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Describing a Classroom Positionality Reflection for First-Year Engineering Coursework

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Luke Perreault earned his B.S. and M.Eng. in Biomedical Engineering from Worcester Polytechnic Institute and his Ph.D. in Biomedical Engineering from Tufts University under Dr. Lauren D. Black III. Dr. Perreault then joined Boston College (BC) in 2021, as a postdoctoral fellow in BC's newly established Department of Engineering. His research emphasized sustainable decellularized plant biomaterials for cellular agriculture (lab-grown meat), and he collaborated on computational oxygen transport models to support scalable bioreactor design. Appointed a Visiting Assistant Professor and Core Fellow in 2023, Dr. Perreault worked between BC's liberal arts Core Curriculum and the Department of Engineering to teach coursework integrating history and ethics into engineering design, and collaborated with colleagues in engineering education outreach at the K-12 level, including contributing as a Co-PI to an NSF Research Experience for Teachers grant focused on bringing bioengineering and cellular agriculture to high school courses. He joined Cal Poly SLO as an Assistant Professor of Biomedical Engineering in 2025. In his classroom, he strives to help students pursue their own ideas and to reflect on the broader impacts of their work and identities as engineers within an interconnected global community.

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Héctor is currently an assistant professor in Engineering and Computing Education at Florida International University. Before receiving his Ph.D. in Engineering Education, he earned his master's degree in electrical and computer engineering. Héctor's research primarily investigates how students negotiate their visible and less apparent identities as they form their professional identity. Héctor's research projects range from autoethnographic inquiries into culturally informed collaborative qualitative research spaces to asset-based framings of traditionally stigmatized identities such as sexual orientation and neurodivergence, and to the examination of the structural factors that impact student experiences in computer engineering courses. Héctor has taught various engineering and computing courses, showing learners he cares about them and their future success by fostering a space where learners can feel safe to experiment, iterate, get messy, and try different problem-solving approaches while encouraging criticality of their professional practice, leading to holistic solutions for a broader range of individuals.

Describing a Classroom Positionality Reflection for First-Year Engineering Coursework

Abstract

This Practice paper describes a structured "positionality statement" activity designed to help first-year undergraduates to situate themselves within histories of inequality in engineering practice and embrace their unique perspectives as integral to inclusive and equitable engineering design. This exercise used the classroom as a terrain of struggle, where personal identities and relationships with our society and the practice of engineering are sources of tension. The activity formed the basis of a lecture in a first-year engineering design course embedded in a Catholic, Jesuit university core curriculum and was open to all majors. The course integrated historical engineering practice with study of engineering fundamentals. The course included a separate, semester-long laboratory focused on improving accessibility on campus. The positionality reflection was introduced at the mid-point of this project, when stakeholder engagement was at a critical point.

The in-class exercise invited 130 students to engage in written reflections responding to prompts that: (1) describe their own identities, (2) consider how those identities affect how they view engineering problems, (3) think of a lived experience that shaped their understanding of accessibility and privilege, (4) consider how to share their identities with their project teammates, (5) articulate the value of the course to themselves, and (6) reflect on the value of the exercise in their future lives, and (7) imagine how we might create more ethical and inclusive engineering practices. These reflections served as pedagogical exercises on how identity informs engineering design, and as research artifacts illuminating how first-year students understand their own identities, power, and responsibility.

Analysis of more than 60 short reflections revealed that students contend with bias, privilege, and empathy in the context of effective engineering design. Students reflected on assumptions around cost, usability, and what constituted "average" users, revealing unexamined privileges. Several students described noticing gendered design, with one reflecting that "as a woman, I see problems men don't consider, like lack of safe public spaces or design of restrooms." Several connected family relationships to ableism in society: "I want to design so no one feels excluded the way my sister does."

By centering these reflections within an introductory course, this activity demonstrates how a brief, early intervention can begin to cultivate ethical reflection within a campus community. Moreover, this activity contributes to work that demonstrates how engineering education can support societal reform, positioning reflection of one's identity as an introduction to understanding and combating structural harms that underpin our diverse communities.

This practice paper contributes to ongoing ECSJ discussions on the transformative potential of the classroom setting to facilitate student engagement in inclusive, equitable engineering and details facilitation methods and prompts that instructors can adapt to diverse institutional contexts.

