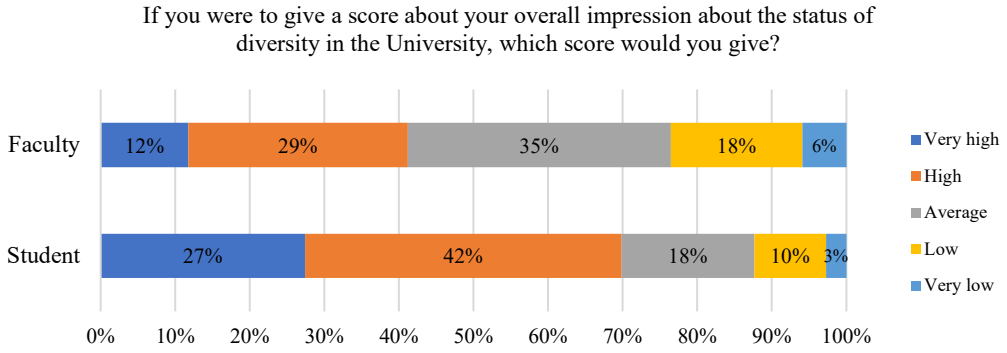

Figure B4. Chart showing the overall rating on the status of diversity in the university.

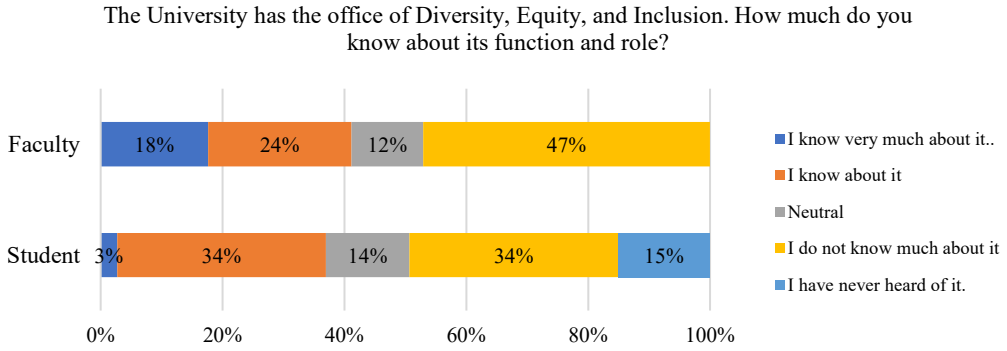

Figure B5. Awareness of the office of diversity, equity, and inclusion in the university.

