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Exploring Nudging Approaches for Growing a Culture of Diversity and Inclusion with Engineering Faculty

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Abstract

We report on a program initiated at a public, urban, research university to promote institutional change in diversity, equity, and inclusion (DEI) practices through a faculty learning community (FLC). The FLC is a three-year cohort of faculty in the College of Engineering, Design and Computing at the University of Colorado Denver with representation from each of the five departments, as well as faculty at multiple stages in their career (instructors, assistant, associate, and full professors in clinical, research, and tenure tracks). This cohort represents a broad sampling across the college, and provides a foundation for the FLC to influence, transform, and layer a culture of diversity, equity, and inclusion throughout the college.

Initial results from this project center on findings that address the research question: How can participation in an FLC nudge engineering faculty to adopt and personalize mindful reflection and DEI best practices? This paper includes initial findings from participant feedback, challenges, and successes from the first year, and a preliminary description of important elements of college culture as a preview of the kind of impacts that may be measured over the duration of the program.

1. Introduction

The Faculty Learning Community (FLC) began in Fall 2021 with support from the Division of Engineering Education and Centers at the U.S. National Science Foundation. The three-year program follows the three-component framework of the Colorado Equity Toolkit [1]: self-inquiry, course design, and creating community. Accordingly, during the first year 2021/22, these workshops emphasize self-inquiry and discussion to work through and process DEI knowledge, mindsets, and skillsets that can be emotionally challenging, especially in the context of a perceived discomfort level experienced by faculty participants. The FLC is paced so that the first year focuses on engagement with DEI knowledge, mindsets, and skillsets such as self-inquiry and reflection; the second focuses on translation of these learnings to the student environment, such as course design; and the third focuses on creating a wider impact and inclusive community across the academic college. This three-stage process includes appropriate feedback loops for reflection, assessment, and improvement of the process.

Reflecting a constructivist theoretical framework, this pacing allows for progressive building on prior learning and understanding to operationalize best practices in a collaborative and positive space. The intentional design of the FLC as a supportive community is also a mechanism that supports the embedding of two Nobel prize-winning concepts in behavioral economics, first the concept of *thinking fast and slow* [2], and second the concept of *nudging* [3]. The first concept posits that humans, including engineering faculty, always process information with a fast, unstoppable, intuitive system 1, which is sometimes (but not always) reviewed and corrected with a slow, reflective system 2. According to this framework, unconscious bias results from system 1, but most faculty DEI training addresses system 2, which might explain some of the difficulty in faculty adopting known best practices for DEI. A supportive and welcoming space

allows freedom to develop intuition (system 1 thinking), beyond rational awareness (system 2 thinking), of DEI best practices. The second concept posits that humans, including engineering faculty, can be nudged to make better choices, where the *nudging* results from the choice architecture rather than rewards or punishment (i.e., bribes or threats). Recognizing that engineering deans do not always have resources to provide rewards, and that engineering faculty resist perceived threats to their academic freedom, nudging is proposed as a more expedient pathway for faculty adopting known best practices for DEI. The challenge of the FLC is to develop a choice architecture that nudges participants towards participation and engagement.

The name of the FLC, Engineering is Not Neutral: Transforming Instruction through Collaboration and Engagement (ENNTICE), embodies several key elements from the proposed approach. The first element, that engineering is not neutral, asks faculty to reconsider the default assumption that engineering is objective, universal, and therefore independent of the cultural framework from which our students arrive. While granting that electrical flow depends on voltage in all nations, this program asks faculty to consider that the application of electricity depends on culture. The second element, transforming instruction, emphasizes the need for transformative changes in engineering faculty culture, based on the premise that engineering faculty culture may itself be a barrier to broadening participation in engineering. The third element, collaboration, draws on a key result from nudging: Humans, including engineering faculty, will follow perceived norms. Can the FLC normalize best practices for DEI? And the fourth element, engagement, draws on a key result from thinking fast and slow: Can the FLC engage faculty with their fast, unstoppable, intuitive system 1? Taken together, this FLC represents an attempt to entice engineering faculty to transform themselves and their culture for the benefit of their colleges, their profession, and our collective society.