Introduction

The purpose of this Practice paper is to describe a structured "positionality statement" activity we developed to help first-year undergraduates to situate themselves within histories of inequality in engineering practice and embrace their unique perspectives as integral to inclusive

and equitable engineering design. Positionality is defined in the SAGE Encyclopedia of Research Methods as "the stance or positioning of the researcher in relation to the social and political context of the study – the community, the organization, or the participant group [1]." The utility in generating these statements is an implicit rejection of the notion of research objectivity [2]: fundamentally, to refute the notion of an objective, disengaged researcher in relation to the study at hand, and an embrace of the decisions and interpretations of a researcher as visible in a study [3]. As engineers, this is particularly pertinent, as our work and scholarship are inherently applied and serve diverse stakeholder communities [4].

This is juxtaposed with the ongoing challenge of addressing a lack of diversity in engineering degree programs and broadening participation in engineering by creating diverse, equitable opportunities to engage in engineering for students discerning their careers [5], [6]. Lockhart et al [7] argue that shaping student perceptions of "who is and can be an engineer" and helping students form inclusive professional engineering identities and internalize value in diversity within engineering contexts is a way to help address gaps in representation. The intervention we highlight in this paper embraces this suggestion and situates an understanding of positionality within the context of team-based, accessibility- and justice-focused engineering design projects as a method to help students empathize with stakeholders and understand the validity of diverse lived experiences and identities in engineering practice.

The university, department, and course in which we piloted this intervention were uniquely situated to both motivate and implement an exercise on positionality and provided a philosophical basis for our work. Our course, "Making the Modern World: Design, Ethics, and Engineering" (MMW), is a first-year 130-seat engineering course and a pioneering course in the Human-Centered Engineering (HCE) program at Boston College (BC), a Jesuit university. The class is team-taught by faculty from engineering and history to provide a sociohistorical context for introducing students to engineering and engineering design fundamentals. The program, within the Department of Engineering in the Morrissey College of Arts and Sciences (MCAS) at BC, prioritizes a synthesis with the humanities and emphasizes Jesuit formative education practices to guide students in their personal, professional, and ethical growth. Moreover, MMW is embedded in the University Core Curriculum, an interdisciplinary program in MCAS that provides a common pedagogical foundation for first-year students. As such, MMW is interdisciplinary and satisfies Core requirements in natural science and history. We served as Core Fellows in the program – effectively, future faculty fellows preparing for tenure-track careers in academia – working directly with both the Core and the Department of Engineering, and providing us with strong support to creatively explore pedagogical interventions with students.

This paper addresses scholarship integrating equity and justice into engineering pedagogy and foundational theories that underpin the development of our intervention. Next, we describe the motivation for developing this intervention in our course, the experience of teaching engineering design projects to multidisciplinary first-year students, and initial qualitative observations of emerging themes that arose from this activity. With this information in mind, we highlight lessons learned for future iterations and methods to translate this intervention to different institutional contexts.

Background and motivation

Positionality, Reflexivity, and Engineering Education

Positionality statements are increasingly common in social science research as tools for reflexivity and transparency, offering a tool to explicitly acknowledge one's identities and standpoints. This, in theory, enhances research by exposing a researcher's social position (e.g., gender, race, culture, and experiences) and how those factors might influence how questions are formulated and data are interpreted [3], [8]. Fundamentally, this is in opposition to the idea of neutrality in the production of scholarship. Within engineering education research, positionality statements are an emerging tool, with Hampton and colleagues arguing that discussing one's position requires a degree of vulnerability and self-reflection uncommon to engineering practice [3]. However, recent years have seen an acknowledgement of the need to acknowledge one's own perspective and context in the interpretation of the personal and social phenomena that guide the educational process, from the impact of past experiences to power relations and patterns of inequality that affect educational outcomes for different demographic groups [9], [10].

King (2024) [2] warns of the risk that the overuse of positionality statements can misalign with the original intention of these tools as methods to reinforce honesty and integrity in research on performative gestures of authority or proximity to a studied group. Effectively, reflecting on positionality can lack substance when treated as another task and not as a method to critically examine one's own identities and values. We kept this caution in mind while developing this paper. Our goal was to provide students with an opportunity to examine their own relationship to engineering and the built world they inhabit, rather than to list personal attributes and token statements about the value of diversity and inclusion.