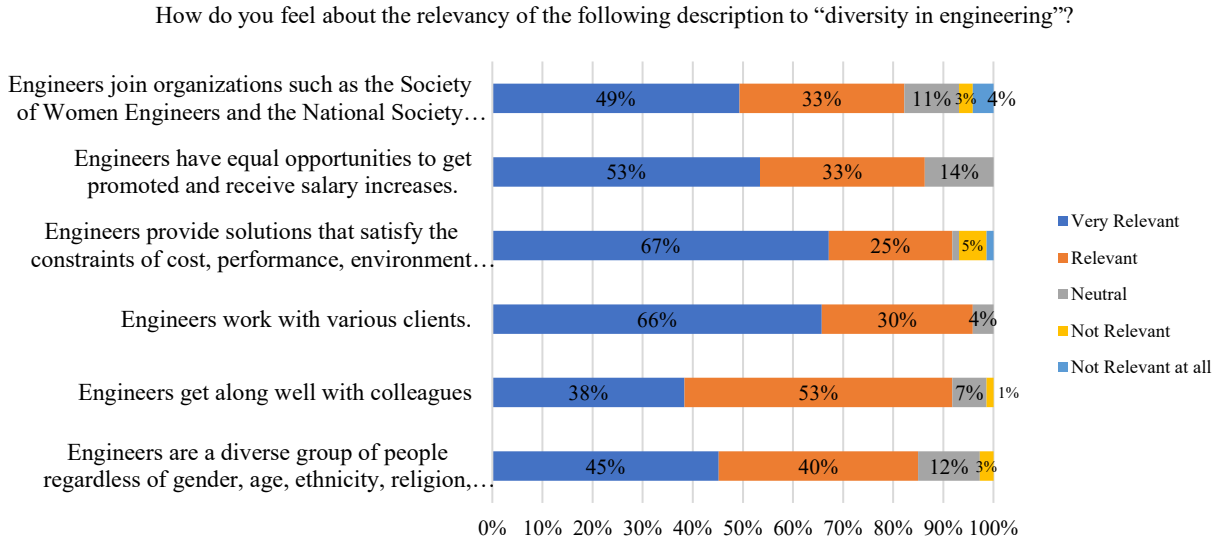

Figure B6. Students’ perception of the relevance of some descriptions of diversity in engineering.

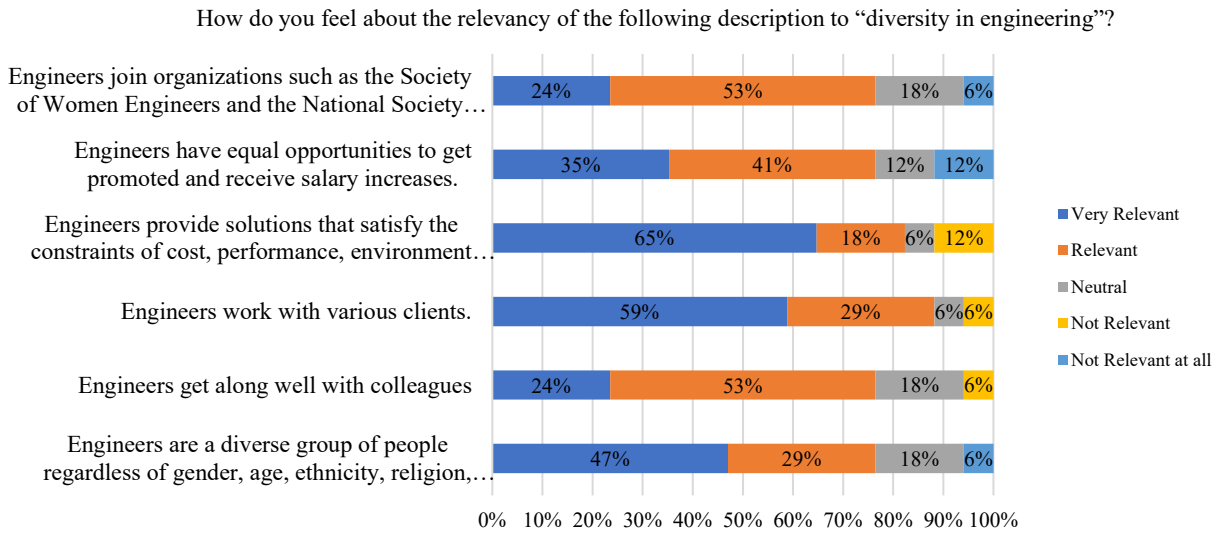

Figure B7. Faculty members' perception of the relevance of some descriptions of diversity in engineering.

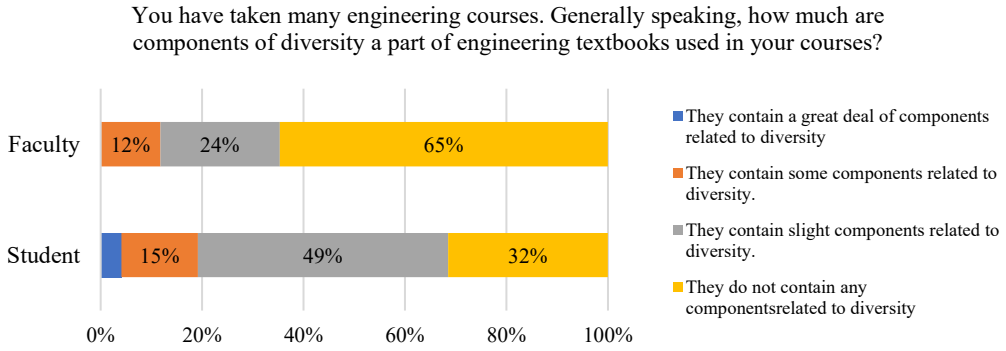

Figure B8. Chart showing students' and Faculty members' perception on the presence of components of diversity in engineering courses.

