

Engineering Faculty Experiences Teaching Social Justice to First Year Students

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Abstract—Can engineers teach social justice? Should they be expected to? What do they need to be successful? This innovative practice work in progress paper shares the thoughts, insights, and suggestions of engineering faculty related to their experiences teaching social justice to freshman engineering students. The work of integrating social justice into engineering curriculum is a relatively new effort that requires engineering faculty to engage in content, reflection, and conversation that may be unfamiliar and potentially uncomfortable. Through detailed reflections, discussions, and in-depth conversations, the authors summarize the successes and challenges experienced by two engineering faculty with different levels of social justice training and teaching experience. Of particular interest is how prior knowledge and training relates to the overall experience, including faculty perception of their ability to effectively educate students and engage in meaningful dialogue on the more generalized aspects of social justice such as microaggressions, bias, discrimination, and dismantling power structures. The insights and viewpoints presented in this paper are relevant to all engineering faculty but may be of particular interest to those who are interested in teaching social justice but are nervous about or unsure of how their prior experiences and knowledge will impact student learning and/or their own personal learning journey. Using auto-ethnography, the authors highlight notable aspects of their experiences. By sharing faculty experiences with the greater engineering community, the authors aim to provide a lens through which other engineering educators can explore the more nuanced aspects of teaching social justice content with the hope of encouraging more faculty to integrate social justice into their courses.

Keywords—engineering, social justice, faculty experience

I. INTRODUCTION

To respond to global challenges and develop sustainable solutions to societal problems, it is essential that engineers recognize and consider the impact of their decisions on society. Most engineering programs do not provide ample opportunity for students to deeply engage with social justice principles or to view engineering as a platform to challenge injustice, foster peace, develop empathy and create a more equitable society [1]. The social implications of engineering are often taught more as an afterthought or sidebar rather than being deeply integrated into the curriculum which can diminish the importance and potentially minimize an engineer's commitment to social good [2] [3]. In recent years, there has been more of an effort to integrate social justice content into engineering curriculum. Although this is a positive step forward, faculty often do not feel prepared to teach these topics [4]. In this work in progress innovative practice paper, the authors document the experience of engineering faculty teaching social justice content in a first-year engineering course. Using auto-ethnography, the authors summarize their experiences and provide insight as to how to support and encourage other faculty in teaching and

integrating social justice related topics into their engineering courses.

II. BACKGROUND

A. Relevance of Social Justice to the Profession

Understanding the role and relevance of social justice to the engineering profession is an important but often overlooked component of engineering education. Engineers, being on the forefront of technological change, have tremendous impact on creating change that benefits society. ABET has recently revised their criteria for accreditation to include a deeper focus on social impact, cultural responsibility, and ethical considerations [5]. In addition, many professional societies and organizations have recently updated and revised their mission statements and core value statements to focus on promotion of socially just education and action, often with emphasis on improving diversity, creating a more inclusive culture, and increasing equity. For example, the Society of Manufacturing Engineers diversity statement professes that SME is “commit[ed] to promoting diversity and inclusion of all within our community” and “believe[s] that diverse perspectives and talents are essential within manufacturing research” [6]. Similarly, the Society of Women Engineers lists “inclusive environment” as one of their 5 core values and commits to “demonstrate the value of diversity and inclusion” as part of their mission statement [7]. This focus on social justice is further emphasized by many engineering corporations and businesses in their mission statements, core values, diversity commitment, and strategic initiatives.

The missions, goals, principals and value statements go beyond a focus on understanding the impact of engineers' work and actions on society and include a commitment to creating a more diverse profession whose constituents value and uphold a commitment to inclusion and equity. As such, it is imperative that faculty are able to educate students on the relevance of social justice to the engineering profession, including building awareness of the role of inclusivity and equity to the field.

B. Engineering Education & Social Justice

Conventional engineering education emphasizes technology-based attributes such as analytical skill development, technical knowledge, and creative problem solving and leaves little time for students to deeply engage with the social implications of their work [3] [8]. As a result, students tend to value technical over nontechnical work and often find social impact extraneous to engineering [9]. Cech (2013) explains that most students do not see social justice as being relevant to their future profession due to a “culture of disengagement” where students disassociate social and political issues from an engineers' work [10]. The highly technical focus of engineering education has effectively

marginalized social components of engineering and thus, limits student engagement with considerations of public welfare [11] [12]. As such, engineering students typically have a difficult time critically analyzing the impact of their work on public welfare and society, especially in the context of creating a more equitable and inclusive society. Recent research has shown that student interest and commitment to social responsibility declines as students' progress through their academic career [3] [13]. Furthermore, although the majority of engineering curriculum includes considerable and meaningful ethics education, it often excludes discussion and connection to larger societal issues and social justice content [1].