Identity, Diversity, and Formation of Student Professional Identities

A parallel thread in engineering education is the ongoing effort to broaden participation and foster inclusive professional identities among students. The lack of diversity in engineering programs and professions is well-documented as a persistent concern, and numerous initiatives focus on outreach, access, and support for underrepresented groups in engineering. These include not only methods for recruiting and retaining students, but also the examination of societal forces that drive recruitment and retention into the field. Some of that work examines how students understand themselves as belonging in engineering [11], how they come to see themselves as engineers [12], and how they internalize a value for diversity and inclusion as part of that identity. Lockhart (2023) [7] examines this acutely in an examination of the formation of inclusive professional engineering identities (IPEIs), defining these as not only how a student perceives themselves as belonging in engineering, but whether they recognize that engineering practice is fundamentally improved by the participation of, and through addressing the needs of, diverse people and communities. In a longitudinal study of first-year engineering majors, students who participated in interventions aimed at promoting inclusive engineering identities (e.g., a guest lecture on the nature of engineering or a panel of professional engineers) [13] showed a positive shift in the development of their IPEIs over time. Exposure to activities that highlight diversity or help motivate inclusive teamwork made first-year students more likely to internalize inclusive values into their professional identities and to disabuse themselves of assumptions of objectivity and neutrality in engineering practice.

In this project, we associated our intervention and practices to drive growth in students' engineering identities and mindsets, as representative of Mezirow's transformative learning theory [14], [15]. This pedagogical framework is predicated on the idea that adult learners can fundamentally change their perspective and incorporate new ideas into their identities by critically and actively evaluating their beliefs, assumptions, and perspectives. The catalyst for this is a "disorienting dilemma" that challenges existing mindsets and creates a need for new frameworks and habits of mind. Engineering design projects, by their nature, challenge students to engage in new habits of mind, such as systems thinking, problem-finding, visualizing, improving, creative problem solving, and adapting [5], in order to functionally identify a need, communicate with diverse stakeholders to address it, and formulate and test a solution. To this end, we aligned our activity with stakeholder interviews conducted by students during team engineering design projects, as discussed further in the next section.

Context and Motivations for Our Classroom Intervention

Our motivation for creating this positionality statement activity was twofold. First, we were motivated to respond to the call for greater reflexivity in engineering education by modeling and fostering positionality awareness at the first-year level. As faculty fellows and, prior to this, educators-in-training, we had become aware of how seldom students were asked to reflect on their own position relative to their work. In alignment with prior work examining positionality and student formation [6], [7], [12], [13], [16], we considered that introducing this practice in a first-year course could normalize the idea that personal backgrounds and lived experiences can and should influence their approach to their professional practice, as a positive, diversifying influence on engineering design and service. Second, we saw a connection and opportunity between understanding positionality and the goals of the HCE program at BC. MMW, in particular, was developed through a sociohistorical lens to substantially integrate the humanities and engineering at the introductory level and to provide a grounding in engineering rooted in foundational skills [17].

MMW originated as a six-credit, first-year, multidisciplinary "Complex Problems" course in the BC Core Curriculum and satisfies requirements in both history and natural science. It has no prerequisites or intended major, and students enter with a range of academic experiences, personal backgrounds, and professional goals (both STEM and non-STEM). During the offering in which this activity was developed, the course had approximately 130 students and was team-taught by four professors: a historian of science and technology, a biological engineer (senior instructors, helming the lecture), a biomedical engineer, and a computer engineer/engineering education scholar (Core Fellows & laboratory leads). The course was subdivided into two 75-minute lectures weekly, with coordination of history and engineering content. Students were divided into 8 separate laboratory sections for once-weekly engineering design laboratories, during which they were gradually introduced to the engineering design process through projects of increasing complexity and independence. Students also participated in weekly evening reflection sessions and therefore had a basis for reflective thinking during our positionality intervention.

Reflection is a critical component of MMW and the HCE program, as well as the pedagogical framework at Boston College. As a Jesuit, Catholic university, BC espouses the education of the "whole person" and emphasizes service to the common good. Its Core Curriculum reinforces those values, with Complex Problems courses like MMW that intersect multiple disciplines and

examine questions of social justice. The Core Fellow program was developed to support this dynamic Core Curriculum: non-tenure track Core Fellows are hired annually for up to three years to help teach and innovate within the curriculum [18]. This creates an environment of interdisciplinarity and collaboration that was crucial to establishing this intervention.

Framing the Intervention within the Course

Having a first-year course within a program and community committed to humanizing engineering education, within an institution predicated on the idea that an education should shape an individual and encourage service to the common good, was a uniquely ideal environment to introduce a non-traditional activity such as our positionality intervention. We had positive encouragement from our co-instructors and leadership in HCE and the Core in developing this intervention, and were given time in the lecture to facilitate the activity. The grounding of MMW in ethics, social justice, innovative engineering education, and multidisciplinary thinking helped us quickly situate students in the activity and empowered us to experiment and engage with them in a natural extension of the course's topics.