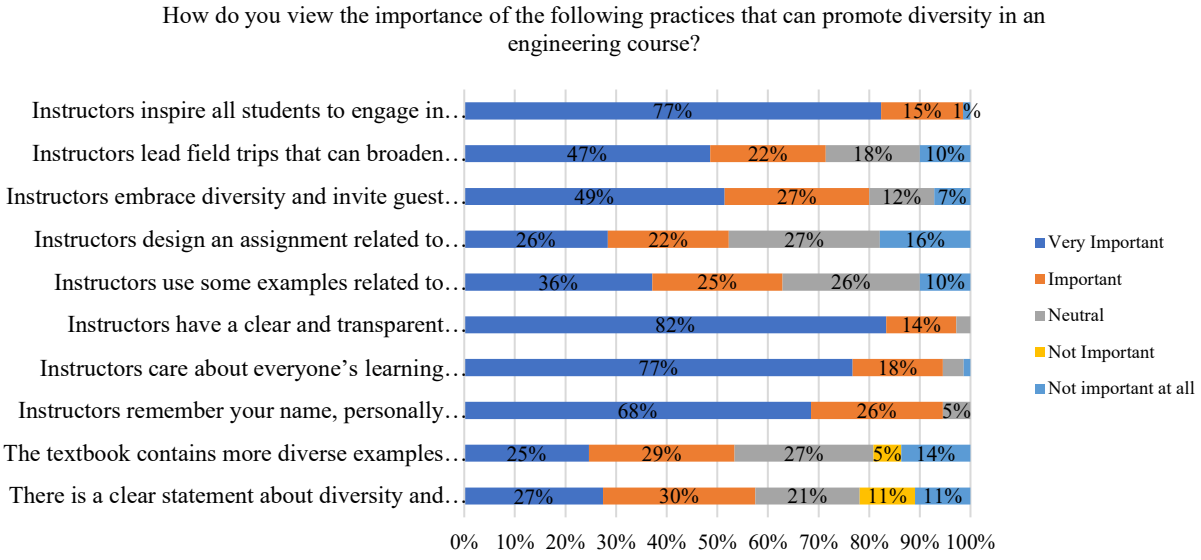

Figure B9. Chart showing students' perception on promoting diversity in engineering courses.

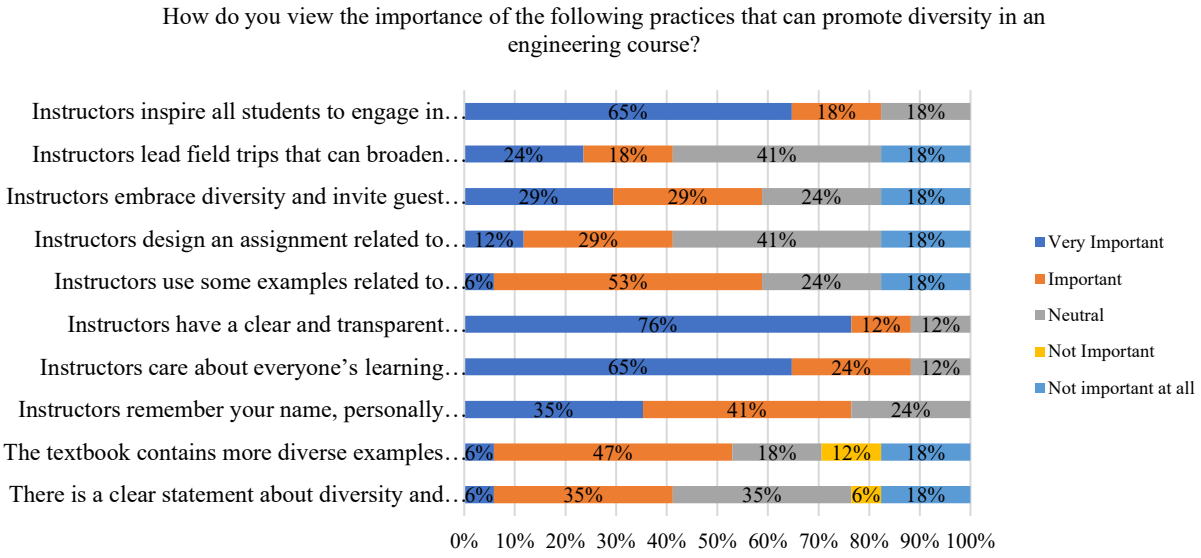

Figure B10. Chart showing faculty members' perception on promoting diversity in engineering courses.