2. Literature Review

One key element of the Engineer of 2020 is the ability to incorporate social needs effectively into engineering design processes [4]. This ability is aided by diverse perspectives among those in the classroom and the way that curriculum is engaged. Moreover, welcoming diverse perspectives into the classroom supports recruitment and retention of diverse students—persons of color, women, those from lower socio-economic backgrounds, and non-traditional students—preventing the missed opportunity when diverse students are represented in degree programs at lower rates, attain STEM degrees at lower rates, and leave STEM career paths at a higher rate [5].

Many factors may contribute to this missed opportunity; such as existing stereotypes of who can be a scientist [6] and norms ingrained so deeply they may not even be recognized by faculty themselves [7]. Prevalent cultural disconnects exist between faculty and students, such as the well-intentioned provision of optional resources and students' use of those resources [8,9]. Another example is the idea that engineering rigor comes from dispassionate facts, which can alienate students [10], compounding the evidence that engineering students actually disengage from feelings of social responsibility during college [11,12]. To confront these issues, there is a recognized need for holistic engineering education that comprises more than technical material [13].

As part of engineering education, aspiring engineers and designers learn from their classes, instructors, and peers what values and norms are central to engineering [11]. Thus classrooms are where changes in how diversity, equity, and inclusion appear can be meaningful. However, though faculty recognize the need for diversity and inclusion in engineering, but feel ill-equipped with tools to make larger change, and desire practical implementations for enhancing diversity and inclusion in the classroom [14]. Programs that focus just on identifying bias are not sufficient for implementation: also needed are opportunities to develop communication skills around bias [15]. Having a language of diversity and bias and the ability to communicate that language with students is an important component of recognized inclusion practices, such as directly addressing the importance of diversity in STEM, and talking to students to find ways to support each student best [16].

The engineering classroom is also a single part of a larger system at the university. Many factors influence and impact faculty behavior, including hierarchical structures and evaluation or promotion criteria [17,18]. This is amid a backdrop of values that stretch from leadership to individual researchers, which Dutt [19] argues need to be reevaluated at all levels to make meaningful impact in reducing bias. Finally, diversity and inclusion is not a single goal to be achieved. For DEI programs to be successful, goals need to be aligned to the population that is served [20], which at a university is a changing population of students. This suggests that specific approaches may change over time.

This points to the need for more resources to directly support faculty in developing the skills to bring diversity and inclusion into the engineering classroom, and building a community within the larger university system so diversity and inclusion efforts are not fragmented. To create sustainable change, faculty beliefs need to change [21]. For example, an instructor's attitude influences classroom effectiveness [22], and careful teaching overcomes the hazard of stereotype threat [23]. Communities of practice and communities of transformation have been shown to support change along these lines [24,25]. Much is known, but despite the literature documenting the need for broadening participation, the recognized cultural disconnect between students and faculty, and the availability of proven best practices, researchers concede that best practices are seldom adopted [17,26,27]. There is evidence that faculty can learn best practices, and notably, new faculty do not resist inclusive pedagogy, because to them, it is not reform [28]. But for strategies to engage incumbent faculty, whose tenure is measured in decades, and whose adoption of best practices is therefore mission-critical, little is known.

Changing faculty culture is not fast or easy. For example, computer science faculty participating in Teaching to Increase Diversity and Equity in STEM (TIDES) invested over 200 hours learning cultural change for DEI [29]. Likewise, the literature on collective impact [29] indicates that full implementation takes 2-24 years [30]. Other scholars active in this area note that there is no easy fix and no checklist guaranteed to work [29,31].

The FLC is designed to respond to these challenges with a focus on faculty behavior and attitudes as a mechanism for enhancing students' experiences in engineering coursework and students' feeling they belong and are welcomed in engineering. There are three factors that are central to the FLC, motivated by this literature: (1) the direct focus on faculty as a vector for making change in a university setting, (2) the adoption of nudging as a pragmatic strategy to

change the ingrained values of academic culture and engineering culture, and (3) the delivery of progressively layered content so that faculty participants not only learn best practices, but have an opportunity to practice implementation and turn those practices into intuition. We hypothesize that these three factors will combine to effect positive impact for the faculty participants, the engineering culture in the college, and students.

3. Research Questions

There are three overarching goals of this program. For each goal, there is a corresponding primary research question. The three goals are as follows:

Goal 1: Develop faculty mindfulness and best practices within the college of engineering.
Goal 2: Cultivate an inclusive engineering culture.
Goal 3: Foster student belonging and success within the college of engineering.