Additionally, we were motivated to create as much cohesion with ABET learning outcomes as possible. In particular, ABET criterion 3 - Student Outcome 4 was a motivating factor for our work in guiding student professional identity formation, and represented a core component of the class's syllabus. It states that engineering bachelor's programs should provide students with "an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts" [18]. The positionality statement activity additionally provides students with an opportunity to reflect on their social position individually and in groups, facilitating Outcome 7: "an ability to acquire and apply new knowledge as needed, using appropriate learning strategies" [18].

This intervention was an extension of work we had done previously in redesigning the MMW lab curriculum. In previous years, the lab component had been divided into two parts: discrete engineering lab modules on topics such as mechanical advantage and electrical circuits, followed by 7 weeks of team-based engineering design projects focused on improving campus accessibility. We opted to focus exclusively on engineering design, repurposing time from the lab modules to provide scaffolded activities that gradually introduce students to the engineering design process. Briefly, students practice the engineering design process by addressing two ill-structured design problems. The first project asked students to analyze a large dataset, identify problems they could help a client address, and write a report that captured their problem-solving approach, conclusions, and future directions. For the second project, students used a similar problem-finding process to address a campus accessibility issue. Student groups formulated a problem statement, interviewed stakeholders, collected data, brainstormed solutions, developed prototypes, provided feedback to classmates, and iterated at least once on their design, culminating in a class-wide design conference where a set of external reviewers with multi-disciplinary expertise evaluated their designs.

We emphasized stakeholder interviews and the design conference to encourage students to understand others' positions and needs. However, immediately after student teams completed their first round of stakeholder interviews, we observed that students struggled not only to understand the different needs of stakeholders but also to identify who the stakeholders were. They struggled to consider the impacts of their designs beyond an immediate level of

engagement. For example, if a student group proposed developing an app to enable students with severe dietary restrictions to access information about safe places to eat on campus, they failed to consider that cafeteria staff were necessary stakeholders and potential program operators, and may not welcome being assigned additional responsibilities. This represented the most acute catalyst in piloting this intervention. We developed the activity to help students reflect on the social aspects of their projects and think deeply not only about how they engaged with stakeholders, but also about the aspects of their mindsets, identities, and lived experiences that informed those engagements.

In summary, our background research and the specific context in which we developed and deployed our intervention supported the use of positionality reflection as a meaningful and useful tool for first-year students to consider their professional identities and their relationship to engineering practice. The literature clearly indicates a need for more reflexive practices in engineering education that highlight inequalities in the engineering profession and offer a perspective to counteract them. With our course's focus on human-centered design as a foundation, we set out to have our students generate positionality statements while in the middle of their design projects, with the hope that this would cultivate a sense of self-awareness, empathy, and understanding of the diverse stakeholders implicitly represented in their projects.

Author Positionality Statements

Positionality Statement for Luke Perreault

Luke is a biomedical engineer specializing in cardiac and skeletal muscle tissue engineering, and has taught both general engineering and biomedical engineering design courses. He is a first-generation college student who had little exposure to engineering prior to college. Additionally, Luke had no experience in qualitative, engineering education research prior to his work at Boston College, during which he was strongly influenced by human-centered Jesuit principles of individual, holistic student formation and emphasis on working for the common good. These perspectives informed his desire to seek additional training and conduct research in engineering education. His commitment to human-centered engineering education animates his curiosity to explore how engineering students construct their own value systems for engineering practice, and how to use that knowledge to incorporate ethical, societally-focused, empathetic thinking into an engineering curriculum in an organic way.

Positionality Statement for Héctor Rodriguez-Simmonds

Héctor is a computer engineer and engineering education researcher. He has extensive qualitative research experience and has instructed engineering design courses at multiple institutions. His instructional experiences, his investigation of students' experiences at the intersection of their social and professional identities, and his research on the culture of engineering have informed his understanding of how individuals' social identities interact with the engineering design process. His experiences coalescing his varied identities alongside his engineering educator identity and his experiences helping students coalesce their identities amidst their engineering identity formation through collaborative projects have informed how he enacts human-centeredness in his engineering, education, and research practices.

Activity Structure and Facilitation

As stated above, we introduced the positionality reflection activity shortly after students conducted stakeholder interviews for their accessibility-focused engineering design project, when their engagement with users was fresh in their minds, but design concepts were still evolving. The activity occupied a single 50-minute lecture session. We opted to maintain an environment free from technology or distractions. We did not prepare PowerPoint slides or lecture content, and asked students to store their laptops and phones. They were given blue exam books for documenting their thoughts on paper. This analog setting signaled that the session was meant for honest dialogue and reflection. Our learning goals for the students were to (1) internalize that slowing down, reflecting, and thinking are important to effective design processes, (2) that empathy is a necessary component of inclusive, equitable engineering practice, and (3) that integrating social and technical aspects of a problem is a necessity in engineering design.