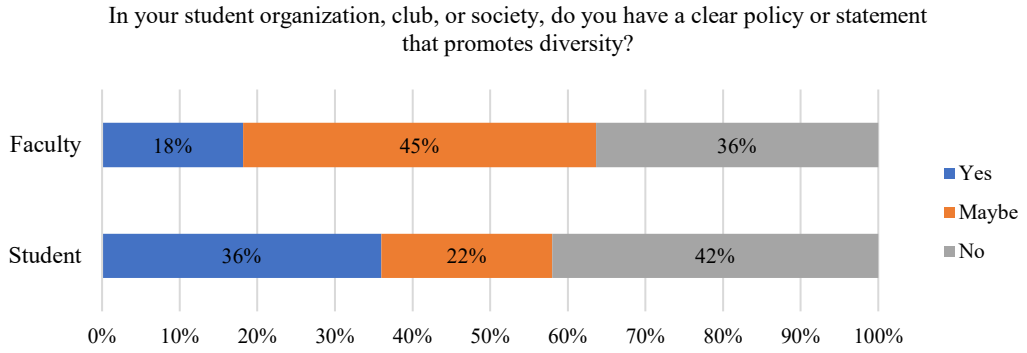

Figure B11. Chart showing students' and Faculty members' perception on clear policy or statement that promotes diversity within student organizations.

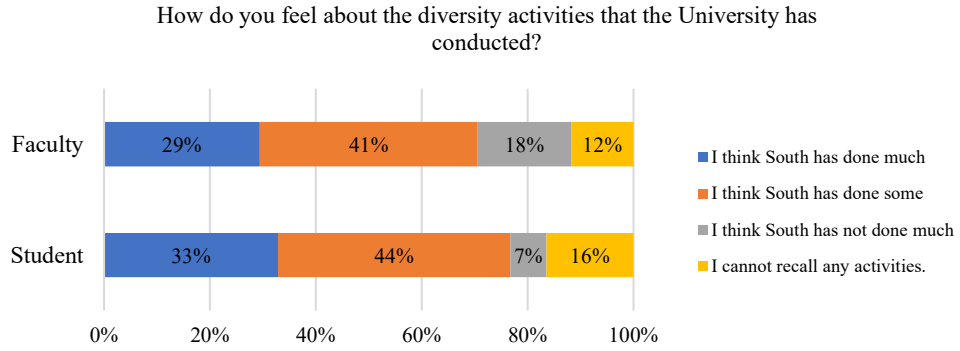

Figure B12. Chart showing how students' and Faculty members' feel about the diversity activities that the University has conducted.