To identify impacts of the FLC, each goal has a corresponding research question to guide inquiry and evaluation:

- Research question 1: How can participation in a faculty learning community (FLC) enable or nudge engineering faculty to adopt and personalize mindful reflection and best practices?

  This research question asks whether the FLC can provide an environment and structure that encourages participants to meaningfully engage with DEI practices, evidenced by changed behavior, for example, change in teaching practices. Following the Colorado Equity Toolkit's three-component framework also allows for evaluation of the effectiveness of each year's FLC content in context of when it is engaged by faculty.

- Research question 2: How and to what degree does faculty participation in an FLC impact engineering college culture?

  This research question asks how the participation of a subset of college faculty can impact the overall college culture. This includes characterizing elements of college-wide culture, as well as measuring changes in that characterization over time.

- Research Question 3: To what degree does faculty participation in an FLC impact engineering student belonging and success?

  This research question asks whether the FLC has observable and measurable impact for students in the college. Impacts from students can be learned by hearing from students regarding their experiences in the classroom and in the community of students, faculty, and staff in the college, as well as observed from trends in student success such as withdrawal and low or failing grades in engineering courses and the percent of students who continue in their major year over year.

4. Intervention: Faculty Learning Community and Project Timeline

The FLC is a cohort of approximately twenty faculty that draws from each department in the college (bioengineering, civil engineering, computer science, electrical engineering, and mechanical engineering) and includes faculty in multiple positions (assistant, associate, and full professors) and tracks (clinical teaching faculty, research faculty, and tenure-track/tenured faculty) The cohort meets once per month during the school year, totaling eight sessions per year, with an additional retreat planned for each summer. Before each workshop session, participants are encouraged to study and reflect on a text from the Equity Toolkit, and during each session the group is guided through a discussion or activity related to the same reading.

Where possible, FLC workshops are held in person, with remote participation made possible when needed. The FLC sessions began in Fall 2021, during a relatively safe period within the COVID-19 pandemic, which allowed the FLC to meet in person. On the one hand, after many months of remote work, faculty have responded well to the invitation to meet in person. Meeting in person is also thought to promote trust within the group, which is essential when discussing emotionally challenging topics such as DEI. On the other hand, the pandemic has added some constraints, such as no food permitted during the workshop, so boxed breakfasts have instead been offered in the kitchen area outside the workshop room. On the whole, meeting in person has made faculty familiar and more comfortable with each other, which facilitated subsequent FLC sessions, for example in January 2022, during the omicron spike of the COVID-19 pandemic, when remote participation was needed.

Building on the essential element of trust, one of the most important guiding principles for facilitating the FLC workshop sessions is to emphasize vulnerability and collegiality. A few specific facilitation strategies include (1) all voices are welcome and encouraged; (2) small group discussions allow participants to hear from each other and listen deeply; (3) acknowledgement that, as a group, the work to develop DEI skills and practices will take time so that mistakes and learning will both happen; and (4) the FLC is a space where those mistakes and learning will be not just accepted but celebrated.

The overall project timeline, shown in Figure 1, indicates when each Equity Toolkit module will be used, ongoing community building events, and research activities to evaluate the FLC and the impacts of faculty experience in the FLC.

