# WIP: Exploring Faculty Members' Conceptualizations of Diversity, Equity, and Inclusion in Engineering Education

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*Abstract*—**In this WIP research study, we depict our approach to investigating how US faculty members in engineering education conceptualize Diversity, Equity, and Inclusion (DEI). The recruitment of underrepresented faculty members, retention of these faculty members, and institutional racism are continuing issues in higher education. Implementing DEI initiatives within institutions can help engineering departments effectively respond to the aforementioned issues. Prioritizing DEI in institutional cultures is not only morally necessary, but its incorporation may also affect minoritized individuals' feelings of belongingness and performance in research, teaching practices in classrooms, and service. We argue that is essential to understand faculty members' perceptions and experiences with DEI in order to modify institutional cultures in ways that can wholly realize DEI aspirations. The purpose of this study is to address the research questions, "How do faculty members in engineering conceptualize Diversity, Equity, and Inclusion?", "How do faculty members in engineering experience Diversity, Equity, and Inclusion in their work?", and "How do faculty members' conceptions manifest in their experiences with DEI in their work?" We explored faculty members' experiences related to DEI in their work environment and participants unpacked experiences in research, teaching, or service. We collected interviews with 25 faculty members from engineering or philosophy programs who teach engineering students in U.S. universities. We used a purposeful recruitment method to include participants who self-identified across a range of demographic characteristics and who brought expertise in either DEI or engineering ethics. Findings from this study provide administrators, faculty members, professionals, and researchers in engineering education with strategies improve cultures by prioritizing DEI in U.S. higher education institutions and organizations.**

*Keywords— faculty success; Diversity, Equity, and Inclusion; Sense of belonging; Retention; faculty perception*

## I. Introduction & Background

We begin this study with the premise that Diversity, Equity, and Inclusion (DEI) are important in engineering education. Yet, there are competing views regarding why DEI is important, what constitutes DEI, and how it ought to be brought into engineering curriculum [1], [2]. This variation manifests, in part, due to diversity itself [1], which is evident in research on faculty and students in engineering. With respect to the former, faculty members from diverse backgrounds may introduce different topics into engineering curriculums. For example, Bielefeldt et al. found when comparing survey responses from a large sample of engineering faculty members that "a larger percentage of instructors from underrepresented racial/ethnic groups taught students about social justice issues" [3, p. 6]. As social justice is one primary way to connect ethics and DEI in engineering curriculums [4], this also suggests that underrepresented faculty members are more likely to prompt students to engage with DEI considerations. With respect to research on engineering students, some engineering students resist prioritizing DEI even when it is explicit in curriculum. For example, students may de-prioritize diversity considerations in engineering teams [5] or resist engaging with equity during ethical thinking [6]. Thus, while DEI may be important in engineering education, extant work indicates that the effective integration of DEI into engineering curriculums and cultures remains a challenge.

Diversity is important to many facets of engineering practice. For example, under the right conditions, diversity can enhance creativity [7], which in of itself is essential for generating novel ideas and solutions to today's engineering problems. Importantly, this line of argumentation includes an economic-oriented justification for diversity, but scholars in engineering education have often justified DEI based on morality, fairness, or justice [8], [9]. Scholars have argued that realizing a diverse faculty body can also increase the retention of underrepresented students in engineering programs [10], [11]. Promoting positive student experiences are based on numerous factors, including social identities and demographic characteristics [12] as well as the availability of faculty and the quality of student-faculty interactions (sometimes irrespective of demographic considerations, see [10]).

We conjecture that a focus on diversity alone is insufficient to realize DEI. Inclusion was ostensibly the second DEI pillar to be introduced into engineering education (e.g., see [13]), and we have seen global initiatives focused on D&I [14]. Inclusion may focus on higher education, the workplace, or individual's ways of thinking [4]. "Multi-vocality," which promotes or encourages the inclusion of diverse voices [13], is one example of encouraging diversity and inclusion in thinking processes. Another example of diversity and inclusion in higher education

may constitute considerations associated with hiring faculty members from minoritized backgrounds or seeking to support the success of minoritized students. For example, Jensen and Cross identified that the stress culture of engineering can be particularly challenging for female and first-generation students [12]. As these authors argued, if we want individuals to thrive, particularly students from underrepresented backgrounds, then engineering programs must develop inclusive cultures. Finally, other scholars argue for developing an inclusive work environment, or one that has demographic parity. As white males are traditionally the majority group in engineering in the US [15], increasing diversity and inclusion of less well represented groups in engineering programs at the faculty and the student levels seems necessary to eventually realize workplace diversification [16].