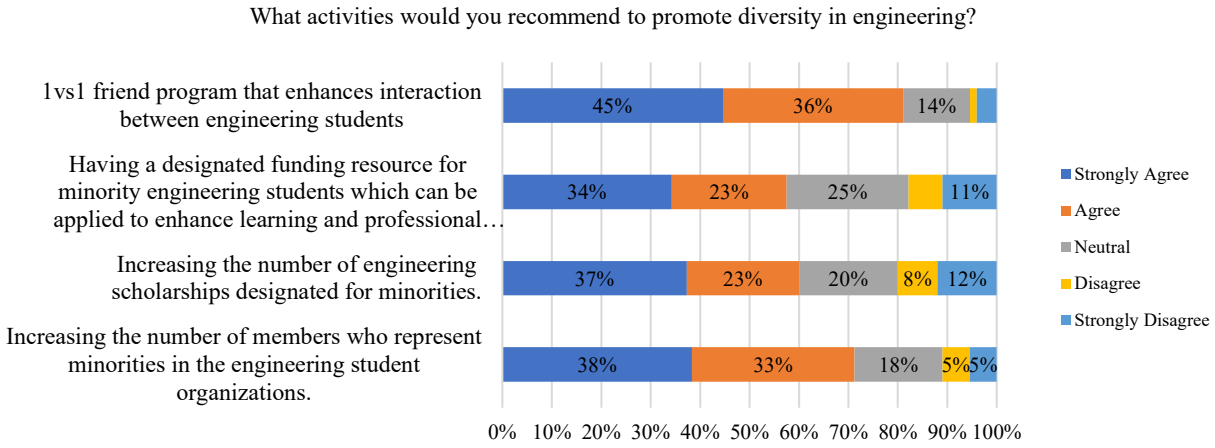

Figure B13. Students' agreement with activities that promote diversity in engineering.

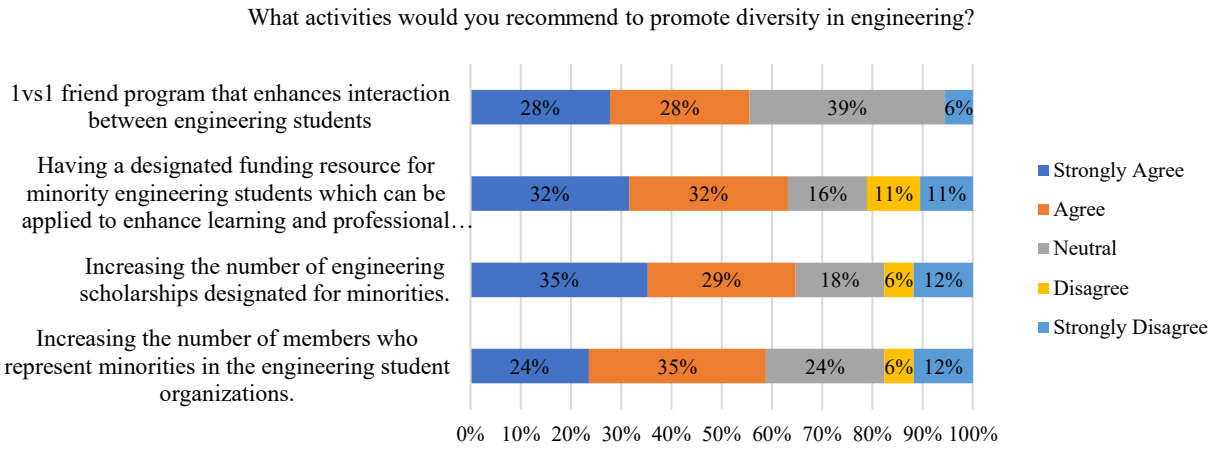

Figure B14. Faculty members' agreement with activities that promote diversity in engineering.

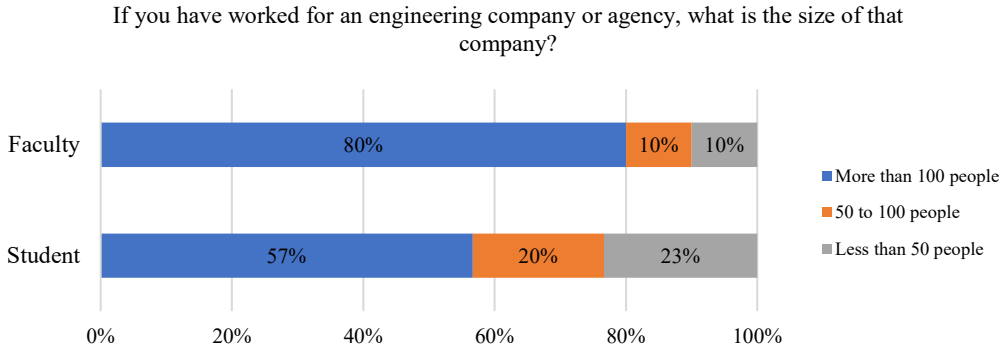

Figure B15. Size of the companies that respondents have worked for.