In recent years, there has been an increased effort to integrate social justice content into engineering curriculum [14-18]. One method has been to encourage students to take social justice based electives offered by humanities and social science departments, an approach that tends to perpetuate the division between social and technical work [16]. There are also examples of curriculum efforts that integrate social justice into design projects, project based learning activities, and team based assignments however, in most cases, this is done using fairly broad swipes with the emphasis still being on the technical solutions [16] [17]. Although this is a good start, much of the work upholds vertical power relationships between the expert (engineer) and the user (society) and thus, perpetuates systemic inequality [17] [18]. It is important to note that socially just design not only examines the impact of a design on particular aspects of society but seeks to acknowledge and dismantle systemic inequities of power [12]. Service learning offers another opportunity to integrate social justice related work into engineering educational experiences however, these opportunities are typically either elective courses or co-curricular activities rather than requirements, limiting their ability to impact all engineering students [15].

Engineering education plays an important role in changing student attitudes and commitment to social justice and public welfare. An introduction to social justice topics is not enough to counter the "culture of disengagement" that currently exists in engineering education [3]. When engineering practice includes a consistent and deep connection to society, it provides the framework for engineers to think critically and act more ethically. This can be accomplished by reframing engineering education as sociotechnical with emphasis on challenging dominate narratives [14]. There must be a deeper commitment to the integration of social justice into engineering curriculum that involves engaging students in a way that transforms the culture. Changing a culture is challenging and it requires time, dedication, and commitment from all constituents: students, faculty, and professionals. Unfortunately, many engineering faculty do not have formal training in social justice which leaves them unprepared to effectively integrate the content into their courses [4].

C. Challenges & Resistance to Pedagogical Changes

As social justice and equity-focused curriculum is seeing more integration into engineering and related STEM curriculum, an increasing number of scholars have studied the experiences and perceptions of faculty teaching those courses. The literature describes both positive and negative faculty experiences, although the major focus is on the challenges encountered by faculty. Challenges described in the literature can be categorized into the following main areas: challenges related to the students, challenges related to the faculty, and

challenges related to the institution/curricular requirements [19]. Within these areas, faculty reported the primary challenges as lack of student interest and student resistance; lack of training, lack of time, discomfort with subject matter; and lack of institutional support, packed curriculum and issues associated with accreditation [4] [19] [20]. In a recent study exploring faculty integration of social justice into engineering curriculum, Bielefeldt (2021) found that "personal convictions and life experiences of the faculty were important to facilitating and orchestrating student learning and ethical development" (p 15). This study revealed that this work required perseverance, reflection, commitment, and effort on part of the faculty. Furthermore, it was suggested that the time and emotional energy required could limit the extent to which faculty participate in these efforts [15].

Beyond this, research has shown that faculty show resistance to pedagogical change. Brownell and Tanner (2017) identify barriers to change as the traditional "Big 3" (lack of training, time, and incentives) as well as a fourth impediment: tension between faculties' professional identity and changing curriculum [21]. They write that many institutions reward research over teaching, leading faculty to devalue efforts related to curricular improvement. Lane (2007) details additional ways in which institutions hinder pedagogical change, such as perpetuating conservative educational cultures, including fierce protection of current practices and skepticism of alternative pedagogical viewpoints [22].

D. Introductory Engineering Course on Social Justice

With the goals of building foundational knowledge of social justice and introducing students to the relevance of social justice to the profession early on in their academic career, a new introductory engineering course (ENGR 101: Engineering, Design, and Society) was developed for first year engineering students at Western Washington University (WWU) in Fall 2019. The course was designed to highlight the relationship between engineering, design, and society and to create inseparable connections between those three elements. All engineering students are strongly encouraged to take the class in either their first or second quarter of study and 3 of the 4 WWU engineering programs require the course. The course provides a structure for students to explore and understand the role of social justice in engineering and to recognize the connection to the profession. Course topics are rooted in social justice and include discussion of identity, belonging, systems of power and privilege, mindfulness in decision making, cultural competence, values and beliefs, ethics and social responsibility, and the societal impact of technology. The class also includes an introduction to technical topics such as 3D visualization, the design process, and orthographic projection. The class has been taught by two different faculty members whose experiences will be shared in this paper using auto-ethnography. The goal is to document and share experiences with the greater engineering community to provide perspective on teaching social justice in the context of an introductory engineering course.