Finally, incorporating equity into D&I draws attention to systemic issues, such as institutional racism and discrimination [6], [17]. In European institutions with engineering programs, prominent DEI considerations include "gender balance" and "disability," which can be addressed in numerous (and, likely, combinatorial) ways [18]. In common vernacular, equity is often conflated with equality, but the two terms bring different connotations. As Rottmann and Reeve note, "Equality builds on an assumption of baseline parity and involves standardized or impartial treatment of all individuals, while equity builds on an assumption of baseline discrimination and involves the removal of barriers to justice" [6, p. 147]. Thus, a critical social justice perspective on equity that accounts for structural injustices and inequities [6] is distinct from Rawls' notion of distributive justice that emphasizes baseline equity as theorized from a veil of ignorance wherein one aspires to infer an "initial status quo" [19, p. 15] for fair agreement.

The purpose of this study is to examine faculty views of and experiences with DEI. We present the theoretical framework, our research procedures, and future work. We aim to address the following research questions: "How do faculty members in engineering education conceptualize Diversity, Equity, and Inclusion?", "How do faculty members in engineering education experience Diversity, Equity, and Inclusion in their work?", and "How do faculty members' conceptions manifest in their experiences with DEI in their work?"

## II. Theoretical Framework

We employed Brewer's Optimal Distinctiveness Theory (ODT) [20]. Brewer theorizes that "social identity derives from a fundamental tension between human needs for validation and similarity to other[s] (on the one hand) and a countervailing need for uniqueness and individuation (on the other)" [20, p. 477]. According to ODT, assimilation and differentiation are the opposing forces that meet distinct individual needs. Brewer stated that "the higher level of inclusiveness at which self-categorization is made, the more depersonalized the self-concept becomes" [20, p. 477]. ODT thus focuses on the individual-system dyad or relationality.

Faculty members have unique personal identities with different backgrounds and social identities. ODT theorizes that individuals require uniqueness for their self-esteem and to develop satisfaction with their workplace [20]. While individuals bring their uniqueness to their research, teaching, work and social environment, they simultaneously need similarities with "others" and, in many instances, validation by their peers or colleagues.

Brewer viewed social identity as "a compromise between assimilation and differentiation from others, where the need for deindividuation is satisfied within groups, while the need for distinctiveness is met through inter-group comparison" [20, p. 477]. In this study, we focus on assimilation and differentiation as a way to view social identities. Herein, "others" may include other professionals at one's institution, affiliated institutions, colleagues in the larger context of a discipline or profession, students, administrators, community members, or any others outside of the university. Faculty members self-identify in different ways with these groups and may find similar or dissimilar social identities, career interests, personal goals, views of success, and so on. Brewer argues that assimilation and differentiation are opposing forces which work in conjunction to support the need of individuation [20]. Thus, assimilation and differentiation must manifest in a stable way for individuals to feel as if they belong.

We conceive of uniqueness as related to how faculty members experience the concept of DEI in their institutional environments. During interviews, this conception manifests in how they express perspectives on DEI and how such conceptions do (and do not) manifest in their background and experiences. Diversity hearkens to the need for differentiation whereas assimilation hearkens to inclusion. Equity draws attention to the counterbalancing of these opposing forces and the extent to which individuals can find equilibrium.

## III. Method

### A. Data collection

#### 1) Interview Protocol

We implemented a semi-structured mental models interview focused on ethics and DEI. There were three primary parts of the interview, designed in alignment with Ford and Sterman, including (1) Positioning, (2) Description, and (3) Summation [21]. Example questions associated with DEI in positioning included: "When you think of this phrase, "DEI", what does this mean for you?", and "Can you give an example or two of where you have observed or experienced DEI in your work?" Example questions associated with DEI in Summation included: "Are there important differences between D, Diversity, E, Equity, and I, Inclusion that we ought to consider when using this combined phrase in engineering?" and "When considering engineering ethics connections, are D, E, and I equally important? If yes, can you explain why?" Interviews generally were between 90-120 minutes in duration. The interview protocol is shared in its entirety in [4].

#### 2) Interviewer Overview

While Anakok served as the lead interviewer for the majority of interviews, Hess and Katz also served as lead interviewers. In addition, Panuganti and Whitehead (refer to acknowledgment) sometimes joined interviews in a supporting role. Anakok, an underrepresented and international female, has

a mechanical engineering and engineering education background and has been working in a DEI office as a graduate assistant in their institution. Hess, a white male from the US, holds a PhD in engineering education. Panuganti, an underrepresented female, has a background in materials engineering and engineering education. Katz, a white male from the US, also holds a PhD in engineering education.