The structure of the activity was as follows:

- *Mindful Opening:* The session began with a brief guided meditation and breathing exercise. For about 10 minutes, students sat quietly as one of the instructors led them in focusing on the present moment. The intention of this opening was to shift students' expectations for an academic class period, center students' attention, calm any anxieties, and set a tone of introspection and openness.

- *Free Writing & Discussion:* Next, we briefly introduced the concept of positionality by sharing our own identities, perspectives, and backgrounds, and discussing how they inform our work. We asked students to reflect on their own identities and answer the following questions:
  "What are some of your identities?"
  "What aspects of your identities affect how you view engineering problems?"
  "Can you think of a time when your lived experience influenced how you understood a challenge someone else was facing?"
  Once we noticed most students were done writing (approximately 5-10 minutes), we asked them to form groups of 4-5 and discuss their answers for a few minutes, reminding them they could finish writing as needed. We walked around the room and listened to group discussions, continually reminding them to move on to the next question. Once most teams had finished discussing their answers, we asked teams to share with the class interesting points of context or continuity that their group discussion had revealed.

- *Individual Reflection:* We then had students return to private reflection, asking them to document in their blue books a personal reflection on how positionality affected/would affect their professional future to promote metacognition. We asked them to reflect and write on the questions below for 5-7 minutes, and indicated to them that these would not be shared/discussed with the class:
  "How can you share your identities with someone else?"
  "What is the value of this course to you?"
  "What about today's conversation might be useful to you in the future, either in this class or in your professional life?"

- *Wrap-Up:* Last, we concluded with a broader discussion of **what would be necessary to pilot more ethical, inclusive engineering solutions around the world**, and asked them to write one- or two-word, or single-phrase, ideas on the whiteboard. We documented the thoughts students placed on the whiteboard.

Student Reflections, Exploratory Analysis, and Observations

While the class totaled approximately 130 students, participation in the blue book responses was entirely optional and students could participate as much as they desired. As stated previously, all subject data was anonymized prior to analysis and students were not compelled in any way to participate in the activity that generated this data. We informed students we would be collecting blue books for later analysis. While conducted at Boston College, this study was submitted to and given retroactive approval by the California Polytechnic State University, San Luis Obispo IRB. All raw data was provided to the IRB for review prior to approval. Therefore, our response numbers varied and are noted below.

In the wake of the positionality activity, we reviewed student reflections from the blue books and noted recurring themes in the subsequent class discussions and design work. We first anonymized the reflections by documenting responses to each question and compiling them, omitting names and other clear identifiers. We worked with an undergraduate student researcher to digitize blue book responses by question for further review and analysis. For this initial intervention activity, we chose to qualitatively evaluate responses and document common themes and observations that emerged. Our objective was to use this information to justify future research and analysis and to uncover emerging questions and areas for refinement in the intervention. Luke primarily conducted the first coding pass by reading student responses to each question and creating codes across responses. Initially, he looked for responses where students discussed their identities, such as race, ethnicity, religiosity, and socioeconomic background. As he coded, he analytically memo'd, reflecting on emerging ideas in the data. Through the analytical memoing process, themes began emerging based on repeated codes that described, in part, how students discussed themselves and their relationships to others in relation to a specific experience (e.g., helping someone address a problem, helping someone understand an experience they had). As Luke developed themes, Héctor would discuss Luke's themes to refine and further develop codes, asking for clarification as necessary. As themes emerged, Héctor examined quotes to ensure they aligned with the ideas Luke was trying to capture. Our process resembled analytical memoing more than a structured thematic analysis; hence, we are reporting our results as initial insights into the data. The most common themes and some exemplary responses are highlighted below, organized by question.

"What are some of your identities?" – N=66 responses

Across responses, students articulated a wide range of identities spanning ethnicity, gender, nationality, class, religion, ability status, sexual orientation, family roles, and personal interests. Students readily listed multiple identities simultaneously (Examples: "Female, British, Swedish, Danish, bisexual, sister, friend, daughter, student, temporarily able" and "White, straight, male, English, able-bodied, student, adult, Christian, upper class"), blending demographic descriptors with relational or experiential identities. We observed that many students framed their identities in terms of privilege and access, naming their socioeconomic status or their ability to be able-bodied. Several students acknowledged their identities are underpinned by a desire to be of service to people or communities important to them ("I enjoy helping others, specifically

children who are less fortunate than me. I have two sisters, one who has epilepsy"), or acknowledgment of problems in equity in engineering ("As a woman, I understand misrepresentation and strive for better in engineering").