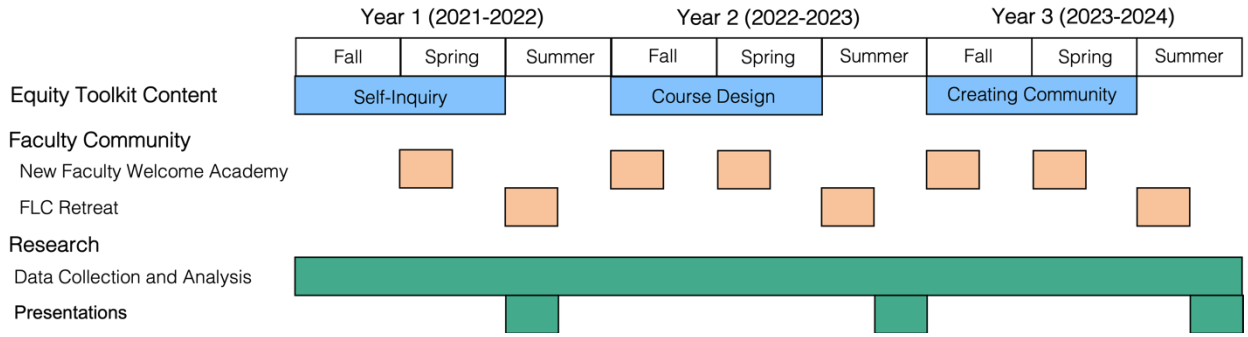

Figure 1: Timeline of ENNTICE Project, including FLC workshop content from the Equity Toolkit (blue), faculty community building events (orange), and research activities (green).

5. Methodology

The overall methodology for evaluating the impacts of the FLC is shown in Figure 2.

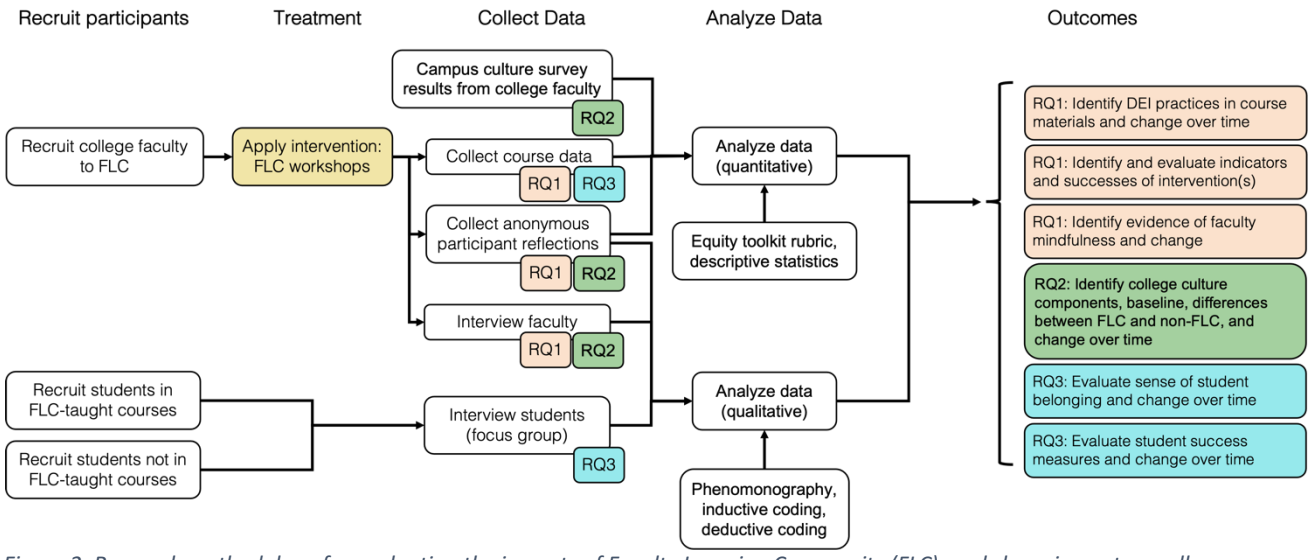

Figure 2: Research methodology for evaluating the impacts of Faculty Learning Community (FLC) workshops impact on college culture for faculty participants, students, and the college overall. Background shading identifies each research question (RQ).

The research methodology includes mixed methods approaches, as well as using observational and self-reported data together for a holistic evaluation of the FLC. All data is coded with a participant number that corresponds to an individual, allowing deidentified data to be used for all stages of analysis. The coding is kept securely guarded by a single member of the study team separate from the analysis team. To increase the comfort of participants with data collection, participants can opt out of any part of data collection at any time. An example is that written reflections for the monthly reading are encouraged for meaningful participation in each workshop session. For the reflections to be included as data, the participant's reflections need to be uploaded to a secure drop folder from which the responses are anonymized. Thus, participation in the FLC and participation in the research study are decoupled. This decoupling is why there are multiple data collection modes included for each research question, ensuring the best evaluation possible.