### 3) Post-Interview Memoing

At least one of the interviewers recording a memo following each interview where they addressed the questions: "Procedurally, what went well?", "Procedurally, what can we do better next time?", "What aspects of the participants' perspective were most insightful?", and "Do you have any general comments about the interview?" Memos recorded these thoughts and helped other team members understand how interviewer(s) perceived each interview experience.

### 4) Participant Overview

We interviewed 25 academics. Based on their responses to the recruitment survey, Table I summarizes participant demographics.

TABLE I.    THE DEMOGRAPHICS OF PARTICIPANTS

| Demographics | # of the Participants |
|---|---|
| *Gender* | |
| Female | 11 |
| Male | 14 |
| | |
| *Race/Ethnicity* | |
| White/Caucasian | 17 |
| Black/African American | 5 |
| Asian | 1 |
| American Indian/Alaska Native | 1 |
| Multi-Racial | 1 |
| | |
| *Nationality* | |
| United States | 22 |
| Mexico | 1 |
| Sweden | 1 |
| Greece | 1 |
| | |
| *Current Position* | |
| Instructor | 1 |
| Teaching Faculty | 2 |
| Research Faculty | 1 |
| Adjunct Faculty | 1 |
| Assistant Professor | 6 |
| Associate Professor | 4 |
| Full Professor | 5 |
| Distinguished or Endowed Professor | 1 |
| Professor Emeriti | 1 |
| Independent Scholar | 1 |
| *Multiple Current Position* | |
| Associate, Research, Teaching Faculty | 1 |
| Full Professor, Administrator | 1 |

We interviewed fewer female (n = 11) than males (n = 14). The majority of participants reported White/Caucasian (n = 17) as their race/ethnicity, followed by Black/African American (n = 5), Asian (n = 1), American Indian/Alaska Native (n = 1), and multi-racial (n = 1). We invited participants from US institutions; thus, the nationalities of the participants were primarily from the US (n = 22), and the remaining three participants identified their nationalities as Mexico, Greece, and Sweden, respectively. Most participants were assistant professors (n = 6), followed by full professors (n = 5) then associate professors (n = 4). Table I summarizes and provides additional demographic information.

As part of our recruitment objectives, we aimed to recruit individuals who brought experience in DEI *or* engineering ethics. While we recruited individuals who likely had such expertise based on their roles or prior work, we conceptualized expertise via self-report. Specifically, participants indicated their levels of expertise with ethics, diversity, equity, inclusion, or "other" (participants could fill-in a related term if they desired). We separately asked the following questions for each term Diversity, Equity, Inclusion and other: "What do you consider your level of expertise on the following topics (Diversity, Equity, Inclusion) in engineering or engineering education?" and "To what extent does your research focus on the following topics in engineering or engineering education?" The responses for each question are presented in Table II.

Table II shows the number of participants for each topic (Diversity or D, Equity or E, and Inclusion or I), including their self-reported expertise and the extent that their research focuses on these topics. Most participants indicated that their expertise level was Medium or High on all topics (Diversity = 22, Equity = 24, Inclusion = 22). The majority also reported that they have Moderately or Primarily do research on three topics (Diversity = 18, Equity = 21, Inclusion = 20).

TABLE II.    THE LEVEL OF EXPERTISE OF PARTICIPANTS ON DEI

| Level of Expertise | | | | Extent of Research Focus | | | |
|---|---|---|---|---|---|---|---|
| | D | E | I | | D | E | I |
| None | 0 | 0 | 0 | Not at all | 1 | 1 | 1 |
| Low | 3 | 1 | 3 | Minimal | 6 | 3 | 4 |
| Medium | 9 | 12 | 10 | Moderately | 11 | 13 | 11 |
| High | 13 | 12 | 12 | Primarily | 7 | 8 | 9 |

## B. Data Analysis

### 1) Conceptions of DEI

We first focused on RQ1, "How do faculty members in engineering conceptualize Diversity, Equity, and Inclusion?" At the time of writing, we have collected data and have nearly completed transcribing interviews. In this section, we explain how we plan to conduct data analysis.

We will employ a qualitative content analytic approach [22], with deductive codes adapted from the Theoretical Framework coupled with codes from [4]. We selected DEI conceptual questions, including: (1) ways of framing DEI in the Positioning Section and (2) conceptions of how individual D-E-I are relatively important in the Summation Section.