"What aspects of your identities affect how you view engineering problems?" – N=70 responses

Students overwhelmingly recognized that identity shapes perspective. Many responses emphasized that lived experience shapes which problems in their lives felt most visible, urgent, or personally meaningful. For example, one student remarked that their multinational upbringing amplified their awareness of societal needs, since "... living in mostly developing countries and developed countries allows you to see how important basic infrastructure and healthcare systems are to society, especially when a society lacks them." Students cited gender, disability status, class background, cultural upbringing, and geographic context as lenses that influence how they interpret constraints such as accessibility, affordability, safety, and usability.

Women frequently noted awareness of gendered design shortcomings ("As a female I view engineering designs that are often designed by men… sometimes male engineers do not know a women's lifestyle. This can be displayed by bathrooms designed by men who don't take into account women necessities"), while able-bodied students acknowledged their own emerging awareness of inequalities in access ("Able-bodied, so accessibility isn't something I think of often"). Students from societally privileged backgrounds reflected on the ways social or economic advantages shaped their perspective and drove them to try to empathize with broader experiences and contexts ("Fortunate enough to have gone to a very nice all boys' school which focused a lot on perspective, attempt to do my best to see many perspectives when facing a problem").

"Can you think of a time when your lived experience influenced how you understood a challenge someone else was facing?" – N=56 responses

Students most frequently cited temporary disability, injury, or proximity to disability (e.g., family members, friends) as moments when lived experience created empathy or understanding. Short-term injury experiences were highlighted as formative and made barriers to access acutely visible ("...I had a broken foot. I couldn't go up the steps to enter the science building and the ramp was on the other side of the building, causing me to be late to class").

Students also commonly referenced experiences with family illness, loss, immigration status, racism, and economic hardship as shaping their experiences and ability to empathize with others. These were often articulated as a powerful advantage in establishing understanding and empathy, acknowledging the value of their experiences, with one minoritized student notably remarking, "because I have lived as someone first-generation, low-income, and a minority, I am able to understand lots of different people, and engage in conversation that offer a unique insight that resonates more heavily. I can articulate the abstract feelings more easily. Identities give you perspectives that could not be inferred or authentically imitated."

"How can you share your identities with someone else?" – N=66 responses

Students consistently emphasized openness, conversation, and trust as prerequisites for sharing identity. Many described identity-sharing as relational and reciprocal, emerging through active listening and dialogue, and requiring meaningful effort, engagement, and learning, with one

student emphasizing that people ought to “take opportunities to participate and share your understanding of the world. People don’t know unless you say something. Go to events, learn, take classes.”

Importantly, students did not frame identity-sharing as obligatory and urged that individuals should retain agency over what they share. This nuance might suggest that students were not reflecting on positionality as performative transparency, but as intentional, substantive communication.

“What is the value of this course to you?” – N=65 responses

Students identified the course’s value in integrating engineering with the humanities, describing a shift from viewing engineering as purely technical to understanding it as a field with deeply social, political, and moral considerations. Examples and methods that align course content with historical examples were identified as particularly valuable to “learn from past mistakes and not commit them again.” Students found the connection between technology and society particularly rewarding, enabling them to understand and empathize with how different communities are affected by the built world. One student remarked that the course “opens my eyes to some of the more technical faults behind “systemic” racism and other ableist ideas that often aren’t on the front page of the WSJ or reported on but occur daily and affect thousands of marginalized individuals. It gives perspective on how fortunate I am”. Comments like these reinforced that the course's sociohistorical context helped students make visible how engineering practice relates to inequitable social systems and structures. The students' reflection on the course’s value in the context of the positonality activity may also ground their understanding of engineering in an inclusive, equitable framework.

“What about today’s conversation might be useful to you in the future, either in this class or in your professional life?” – N=53 responses

In responding to this question, students frequently pointed to increased awareness of bias and perspective as an enduring outcome. They described learning how to anticipate blind spots and reflect on their own stance or social positioning before making decisions (“By reflecting on ourselves we can better anticipate our bias and provide better output on life”). Students regarded lessons learned during the conversation as an opportunity to improve their design projects, particularly with respect to accessibility (“I think taking other people’s perspectives, identities, and needs into account is key to having a successful engineering design. Because the design may be successful to me, but may not work for others, or others may have suggestions”).

Whiteboard Highlights: "How can we create more ethical, equitable, just, and inclusive engineering solutions?"