For the first research question, that asks how the FLC can nudge or encourage faculty to develop mindful reflection and best practices, qualitative data includes interviews and reactions from faculty regarding their experiences in the FLC. Qualitative data will be analyzed using phenomenography to show evolution in participants' experiences and ideologies or ways of thinking, over time [32]. This is joined with quantitative data from faculty participants' courses, evaluated with tools like the CUE Syllabus Review Tool [33].

For the second research question, which asks how and to what degree does participation in an FLC impact engineering college culture, deductive and inductive coding of faculty interviews and participant reflections are used to identify components of college culture and any changes over the course of the program.

The third research question, which asks to what degree participation in an FLC impacts engineering student belonging and success, will also be evaluated with a combination of qualitative data and quantitative data. Students in the college will be recruited through courses and student organizations to participate in interviews in a focus group format. These data will be analyzed with a combination of inductive and deductive coding to identify factors that contribute positively or negatively to student belonging and success. Quantitative analysis of course data examines the rate of low grades (D, F) or withdrawal (W) over time, as well as rates of continuation in an engineering degree year over year for students in the college.

In conjunction with the above research methodology, an external evaluation team is present at each workshop session and runs independent focus groups with faculty participants. This evaluation team prepares biannual reports evaluating the program and its efficacy which inform continuous improvements to the program itself as well as understanding of the program's impacts.

6. Initial Results

Results from the first semester of the FLC include initial feedback from faculty participants on their experience in the program, which represent a point in time estimate of progress towards program goals, and a preliminary description of important elements of college culture for both faculty and students.

A survey of workshop participants asked for an evaluation of their experiences in the FLC through the first semester, comprising four workshops in the first component of the Equity Toolkit, namely self-inquiry. Participants were asked to rate their level of agreement to five statements on a five point Likert scale where 1 = "strongly disagree" and 5 = "strongly agree." The average response from twelve participants is shown in Figure 3. The statements can be mapped to research questions and goals 1 and 3.

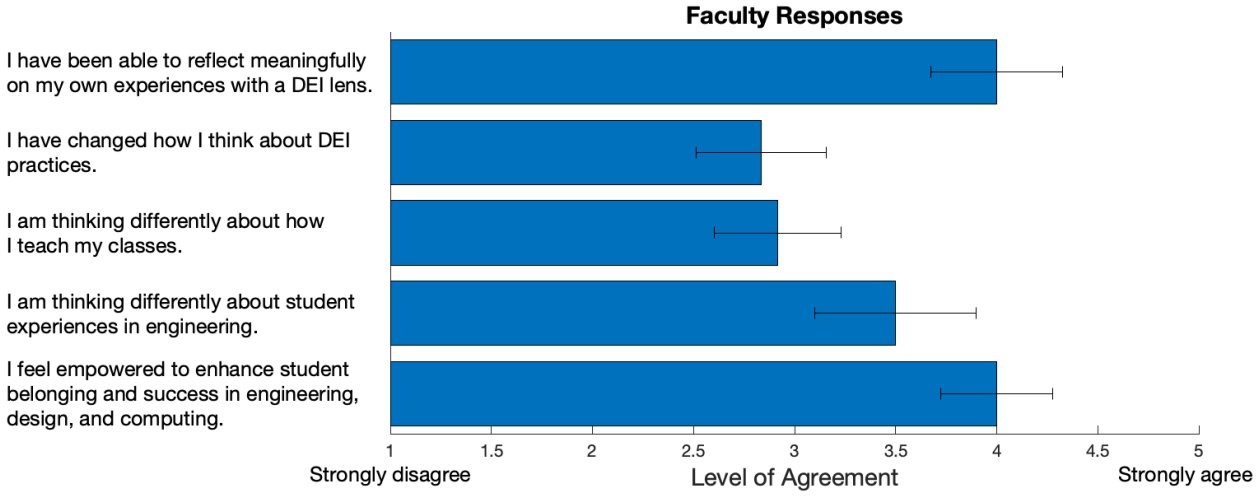

Figure 3: Responses from faculty workshop participants to five Likert-scale evaluation questions. The average response (n=12) is shown and error bars represent the standard error above and below the average.