A lead coder (Author 1) first will review a subset of transcripts (approximately 5), therein modifying extant codes and generating new codes inductively. Next, a second coder will review coded passages indicating agreement, disagreement, and providing suggestions (which may take the

form of offering novel codes, splitting existing codes, or merging existing codes). The lead coder and second coder will meet with the whole research team and discuss any discrepancies. The team will then co-generate an updated coding framework. This procedure will occur in multiple rounds until the coding framework is stable and reaches saturation. The lead interviewer will then review remaining passages and then share coded passages with other interviewers to again agree, disagree, or suggest revisions.

### 2) Experiences with DEI

Next, we will address RQ2, "How do faculty members' conceptions manifest in their experiences with DEI in their work?" The coding framework applied to RQ1 will again be used to analyze the experiences discussed in the Positioning interview section. We anticipate the conceptions observed elsewhere will be present here, but we will remain open to developing novel conceptions not captured in prior coding. We will also attend to the pervasiveness of conceptions, including which conceptions are most frequent and which conceptions seem to be missing. As one example, we envision individuals might conceive of inclusion as activities aimed at including diverse others, but the contexts of inclusion may vary (e.g., classroom versus a research lab), how diversity is defined may vary (e.g., demographics versus diversity of thought), the strategies for inclusion may vary (e.g., promoting assimilation versus differentiation), and some experiences may or may not focus on equity or equity-related phenomena (e.g., attending to systemic injustices versus accepting the status quo).

## IV. CLOSING DISCUSSION

### A. Next Research Steps

Exploring how faculty members conceptualize and experience DEI in engineering education will generate an understanding of extant DEI issues in US higher education. Our findings will uncover experiences across administrators and faculty members who are committed to promoting ethics and DEI and thus yield insights from leaders in the field. Understanding current issues and solutions from these perspectives will help identify how existing DEI efforts or initiatives in institutions succeed and can be improved to generate inclusive environments in institutions.

While we aspire to address two research questions on conceptions and experiences, we envision that immersion in the dataset (an activity we have begun) will lead to additional research pathways and questions. For example, we have observed a greater commitment to DEI among underrepresented participants, with more critical engagement with DEI among non-white participants.

We have begun to notice varying conceptions of DEI amongst underrepresented participants. These conceptions are often shaped by their experiences with DEI. With our current research procedures, we will be positioned to compare conceptions and experiences by participant demographics, but such a research focus will be emergent (rather than prescribed).

As many conceptions and experiences involve professional skills or orientations, we foresee that this study may also uncover the import of related skills, such as communication and collaboration. We also foresee that our coding will guide us to explore related phenomena in faculty members' experiences with DEI, such as belonging, justice, or accessibility.

This paper has focused on our processes associated with exploring conceptions and experiences among academics, but we have conducted this same line of research with engineering practitioners. Another future study aspect will involve applying this process to the practitioner data. Thereafter, we will be positioned to compare conceptions and experiences with DEI across these two populations.

Finally, in the spirit of ethical validation [23], we will continue to consider how best to tell these participants' stories while respecting their anonymity and autonomy. We also hope to respect readers by presenting these stories authentically and accurately.

### B. Potential Impacts

DEI efforts are beneficial to engineering education in several ways. Incorporating DEI into institutions of higher education can promote faculty belongingness and positively affect their performance. This can in turn lead to a higher retention and success of underrepresented minority students at an institution. Underrepresented or minoritized faculty members are more likely to incorporate DEI considerations into their teachings, such as through the introduction of social justice into curriculum [4]. The term diversity can be conceptualized in many different ways, such as a way of thinking, a focus on demographics, or considering global differences [4]. Centering conceptions in this study will enable us to carefully articulate *how* participants perceive DEI which will enrich discourses on studying DEI in engineering education. Similarly, inclusion and equity are also important pillars of DEI, but these terms are similarly conceptualized in various ways as well [6]. As equity is often 'missing' [6], this work can also help academics prioritize equity while engaging in DEI work.

Understanding how faculty members from different backgrounds experience and conceptualize DEI can aid in the development of various DEI initiatives. Generating such initiatives by building on faculty experiences can ensure that such training attends to the experiences of faculty members from diverse backgrounds. We posit that improving such experiences will help generate more welcoming cultures of higher education, therein enabling faculty members to grow as researchers, educators, and leaders while simultaneously improving the classroom experiences, recruitment, and retention of minoritized students in engineering programs.

The above changes will have indirect benefits from academia to postgraduation employment outcomes, which is important for several reasons. Foremostly, a diverse engineering faculty body can improve the overall functioning of departments and bolster future faculty recruiting efforts in a positive feedback loop. A more diverse engineering workforce can generate positive outcomes for individual businesses and the profession writ large, lead to more effective design teams, and improve cultural competency among team members [24].

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