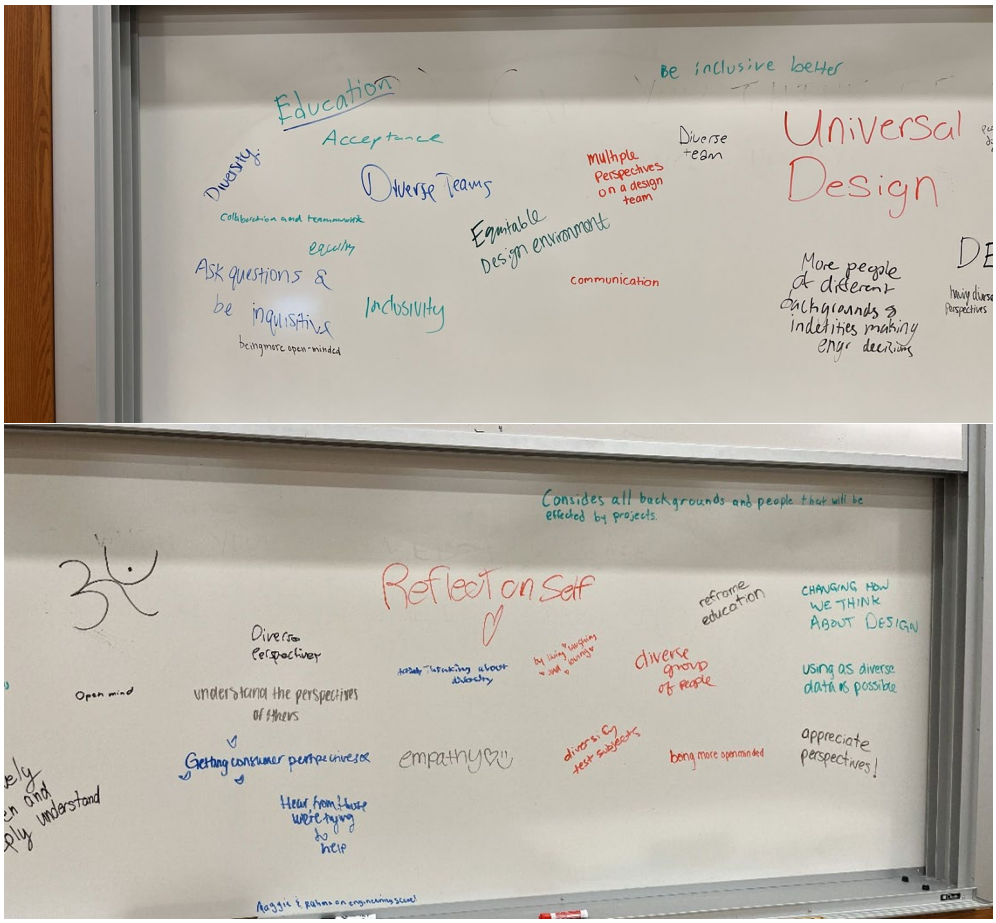

Figure 1: Highlights from whiteboard activity, documenting one-phrase responses on how to create more inclusive engineering solutions.

As students exited the classroom, they were encouraged to quickly reflect, in short responses (one word or one phrase), how we can create more inclusive engineering solutions, focusing on aspects of the activity that resonated with them. We had arranged this "exit reflection" as an opportunity to provide a conclusion to the activity and encourage students to leave considering how to implement the lessons learned in the future. Students frequently highlighted self-reflection, the value of diverse perspectives and backgrounds, empathy, and open communication as elements necessary to create ethical, equitable, just, and inclusive solutions.

Discussion, Future Work, and Translation to Different Institutional Contexts

Effectiveness of Positionality Reflection in Engineering Design Coursework

Based on student responses, this positionality statement activity achieved its intended learning goals, prompting students to reflect on how their identities, lived experiences, and social positioning shape their view of engineering and shape engineering design decisions. Student responses demonstrated an awareness of their identities, social locations, traits, and affordances, including recognition of privilege, blind spots, and the limits of their own perspectives when

scoping out a problem. Many students explicitly connected this reflection to their design work, citing considerations such as accessibility, affordability, stakeholder diversity, and moral responsibility as aspects of engineering practice that are acutely informed by their lived experiences and backgrounds. This aligns with prior work suggesting that students' formation of professional identity is tied to their backgrounds and foundational experiences, and that interventions that encourage reflection on these connections can help students develop a more inclusive, human-centered perspective on engineering practice [7].