The statements, "I have been able to reflect meaningfully on my own experiences with a DEI lens," "I have changed how I think about DEI practices," and "I am thinking differently about how I teach my classes" are connected to the first goal and first research question. The results reflect the context that, at this stage, the first component of the Equity Toolkit is focused on self-inquiry, and the second component on course design has not yet started. These results are encouraging in that meaningful reflection (average of 4 out of 5), the goal of the first Equity Toolkit module, is being achieved, and suggest that the work to translate those reflections to a change in personal practice (average of 2.8 out of 5) and teaching practice (average of 3 out of 5) are in progress. The level of agreement to the latter two questions are expected to rise as the program continues into year 2.

The final two statements, "I am thinking differently about student experiences in engineering" and "I feel empowered to enhance student belonging and success in engineering, design, and computing" relate most closely to research question and goal 3, which emphasizes student belonging and success in engineering. Recognizing students' experiences in engineering (average 3.5 out of 5) suggests a logical extension of reflecting on one's own experiences and how others share (or do not) those experience. And empowerment to make change in student experience (average 4 out of 5) suggests confidence in faculty participants' ability to make positive change in student experiences through their roles, behavior, and actions.

An initial understanding of college culture can be seen in Figure 4, which shows a word cloud of responses to a prompt to share words that one would use to describe the most important aspects of college culture for faculty and for students. There is overlap between the two groups but many terms are unique to each group. The overlap area emphasizes diversity and inclusion broadly: belonging, representation, welcoming, community, connections, and progress.

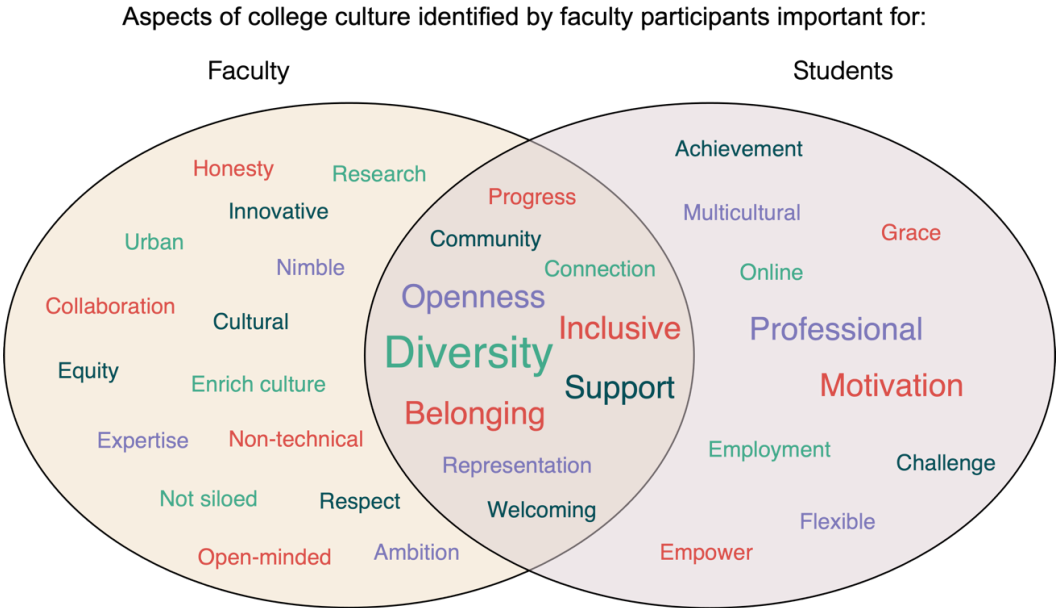

Figure 4: Responses to a survey asking faculty workshop participants to share words they would use to describe important elements of college culture for faculty, and for students. Larger text size indicates more responses of the same word. The largest text corresponds to 3 mentions, the medium size text 2 mentions, and the smallest text a single mention. Color is for the purpose of illustration only.

Terms used only for important aspects of culture for faculty include terms that evoke inclusive collegiality, e.g., collaboration, honesty, respect, cultural and enriching culture, and open minded. Other terms reflect typical career goals of faculty, including research, expertise, and ambition. Terms like "not siloed" and non-technical suggest an emphasis on interdisciplinary collaborations and the importance of human connections between colleagues beyond disciplinary affiliations.

