

Work-in-Progress: Diversity, Equity, and Inclusion Initiatives and Assessments in a non-Ph.D. Granting School of Engineering and Applied Science Embedded in a Multicultural Region

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**Title: Diversity, equity, and inclusion initiatives and assessments
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Abstract

The concepts of diversity, equity, and inclusion (DEI) contribute to producing an engineering workforce that is poised to solve the complex technological issues facing a global workforce, thereby ensuring a better life for the global community. This principle has been recognized by ASEE in its creation of the Diversity Recognition Program (ADRP), and by ABET through the changes in Criteria 5 and 6 scheduled to take effect for the 2024-2025 accreditation cycle. Hofstra University's DeMatteis School of Engineering and Applied Science underwent reaccreditation for six of its programs in the 2023-2024 cycle during which DEI initiatives were collected but not formally reviewed by ABET visitors and the school has obtained reaffirmation of its Bronze status under the ASEE ADRP. Hofstra University is situated in the New York metropolitan area. This region represents a very diverse community and the students in its engineering programs mirror this diversity. In addition, there is no separate admission to the School of Engineering and Applied Science. The combination of our region's multi-ethnic demographics and non-school specific entrance to DeMatteis programs guarantees that the school will tend to have a larger proportion of first-generation students, and implies a concomitant need to address the varied preparation that students receive in mathematics before entering the university. The following paper covers approaches to DEI as a culture within the university and specifically for the School of Engineering and Applied Science. To aid in the development and assessment of DEI initiatives a seven-member committee was created. The committee developed a DEI Statement which is published on the Hofstra University website. Our previous ADRP plan of action to promote diversity in the student and faculty populations included four measures: increasing the proportion of women, increasing the retention of African-American students between their first and second years, welcoming more international students, and maintaining a high level of diversity among faculty by utilizing recruitment strategies in conjunction with the university's Chief Diversity and Inclusion Officer. Several of the initiatives utilized, such as a Women's Summer Program in Computing/Engineering and a special summer math preparation course, were initially adversely impacted by COVID. Despite that interruption in in-person activities in 2020, the school did see progress in the proportion of female students (23.9% in Fall 2022 versus 20.9% in Fall 2019). The revised plan includes a focus on addressing the imbalance of secondary school preparation, continuing to address gender imbalance, detailed monitoring of retention of URM students who participated in specific program initiatives, increasing faculty and staff awareness of diversity, employing best practices learned through participation in professional conferences with DEI components, and creating concrete strategies geared toward fostering a culture of inclusion within the curriculum. The full paper will go into more detail on the initiatives being undertaken to achieve these goals and how such strategies are integrated into preparing for a scheduled ABET visit.

Introduction

Creating an engineering school academic culture that incorporates diversity, equity, and inclusion (DEI) awareness is imperative for the future of those schools' success in educating new generations of professionals, as has been recognized by ABET and ASEE. ABET has included changes to Criteria 5 and 6, which was optionally piloted in the 2023-2024 accreditation cycle [1]. ASEE has created the Diversity Recognition Program (ADRP) which recognizes engineering schools implementing DEI initiatives [2]. Hofstra's Engineering school underwent reaccreditation for six programs in the 2023-2024 cycle and participated in the pilot of the DEI components of Criteria 5 and 6. In addition, the university was accorded renewal of Bronze status under the ASEE ADRP. The present paper discusses the plans and assessments utilized to reach these goals.

The need to address DEI in the region where the university resides is critical in the attraction and retention of students to engineering. The region is a diverse metropolitan area in which the student body reflects the diversity. In addition, the engineering school does not have separate admission criteria to the University. This leads to students with varied preparation levels entering the engineering program. The student population is made up of a substantial portion of first-generation college students. These students can face many challenges in pursuing an engineering or computer science degree and navigating the college ambience. The plans the school has implemented and the programs available at the university reflect the needs of both meeting the new criteria and retaining engineering students. These plans fall into two major areas related to the student body: attracting and supporting a diverse and inclusive student body and educating the student body to become practicing engineers who recognize and incorporate the culture of DEI while still receiving a rigorous academic training in a given degree program. To accomplish the plans for the student body it is important to recognize that this process begins with ensuring that the faculty embody an authentic DEI culture. To that end it is important to consider the guidance and training of faculty to establish a robust culture of inclusion throughout the institution, and especially in the engineering school.

The following is a description of the ABET Changes to incorporate DEI and the ASEE Diversity recognition program (ADRP). It is important to note that ABET defines DEI as the following in the definitions under the general criteria. [1]

Inclusion is the intentional, proactive, and continuing efforts and practices in which all members respect, support, and value others.