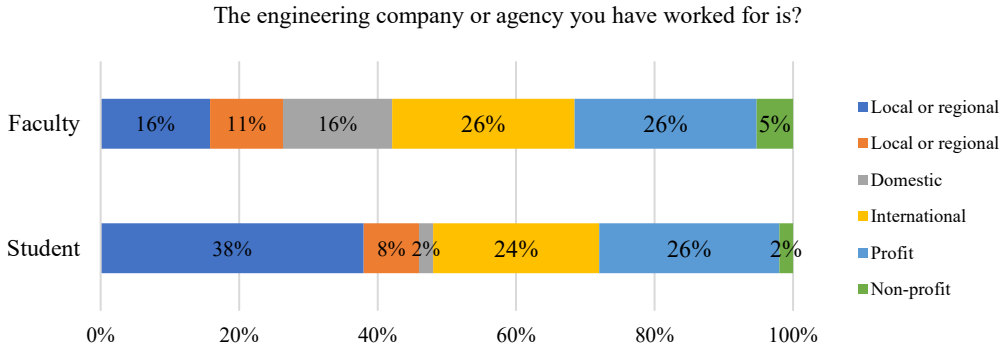

Figure B16. Chart showing the different types of companies for which respondents have worked.

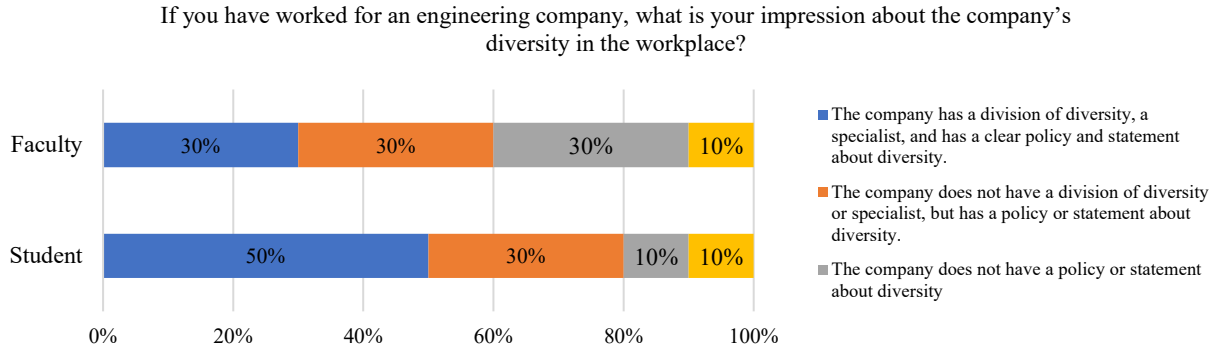

Figure B17. Chart showing respondents' perception on workplace diversity policy.

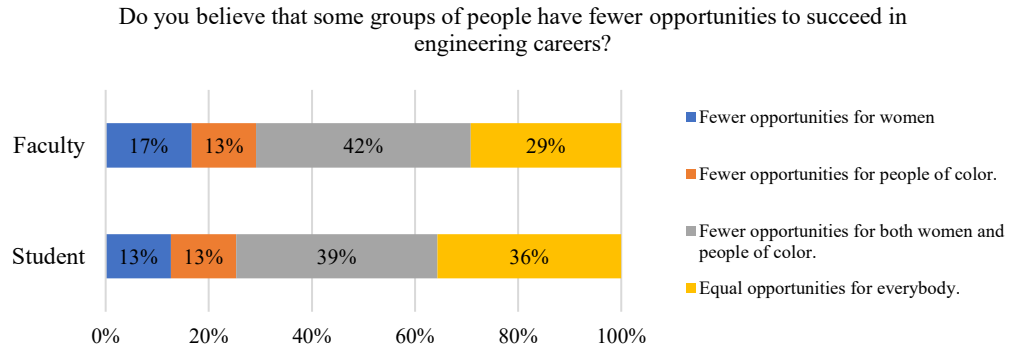

Figure B18. A graph showing students and faculty members' perception on opportunities for minorities to succeed in engineering careers.

