

Work-in-Progress: A Faculty Development Response to Integration of Diversity, Equity, and Inclusion into the Engineering Curriculum

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Abstract—This work-in-progress paper will discuss the evolving response by an engineering education center to proposed changes in the ABET general criteria for accrediting engineering programs relating to diversity, equity, and inclusion (DEI). ABET is a “nonprofit, ISO 9001 certified organization that accredits programs in applied and natural science, computing, engineering and engineering technology.” The paper will discuss the plan of the Leonhard Center for the Enhancement of Engineering Education located in the College of Engineering at Pennsylvania State University to help faculty and departments meet the proposed changes in ABET criteria relating to diversity, equity, and inclusion. In addition, the College’s strategic plan calls for the integration of DEI into the curriculum, leading to a changing emphasis in the work being done in the Center. This paper would likely be of interest to engineering educators and other faculty developers who will have to demonstrate that their engineering programs meet ABET accreditation requirements or have similar strategic goals. In addition, the paper will describe current and evolving efforts to date as well as discuss the challenges that occurred during the development of the DEI curricular integration and training plan.

Keywords—*faculty development, ABET, accreditation, diversity, equity, inclusion*

I. INTRODUCTION

Around the world, ABET is a major accreditation body for engineering and computer science programs. The organization describes itself as a “nonprofit, ISO 9001 certified organization that accredits programs in applied and natural science, computing, engineering and engineering technology” [1]. To date, ABET has accredited more than 4,000 programs in 41 countries around the world. The agency uses a process focused on learning outcomes, examining programs to see if students are meeting program educational objectives. At the baccalaureate level, ABET provides a set of general criteria for students, program educational objectives, student outcomes, continuous improvement, curriculum, faculty, facilities, and institutional support.

In March of 2021, the Engineering Deans of the Big Ten+ Universities in the United States submitted a letter to ABET supporting ABET’s ongoing work on DEI and requesting that

diversity, equity, and inclusion (DEI) be included in the general criteria for the accreditation of engineering programs [2]. The deans argued that DEI needs to be embedded within the engineering curriculum to create an inclusive culture and community within engineering colleges. In late 2021, ABET posted proposed changes to the General Criteria for Accrediting Engineering Programs on their website. These changes were to Criterion 5 (Curriculum) and Criterion 6 (Faculty). Specifically, the proposed criterion that relate to DEI are listed below:

Criterion 5 (Curriculum) – “The curriculum must include...a professional educational component that is consistent with the institution’s mission and the program educational objectives and promotes diversity, equity, and inclusion for career success” [3]

Criterion 6 (Faculty): “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.” [3]

These proposed changes, along with others, have been available for public comment between October 31, 2021, and June 15, 2022, representing a 180-day review and comment period. As of the writing of this paper, it is unclear exactly what the final criteria will be relating to DEI. However, it seems to be clear that DEI will likely be included in some format in the accreditation criteria for engineering programs in the near future.

Simultaneously, at the authors’ institution (along with many other institutions in the United States and around the world), the emphasis on DEI in engineering programs has been steadily increasing. With recent events in the United States and around the world related to racism, gender identity, and other discrimination, many organizations have been creating strategic plans and implementing initiatives to try to reduce racism, sexism, and other forms of discrimination and to create a more inclusive and welcoming environment for all students. At Penn State, the current College of Engineering strategic plan strongly

emphasizes DEI in multiple manners, including the recruitment of students, the hiring of faculty, and the creation of more inclusive classrooms. Both the strategic plan as well as the proposed ABET criterion changes have been impetuses for creating change in the College of Engineering.

This paper describes the role of an engineering education center, the Leonhard Center for the Enhancement of Engineering Education, in the College of Engineering at the authors' institution to be prepared for the proposed ABET changes and to meet the College strategic plan. Of particular emphasis is the development of a student curriculum and a corresponding faculty training program. The paper is considered a work-in-progress because the changes being proposed are ongoing and will likely continue in the years to come. Other institutions who will be facing accreditation and are concerned with how to help their programs meet the newly proposed criterion will likely be interested in this paper. In the following sections, we discuss the proposed curriculum, the corresponding faculty development efforts, professional development efforts being done in the Leonhard Center, and next steps.

II. A PROPOSED STUDENT CURRICULUM

In October of 2021, the authors asked members of the industrial advisory board (IAB) of the Leonhard Center to provide input on desired DEI knowledge, skills, and attitudes of engineering graduates. The IAB members represent all engineering majors in the College. It is approximately balanced between female/male and includes several members from groups that are minoritized in engineering. The degrees of IAB members include BS, MS, and PhD in engineering as well as graduate degrees in business and engineering management. They work in a range of industries from start-ups to Fortune 500 companies as well as state government. The IAB members were placed in breakout groups with engineering staff and faculty members who are leading DEI efforts in the College of Engineering. Three separate breakout groups were presented the following context and prompt for discussion, which included a statement from the Dean of the College, background of the proposed changes, and definitions of relevant terms.