Diversity is the range of human differences, encompassing the characteristics that make one individual or group different from another. Diversity includes, but is not limited to, the following characteristics: race, ethnicity, culture, gender identity and expression, age, national origin, religious beliefs, work sector, physical ability, sexual orientation, socioeconomic status, education, marital status, language, physical appearance, and cognitive differences.

Equity is the fair treatment, access, opportunity, and advancement for all people, achieved by intentional focus on their disparate needs, conditions, and abilities.

Changes to Criterion 5, which describes the required program Curriculum, include the addition of the following statement. [1]

- d. content that ensures awareness of diversity, equity, and inclusion for professional practice consistent with the institution's mission.*

Changes to Criterion 6, which relate to the adequacy of the faculty to meet the needs of the program, are stated in the following manner: [1]

The program faculty must demonstrate awareness and abilities appropriate to providing an equitable and inclusive environment for its students, and knowledge of appropriate institutional policies on diversity, equity, and inclusion.

The ASEE Diversity Recognition Program (ADRP) was initiated from the ASEE Deans Council Diversity Pledge [2] to recognize the programs that were making progress towards specific goals related to increasing diversity and inclusion in enrollment and degree attainment. The pledge commits the signatory programs to engage in four activities to promote diversity in enrollment, retention, and graduation rates which will lead to increased diversity in the workforce and engineering faculty. Applicants must be members of the ASEE Engineering Deans Council (EDC) or the Engineering Technology Council (ETC). The program is projected to have three levels of recognition: Bronze, Silver and Gold. Currently applicants can apply for bronze status, reaffirmation of bronze status, direct to silver status or silver status (for current bronze institutions).

Literature Review

Selection and persistence of STEM majors has been attributed to four factors by Heilbronner [3]: ability, self-efficacy, educational experiences and interest. Engineering majors are more likely to graduate when they have good math preparation [4]. Less than optimal high school preparation has contributed to early switching out of STEM majors, and this phenomenon is experienced at a higher rate by students of color. These students have reported that they were underprepared and overconfident in their college STEM courses. The disconnect was described by these students as being top of their class in high school to being the bottom of their college physics or math classes [5]. Self-efficacy [6] is the belief by an individual that they have the ability to produce the outcome expectancy. This can be described as an individual's belief that they can improve their learning with effort, and consequently these individuals will then be more likely to work harder and longer to attain goals [7], [8]. This persistence can lead to increased self-efficacy. Thiry [9] found that the low math readiness students who persisted were more likely to attribute their persistence to sheer determination and "grit". In examining educational experiences, Hunter [5] describes that switchers listed loss of confidence as a factor in their decision and in the most recent study it was rated as the second highest factor for high performing switchers. This was also particularly true of women and women of color. In the same study students also experienced a negative reaction to the competitive climate in STEM classes.

Harper et al [10] found that teaching methods in STEM can be problematic and may contribute to students leaving STEM. In that study students reported they experienced greater incidence of lecture based instruction compared to active learning in mathematics and engineering courses.

In addition to the factors discussed related to persistence Hunter [5] found that financial problems in completing a STEM degree have become a growing factor in the decision of students to leave those programs. They also found a correlation with an increase in student working hours.

Several studies have been conducted on both the type of first mathematics course and grade obtained in that course being correlated to persistence in engineering [11]-[17]. Van Dyken et al [12] found that 50% of students starting in precalculus left engineering and this decreased to 21 % when students started in calculus. They also found that the initial course grade had an impact on retention. The University in the study did not offer mathematics courses below precalculus for the engineering program. Budny et al [14] found that GPA in the first semester was a strong predictor of retention in the engineering curriculum. Students receiving an A in Precalculus were found to be as likely to persist in engineering as students with a B in Calculus 1 or a C in Calculus 2 as an initial mathematics course. They recommend careful placement into a first math course so that students earn what they perceive to be an acceptable grade. Gardner et al [15] found that the grade earned in the first math course was relevant to one-year retention but the math course type was not. Ohland et al [16] found that students passing Precalculus had higher retention rates than students failing Calculus.

Several studies have been conducted on the use of the ALEKS Placement, Preparation and Learning (PPL) [18] system for placement into mathematics courses of incoming first-year students [19]-[22]. Michigan Tech [22] changed from using Math ACT score to the ALEKS online test and they noted that they thought this would be a better placement since students could retake the test and were provided training opportunities within the learning platform. The switch caused students who would have been placed in precalculus based on the ACT to be placed in college algebra based on the ALEKS score. Ayele et al [21] conducted a study at a historically black college/university and found that most students did not retake the placement exam, but the students that did utilize the ALEKS modules were able to increase their scores by six points, which led to a placement in a higher level mathematics course.