III. METHODOLOGY

Auto-ethnography was used as the primary mechanism for exploration of the successes and challenges associated with faculty experiences teaching the previously described course. Auto-ethnography is particularly useful in this setting, as it explores the qualitative experiences of the researcher and allows them to relate these experiences to larger issues of

teaching social justice, a subject in which they are not considered experts. The use of auto-ethnography for this research was necessary because the authors were the only faculty in the department teaching this course as well as the only faculty involved with engineering education research at their institution. While teaching the course, each faculty member wrote weekly reflections, answering questions related to a variety of topics including successes, challenges, discomfort, and overall impressions. While this is a limited auto-ethnography, the authors feel as though their reflections are valuable to the engineering education community and the work aligns with the benefits of this type of methodology including providing insight into personal experiences and providing rich content through the ability to foster empathy, eliminate boundaries, honor subjectivity, and express vulnerability through sharing of personal truths [23] [24].

The weekly reflection questions used in this work focused on a variety of topics, ranging from “What were the successful aspects of this week?” to “What aspects of teaching this material were uncomfortable?” to “Would additional resources, readings or trainings have been beneficial to you?”. The questions were developed by the authors to gauge the faculty experience of teaching the curriculum, self-reported preparedness level, and proposed changes to curriculum for future course offerings. The results of these reflections are summarized in the discussion section with a focus on successes, challenges, and lessons learned.

The lead author of this paper is an assistant professor in the Engineering & Design department focused on first-year programs. Although she is new to the department, she has been teaching engineering and developing curriculum for over 20 years both as a non-tenure track instructor and a tenured faculty member at another institution. She designed and developed the ENGR 101 course described above and was the first faculty member at the institution to teach the course. The lead author has participated in numerous trainings focused on diversity, equity, and inclusion (DEI) and has experience facilitating DEI related conversations and events. In addition, she was the co-founder of a diversity initiative and advocacy group focused on increasing equity and inclusion in STEM. Although she has experience with a myriad of DEI related efforts, the lead author does not have any formal educational background in social justice nor has she ever taught a class similar in content to ENGR 101. The second author of this paper is a non-tenure track faculty member, whose main position at the university is as a Research Associate. She has relatively little teaching experience, with a background more focused on providing in-lab instruction rather than traditional lecture-style teaching. The second author has very little DEI training, limited to participation in a handful of related workshops offered by the university, although she does have an interest in expanding her knowledge in these areas.

IV. DISCUSSION

The course was taught fall quarter by the lead author and winter quarter by the second author. The fall quarter offering was split into two sections with a total of 68 students and the winter quarter offering had 21 students. All three sections were taught in remote format with 1, 2 hour synchronous class meeting per week. Each author recorded their reflections at the end of each week of class. The weekly reflections were reviewed and discussed by the authors and results were collated and summarized with a focus on the challenges encountered and lessons learned. The main themes that

surfaced within the reflections were focused on student learning and interactions, personal experience teaching the class, and dissemination of content.

A. Successes

Story Sharing: Both authors were surprised by the willingness of students to share personal experiences with the class both online (discussion forums) and during in class discussions and activities. This was especially true with the class activities focused on personal story sharing, social identity, and belonging. Although not required, many students recounted very personal and detailed stories related to their experiences associated with stereotyping, bias, and privilege/power. This provided the opportunity to discuss social justice concepts and topics in depth with connection to real people and real experiences. Both authors were surprised by the extent to which many students were comfortable sharing their authentic selves and vulnerabilities in a classroom setting. This was viewed as a success of the course by both authors as it created a strong social connection between students, led to rich discussions, and created an inclusive classroom environment.

Student Learning: Both authors noted in their early reflections that it was challenging for students to make connections between the social and technical content being presented, emphasizing the social/technical dualist thinking typical of engineering. However, both authors noted that student engagement in the social justice components of the course increased towards the end of the quarter. More specifically, in the last unit (“challenging injustice”), both authors noted that most students, even those resistant to the material, had developed a social lens through which to view innovation and could reflect on the important and relevance of social justice to engineering and design. Both authors felt as though this was a major success of the course.

Faculty Experience: Both authors felt as though they learned new things over the course of the quarter and also noted that they feel like they have a lot of learning left to do when it comes to teaching and facilitating conversations related to social justice topics. The lead author noted that she learned from the students who regularly shared content with the class (articles, videos, podcasts, TEDtalks, etc.). The lead author also noted that the shared experience of learning from and along with her students was new to her as it is not typical when teaching more technical engineering courses. She plans to integrate some of what she learned from students into future offerings of the course. The second author noted that she spent a lot of time reviewing materials to support her own learning and became increasingly comfortable with the social justice content as the quarter progressed. The lead author noted that she relied on previous knowledge of and experience with DEI related topics when teaching the course, specifically implicit bias, microaggressions, identity, and power and privilege.