Background

From the Dean: "Our job' is to ensure that all of our graduates are the most prepared to contribute in their subsequent role. Today this means not only technical excellence, but also playing a positive role in having a favorable workplace culture and climate, which includes understanding issues of equity and inclusion."

The Engineering Deans of Big 10++ schools sent a letter to ABET to support advocate for incorporating diversity, equity, and inclusion (DEI) into accreditation criteria. It is likely that the Engineering Accreditation Commission of ABET will release DEI-related changes to their criteria for public comment before the end of the year. One of those

changes will be in the Criterion on Curriculum, which will add a requirement for a "professional component" related to DEI.

Goal for Breakout Sessions

The Breakout sessions are intended to provide a starting point for the development of DEI learning objectives for a professional component on DEI in our undergraduate programs.

Agenda for Breakouts

Guiding Question: What DEI knowledge, skills, and abilities will College of Engineering graduates need to succeed and play a positive role in having a favorable workplace culture and climate?

Quick introductions (10 min)

Idea Generation on DEI-related Knowledge, Skills, and Abilities. (50 minutes)

Synthesis/Prioritization (30 minutes)

The group was also provided definitions of diversity, equity, and inclusion from ABET's website [2]:

- 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. Achieving equity requires understanding of historical and systemic patterns of disparity to address and eliminate barriers and remove participation gaps as part of a comprehensive strategy to achieve equitable outcomes and social justice."
- Inclusion is "the intentional, proactive, and continuing efforts and practices in which all members respect, support, and value others. An inclusive environment provides equitable access to opportunities and resources, empowers everyone to participate equally, and offers respect in words and actions for all."

Each group provided detailed minutes from their discussions. After the IAB meeting, the authors reviewed and synthesized the input from all teams to develop a framework for a DEI curriculum. The authors then convened the DEI-working group from the engineering education center to review the synthesis and to add more detail to the curriculum model, which is presented in Figure 1. These four components of the curriculum model are Motivation, Foundational Knowledge, DEI in

Design, and Inclusive Team-skills. Table 1 provides more detail on what is included in each of the four curricular components. Figure 1 also lists two key abilities that are required for successful learning and growth in DEI, “DEI-centered self-awareness and reflection,” which is intended to be incorporated within all the other components.



Figure 1: Draft DEI Undergraduate Curriculum

Table 1: Components of the DEI Curriculum Model

| |
|---|
| <p>Motivation</p> <ul style="list-style-type: none"> • Creating inclusive Campus Community (Core values) • Importance of DEI to engineering practice • Justice; addressing past inequities • Myth of the meritocracy |
| <p>Foundational Knowledge</p> <ul style="list-style-type: none"> • Definitions of diversity, equity, and inclusion and related terms • Types of diversity • Multi-identities (Intersectionality) • Historical background on socio-cultural impacts on minoritized groups • Barriers to achievement and success (Privilege) • Engineering’s role in discriminatory practices, e.g., environmental injustices. |
| <p>DEI in Design</p> <ul style="list-style-type: none"> • Ability to recognize the impact of your design on others |

| |
|---|
| <ul style="list-style-type: none"> • Cultural differences and design (DEI curriculum should not be US-centric) • Engaging communities that will use the design • Critical analysis – impact on DEI, environment, society, economics, sustainability, etc. |
| <p>Inclusive team skills</p> <ul style="list-style-type: none"> • Building and maintaining trust • Holding team members accountable • Seeking, giving, and accepting feedback • Willingness, comfort, and experience to engage in difficult conversations • Active listening • Inclusive interactions and facilitation • Consensus building |

The proposed student curriculum was shared with College of Engineering faculty in spring of 2022, to gather additional feedback on the curriculum. This feedback is currently being synthesized and will be used to consider how to revise the proposed curricular framework.

III. A PROPOSED FACULTY TRAINING PROGRAM

In parallel, a proposed faculty development program is being planned. The program model mirrors the undergraduate curriculum, with the recognition that in order for DEI to be integrated into the curriculum, engineering faculty will also have to gain in the knowledge and skills relating to DEI. Figure 2 displays the components of the faculty development model. One primary difference between the models is that there is an emphasis on faculty understanding DEI more broadly within the disciplines of engineering and computer science, rather than just focusing on design. In addition, rather than focusing on “Inclusive Team Skills,” the faculty need to gain expertise relating to “Inclusive Teaching and Mentoring.”