Research on First-Year programs has shown that they can increase first-year retention rates and graduation rate of engineering students [23]-[25]. This is partially due to the engineering students feeling a disconnect from their program since they are taking predominantly courses outside their major such as mathematics and science. In addition, the first-year programs can aid in the building of a community of learning which has also been shown to aid in retention [26]. Learning communities can increase levels of academic engagement, improved social awareness and increased level of student learning. This has been attributed to shared experiences and common academic interests. [27]. Four forms of learning communities typically occur: curricular, classroom, residential and student type. Positive belonging can also be cultivated by STEM research experiences and peer support through professional societies, study groups and other formal or informal opportunities [9].

Handley and Marnewick [28] present a DEI model for engineering curricula which was adapted from incorporating international competencies into systems engineering courses. Two competencies necessary to be successful globally are cognitive-style awareness and teamwork. Cognitive-style awareness is the recognition that people approach problem-solving in different ways. This includes recognizing that people think and respond in different ways, and consequently adapting to these varied views, values and beliefs. Teamwork represents the ability to work on diverse teams by recognizing that team members may think differently. This can be manifested by examining the knowledge of team goals, contributing to team assignments, participating in team decisions and respecting team members and their contributions. They propose that this requires the addition of social learning to the engineering curriculum.

The DEI approach and assessments of the engineering programs at Hofstra University were informed by the literature in terms of improving mathematics placement, creating peer groups for women and a strong focus on team-building in the first-year program.

Current Approach and Assessments in Light of the ASEE ARDP and ABET Visit

The three-year plan of action to promote diversity in the student and faculty populations submitted by the School of Engineering and Applied Science in November 2019 included the following initiatives and their measures of success:

1. Increasing the proportion of women students from 21 % to 25% by Fall 2022.
Initiative: A five-week paid summer program for women in computing and engineering named Women's Summer Program in Computing/Engineering (W-SPiCE) was utilized as an incentive for women to enter the school as first year students and continue past their first year. The program focuses on learning about five degree options available to them for future careers, devoting one week of instruction and design to each area, with five different faculty leading the activities. A stipend of \$2500 is awarded to the participants. The program is limited to no more than 15 students per summer who have demonstrated academic proficiency in their first year.

Measure of Success: The proportion of women undergraduate students increased from 20.9% in Fall 2019 to 23.9% in Fall 2022. Improvements can be seen from 2021 to 2022 when the summer program was operating. (The summer 2020 offering of the program was canceled due to COVID restrictions and may have impacted the earlier results.) More recently a study was undertaken of all the participants through summer 2023, with the following results. Of the 50 women students who participated in the summer program, 43 have either graduated from or are still enrolled in the DeMatteis School, a retention rate of 86%. This is compared to a 64% retention rate (197/306) for all women students over the past six years, and a retention rate of 60% (760/1265) for all DeMatteis students over the same time period. Although a direct cause and effect has not yet been established, the availability of this program may partially account for the fact that the fraction of first-year women students has increased from an average of 21% during the years 2018 through 2020 to an average of 27% during the years 2021 through 2023.

2. Increasing the retention rate of African American students between first and second years from 50% to 75%.

Initiative: Implementation of a tuition-free summer math preparation course for students from primarily under-resourced schools prior to the start of the first year and post placement exam indicating a need for a better understanding of pre-calculus and algebra. The program was started in summer of 2021. Students in the summer 2022 cohort were tracked through their 2022-2023 progress through mathematics courses.

Measure of Success: Once again this goal was impacted by COVID. Improvements were observed but the goal was not met. From Fall 2019 to Fall 2020 the retention rate was 53%, from Fall 2020 to Fall 2021 it was only 32% and from Fall 2021 to Fall 2022 it was 58%. However, an analysis of the 19 participants in the Summer 2022 program indicated that 16 had first semester GPAs of 2.50 or higher, all had passed their Fall 2022 math course, and the top 6 GPAs were earned by African American students. As of Spring 2024, many of these students are currently completing their second year in the school and are on schedule in their degree programs, including five of the six African American students just mentioned. On the other hand, the summer 2023 offering of the course was not as well attended, dropping to 12 initial enrollees of whom only five completed the course. This course is consequently being reexamined to make it more attractive and accessible to students with an optimal summer timeframe and delivery mode.

3. Welcoming more international students through the INTO partnership [29], with goal of maintaining a steady number of 25 to 30 students accounting for 3% of the undergraduate population by Fall 2022.

Initiative: Partnership with the INTO program which recruits around the globe. Students in this program typically have the first year at the university focused on English as a Second Language (ESL) courses before mainstreaming into the desired program of study.