Terms used only for students indicate valuing the personal and professional growth of students, e.g., professional, motivation, achievement, challenge, and employment. Additional terms highlight the importance of respecting students and the student body for who they are, e.g., flexible, grace, and multicultural. The differences between the terms that appear only for faculty or only for students emphasize the different nature of each group's experience at the university. Faculty often are at the university for long periods of time and build networks of peers at the university and elsewhere as they work towards personal and professional goals. Meanwhile students are at the university for a comparatively short amount of time and the university serves students in setting them on a path to achieve personal and professional goals in the near and long term.

7. Discussion

Initial findings suggest signs of progress towards the stated program goals of developing faculty mindfulness, cultivating an inclusive engineering culture, and fostering student belonging and success in the college of engineering, design, and computing. A fuller characterization of progress towards these goals will emerge over the next two years of the FLC, and beyond.

Goal 1 is aligned with the focus of the first year of the FLC, on self-inquiry and reflection. The next step for this goal is to practice implementing diversity and inclusion best practices to build intuition beyond awareness. This addresses findings in literature that faculty appreciate learning about best practices and also need opportunities to try implementing those best practices. This has already been echoed by FLC participant feedback, provided in reports from the external evaluation team – participants are eager to learn how to implement their new perspectives in the classroom. Goal 2 progress is primarily in the form of the community that is building within the FLC itself, and this is expected to continue. A more comprehensive view of the college-wide faculty culture is a possible future complement to an assessment of the within-FLC community and culture. Goal 3 progress is shown by faculty participants both understanding student experiences in new ways through participation in the FLC, as well as feeling empowered to make positive impact for students. Future work towards this goal, similar to Goal 1, includes identifying evidence of those outcomes and impacts for students.

Where this program has been successful so far is in building a trusting, vulnerable space for faculty participants to learn from each other, which is a key part of both developing mindfulness of oneself and others and is an environment conducive for practicing diversity and inclusion practices. Another success has been identified from participants that they appreciate the dedicated time for this work, reflecting a successful framing of the choice for how to spend one's time. This is a sign of a successful nudge toward incorporating diversity and inclusion practices and learning as normal faculty work.

Challenges of this work so far apply to the workshops themselves and the research. For the workshops, many pivots have been required to adapt to changing circumstances and COVID-19 precautions. While this agility has been recognized by faculty participants as a positive, there has been some frustration that the self-reflection module does not have immediately apparent applicability to courses and instruction. Concrete strategies to address this is to more closely link the content of years 1 and 2, and looking ahead, between years 2 and 3 to provide a gradual transition, as well as ensuring to clearly communicate goals of each workshop session and how it fits with the larger picture of the ENNTICE program plan.

The main challenge identified in the research to date is inconsistent data collection. Faculty seem prepared to discuss the given text, but do not always upload their written reflections. This is likely due in part to the introspective and vulnerable nature of the reflection prompts, which participants may be reluctant to share for research purposes. This may be mitigated by a restructuring reflection prompts to instead focus on actualizing reflections for impact: how do we translate these ideas into pedagogical practice?

The research team is also learning to adjust the usage of The Equity Toolkit content for the pacing this particular cohort needs. In addition, efforts to triangulate ENNTICE data with broader institutional research and other faculty DEI projects across campus have produced no results thus far. Even with a broad set of similarly oriented efforts, extensive work is still required to coordinate.

8. Conclusions

In this paper we have reported on a novel Faculty Learning Community, FLC, that is built on the premise that engineering is not neutral, and that we can transform instruction through collaboration and engagement (thus named ENNTICE). The primary contribution of this work is to introduce the structure of the ENNTICE program and demonstrate initial progress towards goals that impact faculty participants, the larger faculty community in the engineering college, and the student body served by the engineering faculty. Initial results show progress towards developing faculty mindfulness of their own practices and students' experiences, as well as an initial understanding of elements of college culture perceived as most important: with diversity, inclusivity, belonging, and support central for both faculty and students.

Future work for this research within the specific context of ENNTICE is to continue analysis of participant experiences to identify factors that contribute most directly to the identified goals and outcomes for faculty, students, and the college overall. More broadly, there are opportunities for future work to examine how the context of the university, college, and leadership goals at all levels can shift the perception of such a FLC and its potential for positive impact by its members as well as the effectiveness of such a community. In other words, what factors need to exist within the university system that either support or hinder the effectiveness of a faculty learning community focused on diversity and inclusion? This future work will point the way for engineering faculty to grow a culture of diversity and inclusion.

Acknowledgments

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