The components of the DEI faculty training model are still being developed and refined. Table 2 illustrates the objectives relating to the “Inclusive Teaching and Mentoring” component of the model, since this is quite different than the student model. This component was developed using various resources [e.g., 4]. The components of motivation and foundational knowledge map directly to the curricular model. The DEI in engineering and computer science component is still being defined.

IV. PROFESSIONAL DEVELOPMENT OF LEONHARD CENTER FACULTY AND STAFF

One of the major concerns that the Leonhard Center team realized early in the development of these models was the need to increase the professional development of the faculty and staff in DEI issues. The Leonhard Center consists of faculty with expertise in engineering, engineering education, educational psychology, assessment and measurement, and communication. At the current time, none of the faculty within the Center have DEI as their primary area of expertise. Given the new aims of

the College and the likely ABET changes, this expertise had to grow.

The Leonhard Center engaged in several types of professional development activities. First, for the entire faculty and staff of the Center, monthly meetings were hosted to discuss varying issues relating to DEI. Each member of the Center took a turn leading the discussion. Topics selected for these discussions included: 1) Anti-racism [5] and the Black Lives Movement, 2) differences in communication styles by gender identity [6], 3) the relationship between race, religion, and current events in Ukraine, and 4) the “Don’t Say Gay” bill being proposed in Florida [7]. Each month, the lead discussant would identify several readings or videos for the group to watch and then provided multiple discussion questions.

A smaller group of faculty members within the Center worked to focus more intensely on how to bring DEI into teaching. This group met bi-weekly to discuss objectives and approaches for implementing DEI into the curriculum, to identify possible future external speakers, and to plan workshops for the faculty.

In parallel, faculty within the Center engaged in their own personal professional development. Some took training from the Equity Literacy Institute, such as the Racial Equity Facilitator Training, the Racial Equity Advanced Facilitator Training, and the Antiracist Educator Summer Series [8]. Others enrolled in the National Science Foundation (NSF) funded STEM Inclusive Teaching Project online course [9], the NSF Game Changers Academy [10], and participated in local offerings such as a Racial Consciousness Book Club held in the College.

With all of these professional development opportunities, the Leonhard Center team has been growing in expertise relating to DEI. The team is committed to continuing to grow in their knowledge in this area, as we recognize that there is still much to learn.



Figure 2: Draft DEI Faculty Development Model in Engineering (ENGR) and Computer Science (CMPSC)

Table 2: Components of the DEI Faculty Development Model

| Inclusive Teaching and Mentoring |
|---|
| Incorporate a variety of pedagogical practices in the course such as (but not limited to): |
| 1) syllabi and other course messaging that emphasize caring and empathy, |
| 2) use of examples in courses that represent diverse perspectives and highlight individuals from different backgrounds, |
| 3) incorporation of student-centered instructional approaches, such as active learning, project-based learning, etc. |
| 4) allow for student co-construction of certain aspects of the course |
| 5) use of assessments that are considered inclusive practices, such as providing multiple opportunities for feedback |
| 6) use of appropriate, inclusive practices for forming, managing, and evaluating teams. |

V. NEXT STEPS

The integration of DEI into engineering curricula and the development of a corresponding faculty development program are daunting tasks. The Leonhard Center team is currently working with colleagues in other Big 10⁺ engineering programs to organize a workshop on approaches for addressing the proposed DEI-related changes in the ABET general criteria for engineering programs. The hope is that this workshop will allow members of the different engineering programs to learn from each other and to share ideas and resources on how to best address the proposed changes.

One of the challenges with the faculty development program being proposed is that there are many workshops and trainings that would need to be developed and held. Concerns relating to this include: 1) how to offer these many workshops given the small number of faculty and staff in the Center, 2) how to incentive faculty to attend these workshops, and 3) how to continuously offer training to accommodate new members of the College. Implementation strategies currently being considered for the faculty training include the following:

- Developing online trainings that are consistently offered to faculty
- Offering “train the trainer” workshops, in which department representatives convene to learn the material and then teach the faculty within their departments
- Partnering with other teaching and learning centers to expand expertise and reach
- Creating learning communities of faculty
- Utilizing internal funding from the Center’s endowment to pay for training for departments
- Seeking additional external funding for larger initiatives

- Integrating DEI into all Center offerings (such as the annual New Faculty Orientation).

Given the critical importance of DEI for our students, our colleges, and our society, we expect that this will be a challenge that we will be working on for multiple years. However, in order to create systemic change relating to DEI, working on these initiatives is essential.

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