Measure of Success: The program suffered during the pandemic but the combined undergraduate and graduate enrollment increased from 7 in Fall 2019 to 25 in the Fall 2022 representing 2.9% of the total current student enrollment. Recent interactions with INTO executives indicate a large increase in students coming from India and other southern Asian countries, as well as Africa. One consequence is that more potential students will have good English-speaking skills, which will curtail the mainstreaming time into the School of Engineering.

4. Maintaining the School's high level of diversity among the faculty.

Initiative: Work in conjunction with the Chief Diversity and Inclusion Officer when available positions arise.

Measure of Success: The percentage of Women faculty decreased in Fall of 2021 to 21.4% and then increased to 24.1% in Fall 2022. The number of Asian faculty increased from 17.2% to 20.7% over the past three years. The remaining ethnic groups stayed the same (Hispanic at 10.3% and Pacific Islander at 3.5%). The university has begun tracking the ethnic profiles of candidates for available faculty positions, heightening the awareness of faculty search committees to the diversity of applicants, and encouraging a broader distribution of advertisements in venues that historically underrepresented groups

Reaffirmation Plan for Bronze Status

The new plan includes six goals:

1. To create programs that address the imbalance of secondary school preparation for collegiate studies in engineering and computer science.
Initiative: Tuition-free math preparedness course offered during the summer. Students are currently recommended to the program based on their score on the adaptive learning ALEKS program which all students entering the School of Engineering take during the summer months. We are reviewing ways to improve enrollment in the program including requiring the placement exam to be completed early in the summer or *requiring* students below a certain cutoff ALEKS score to take the course.
2. To create programs that address the historic gender imbalance in the engineering and computer science student populations.
Initiative: Continuation of the very successful W-SPiCE summer program. An analysis of the participants between 2020 and 2023 revealed that 43 out of 50 participants (an impressive 86%) have persisted in a SEAS major. This strong reaffirmation of their majors has contributed to the overall improvement in the percentage of women students in the overall SEAS student population. Revitalization of the Society of Women Engineers (SWE) chapter is another strategy for strengthening the women students, including financially supporting sending members of the university chapter to national SWE conferences.
3. To monitor carefully the retention statistics for Underrepresented Minorities (URMs) throughout the curricula, examining data to determine if any major differences exist, and to intervene with added resources where possible to minimize such differences.
Initiative: Use the enhanced capabilities of the university's institutional research office. Tracking of the cohort of students who completed the special math preparation course.
4. To ensure that all faculty and staff are aware of the importance of diversity, equity and inclusion considerations in their interaction with students and with each other.
Initiative: Requiring all persons involved in the hiring process attend a workshop on identifying implicit bias and develop rubrics to eliminate it as much as possible from the decision process. A DEI workshop in the Fall 2023 for all faculty represented an initial commitment to enhancing awareness of relevant issues.
5. To seek to employ best practices through frequent interaction with other institutions and to regularly assess the effectiveness of initiatives already being implemented.
Initiative: Development of a School DEI Committee. Participation of faculty in professional conferences which include a DEI component.
6. To foster the culture of inclusion within the curriculum to ensure that all graduates enter the workforce with a heightened awareness of the value of operating in a diverse professional environment.
Initiatives: The culture of inclusion is a focus of the first-year engineering program sequence of courses. These efforts utilize the curricular, course and student type (engineering) form of learning communities. In three of the courses, students work on teams over the course of their first academic year on design projects, the teams in one

course formed using a modified personality test and speed teaming. Effort is made in the first-year program to ensure student learn to work on teams effectively and given the diversity in the university this leads to exposure to diverse perspectives in the first year. Several activities are being added to the first-year programs to highlight and expose students to DEI awareness. Two of these activities are being repeated and enhanced in upper-level courses [30]. In addition, two of the DEI committee members are part of an NSF-funded program to increase retention of students in STEM through a theoretical framework of legitimate peripheral participation [31]. The program will be expanded to include a local community college. One of the DEI committee members in conjunction with the NSF program is organizing a one-day teaching and learning conference for faculty at both the 4-year institution and the community college.

ABET Pilot and Future Work

The components from the ASEE ADRP plan were utilized in the preparation for the ABET self-report and visit for the 2023-2024 accreditation cycle. A separate report detailing these initiatives was submitted to the ABET visit Team in summer of 2023. ABET deliberately chose not to assess any programs on these criteria during this cycle; instead the accumulated information obtained from all the schools which chose to participate in the pilot may be released this summer. In conclusion, the effort required for the application for Bronze Status in the ADRP program can aid in preparation for the changes to Criteria 5 and 6. This can be accomplished by setting goals which reflect the ABET criteria in the ADRP plan. The narrative above suggests some initiatives which have already proven successful and others which continue to be assessed to better achieve the desired goals of creating a diverse learning environment in a non-PhD granting engineering school.

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