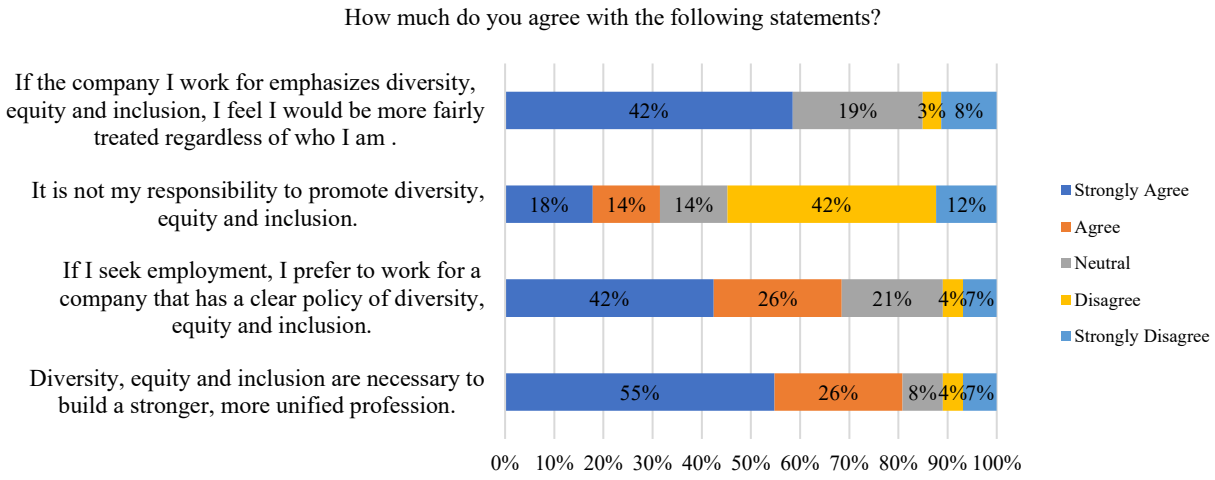

Figure B19. Chart showing students' views on promoting diversity in engineering workplace.

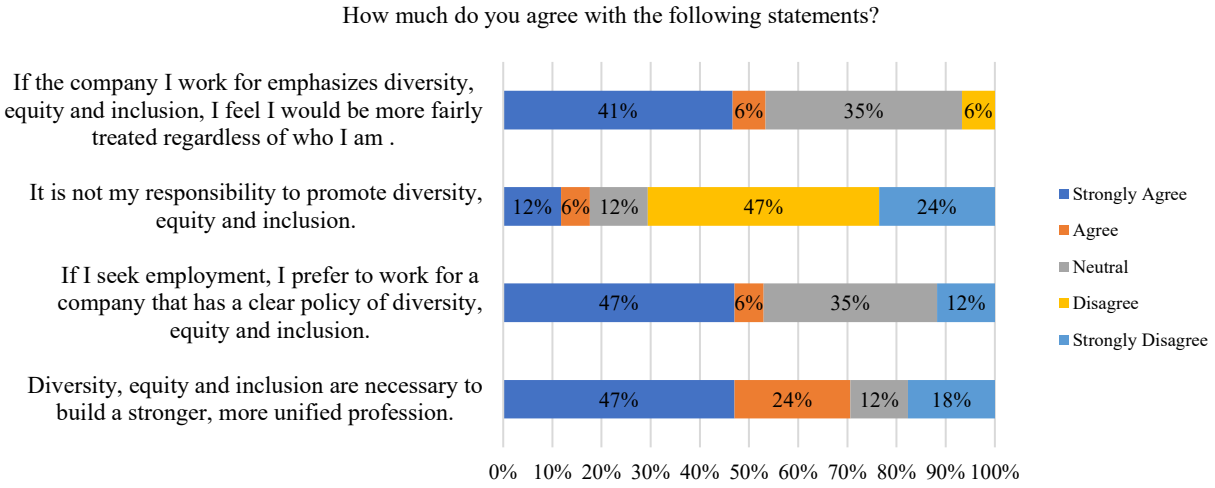

Figure B20. Chart showing Faculty members' view on promoting diversity in engineering workplace.