We understood this intervention through the lens of transformative learning theory, and particularly regarded engineering design projects emphasizing accessibility as aligned with the concept of a *disorienting dilemma* [14], [20]. For many first-year students, this project represented not only their first introduction to engineering design but also their first team-based semester-long project in college. This necessarily placed them in an uncomfortable space, where they had to learn and practice engineering design, justify their own professional decisions, and contend with questions of identity, equity, and responsibility to diverse stakeholders. Challenges like this are necessary precursors to transformative learning and can help prompt reflection on previously unexamined biases and life experiences. We do not claim to have validated this effect on our students, as our observations were limited to high-level meta-analysis of themes in their responses. Further refinement, analysis, and additional iterations of this intervention are necessary to resolve any shifts in thinking that could arise from this activity. Still, student reflections offered comments that they appreciated the utility of reflecting on their positionalities as part of their design experience and found value in more reflexive, inclusive ways of thinking about engineering design. Students repeatedly referenced applying insights from the positionality discussion to design projects and team interactions, aligning with prior work emphasizing the importance of reflexivity in ethical and inclusive engineering design [21], [22].

Limitations and Translation to Other Institutional Contexts

This activity was implemented in a course with a strong sociohistorical grounding and explicitly justice-oriented framework, and it is impossible to separate the effects of the activity and the responses students provided from this course setting. Students contended with questions of inclusivity and equity, both in modern engineering practice and throughout history, for over 7 weeks before engaging in this activity. We did not analyze how students with different privileged or minoritized identities responded differently to the activity. A more thorough analysis of the dialogic and linguistic facets of the narratives could uncover additional phenomena we've begun gleaning, such as how students understand their identities and the systems and structures that differentially affect individuals in relation to technocratic participation. We also did not separate data collected from engineering majors in our course from students in other STEM (or non-STEM) disciplines, a major confounding factor. Further, design project teams were multidisciplinary, and we were unable to account for the impact of this level of multidisciplinary cooperation on students' ability to think reflexively. Lastly, studies that more explicitly consider metacognition in learning or other learning theories in relation to positionality reflections could provide additional insights into the development of effective engineering design curricula.

Still, we think this activity is adaptable and valuable in a wide range of institutional contexts. In programs without dedicated ethics or history components, positionality reflection can be reframed as a competency in user-centered design, need identification, and communication and engagement with stakeholders, skills widely valued across engineering curricula. The activity

required minimal instructional time - one 50-minute class period - and required no background review or preparation on the part of the students, and could thus be incorporated into introductory engineering courses, design studios, or even as a component of senior projects and theses. However, successful translation depends on providing enough introduction to positionality during the activity to facilitate meaningful reflection, particularly if it is the first exposure students have to these activities. Enforcing priorities for psychological safety (i.e., an environment of trust and respect, reassurances that the activity is voluntary), and making explicit connections between reflection and engineering outcomes is crucial, and aligns with best practices [2], [9].

Future Work

This intervention provided a valuable, albeit high-level, view of how positionality can be incorporated into engineering coursework and design projects and support the evolution of inclusive professional mindsets. Future work should examine how students' positionality evolves over a course and whether interventions that encourage reflective and metacognitive thinking influence their design outcomes, professional identity formation, and understanding of the value of inclusivity and equity in engineering. We found the role of multidisciplinarity most intriguing, both in the context of the course's sociohistorical framework for introducing engineering and in the student teams' multidisciplinary composition. It would be valuable for future studies to investigate whether a liberal arts framework in introductory engineering coursework motivates professional identity formation and whether working alongside students from multiple majors drives reflexive practice by fostering a plurality of perspectives and experiences.

Conclusion

This intervention, framed around a positionality statement activity, helped first-year students articulate how their identities and lived experiences shaped their understanding of engineering problems and how reflecting on that connection helped them practice engineering design in more inclusive, equitable ways. Student reflections demonstrated an awareness of their privileges, blind spots, and personal challenges, and an appreciation for how their backgrounds were valuable to their project work. They connected self-reflection and understanding to effective stakeholder communication, accessibility, and professional responsibility. While we did not evaluate a fundamental shift in student perspectives as a result of the activity, their responses suggest a meaningful appreciation for inclusive engineering practice.

Broadly, this project illustrates how structured positionality reflections can be integrated into ongoing coursework without an excessive displacement of technical content. We designed the intervention to take place within one 50-minute lecture period and to coincide with ongoing project work integral to the course. Although we worked inside a course with interdisciplinary, liberal arts-focused, sociohistorical framing, we believe the activity is translatable to different institutional and course contexts, particularly if framed as a method of improving professional competencies in communication and design thinking. By encouraging emerging engineers to engage in reflexive thinking, this intervention offers a scalable approach to fostering empathy and inclusivity with and in the communities they will serve.

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