B. Challenges

Student Interactions: Although the students were willing to participate in discussions and group activities (both online and during synchronous class sessions), both authors found facilitating discussions focused on social justice topics to be challenging. This was especially true when there was student resistance to a particular topic/question or there was disagreement among students. It was also challenging in cases where students seemed uncomfortable with the topics. This was more complicated by the online nature of the course since

it was difficult to gauge student comfort levels and general engagement. Both authors noted that they sometimes felt uncomfortable in their role as instructor since they were not a subject matter expert when it comes to social justice. Both authors noted that students who were resistant to the material usually fell quiet during class but would push back either during office hours or within homework assignments. It was also noted by both authors that resistant students still attended class and willingly participated in small group activities. The lead author observed that when resistant students pushed back, they rarely did it directly but instead, would make passive-aggressive comments on homework requiring the instructor to “read between the lines.” The author addressed this directly by responding to the student, answering/asking questions, and requesting to meet 1:1 during office hours. The author felt nervous and apprehensive about these conversations but overall, learned from them.

Social/Technical Dualism: Both authors noted that it was challenging to get students to connect the social justice components to the technical attributes of engineering/design. For example, when discussing something like identity, students were able to engage in deep conversations about their personal identity and would willingly share hidden aspects of their identity with other students. However, when discussing the impact of a design, it was challenging to get to students to consider the social impact beyond the high-level considerations such as environmental pollution or product recyclability. Thus, connecting the technical attributes of the design to the impact on people of different identities was often challenging for students. It was rare that students were able to connect technical design decisions to inequities based on race, gender, or socio-economic status or to think about how engineers’ decisions impact things such as fair wages, equality of treatment, dismantling of power structures, or the promotion of peace.

Faculty Teaching Experience: In the context of teaching this course, both authors noted there were topics they felt uncomfortable teaching. The second author noted that she was often worried about saying the wrong thing or using incorrect terminology. The lead author noted that she spent considerable time reading articles, papers, and books trying to understand the nuanced language related to social justice. Both authors felt this course required significant preparation and a willingness to learn new things. This was a challenge for both authors in that it required a good deal of time, effort, and learning in order to be prepared for class. With that, both authors noted that no matter how much they prepared, there were always times when they were unable to answer students’ questions or did not know how to respond to a question or comment. In addition, both authors (both of whom are white, cis-gender, female identifying) felt more comfortable talking about gender related topics than those centered around racism.

C. Lessons Learned

Get comfortable with discomfort: One clear lesson learned by the authors was that conversations centering around social justice can be challenging. There will be times when we are faced with uncertainty in the classroom and will not know right away how to answer a question or respond to a student comment. The authors suggest we lean into those experiences and view them as an opportunity for growth. The authors both noted that their comfort level increased throughout the quarter and speculate that with time, experience, and knowledge, this work will become easier.

Create a support team: Having other people to share your experience with will provide opportunity to ask questions, process mistakes, and move through challenges. The authors suggest forming a support team of faculty and teaching assistants who are interested in teaching and integrating social justice into their course work. It can be as simple as meeting once a quarter – every bit of support makes a difference.

Invite others: The authors realize the importance of creating a community of faculty who are dedicated to integrating social justice into their teaching. This might begin with the administration encouraging all faculty to teach these types of courses, rather than leaving it to the select few who willingly volunteer. For faculty already teaching these courses, consider inviting colleagues to visit your class, especially on days where the content/approach/tone differs for more traditional engineering courses. Encouragement and exposure to this content over time could increase willingness of others to teach these courses and/or integrate related topics into their courses.

Be yourself: Although this was challenging at first, the authors learned that it is important to share their own personal experiences, thoughts, beliefs, and feelings with the students. Doing so builds trust and helps to create an inclusive learning environment. The lead author noted that this became easier with time but did not come naturally to her as she was used to teaching technical topics where she was clearly the subject matter expert. A personal approach to teaching can help to break down systems of power and models vulnerability and authenticity.

Keep learning: Both authors noted that additional training opportunities would help them to feel more comfortable and do a better job teaching social justice related topics. The lead author found it challenging to determine what training she would benefit from and mentioned it would be beneficial for the department to compile a suggested list of trainings, webinars, and readings. The second author noted that training in leading student discussions, particularly focused on social justice, would have been useful.

V. CONCLUSIONS

Future work will include documenting experiences of other faculty members who teach this course, investigating the experiences of teaching assistants, and examining the experiences of students who take these courses (both short and long term impact). There is a need for social justice to be integrated into engineering education more broadly and deeply with a focus on providing students with a foundational knowledge of what social justice is, why it is important, and the relevance to the profession. Effectively incorporating social justice into engineering curriculum rests on faculty who are willing, able, and ready to make it happen. Encouragement and exposure to this content over time could increase willingness of others to teach these courses and/or integrate related topics into their courses. It is imperative we share our experiences as we find ways to support one another in this work.

Can engineers teach social justice? Yes. Should they be expected to? Yes, it is an essential component of educating future engineers. What do they need to be successful? Foundational social justice knowledge and/or training, a willingness to learn, and an open mind is a good place to start.

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