

Exploring How the Exercise of Power Contributes to Creating More Inclusive  
Spaces in Engineering Education

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**Abstract**

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Engineering Education in the United States has been trying to address its problem with underrepresentation of minoritized student groups for decades. In recent years, the engineering community has shifted its focus from solely diversity efforts to Diversity, Equity, and Inclusion (DEI) efforts that focus on structural barriers to representation. The work of this dissertation looks to examine efforts to create more inclusive spaces, starting with exploring the educators' perspective followed by collaborative research methods including both faculty and student perspectives. The aim of these co-design efforts is to explore the space of power as it contributes to exclusion. Through co-design sessions, students and faculty discuss experiences of exclusion, reflect on their privileged and marginalized identities, and finally discuss opportunities to create change. Findings from this work re-iterate that doing work to create inclusive spaces is hard, both for students and faculty. Doing this work has both individual components, such as learning about the history and culture of engineering and reflecting on one's identities, and also community-centered work as people learn from each other's experiences, acknowledging that intersec-

tionality creates a multitude of ways one moment in time can be experienced based on the different identities one holds. Using Patricia Hill Collins' Domains of Power, this work dissects how different moments of inclusion are made up of interpersonal, structural, cultural, and disciplinary Domains of Power. This dissertation concludes by offering two steps the engineering education community can continue to take as we work towards creating inclusive spaces. The first is to accept and appreciate the hard work of doing this work. Hard means it is a slow process. It means one must take time to learn and process the learning. Hard means having to reflect on the learning and how one's identities privilege us at times and marginalize us at other times, based on the context and who is in the room. But hard also means taking action to "move the needle" forward. Second, one should not do all of it alone. Have conversations with others. Use conversations to process what one is learning. To seek advice. To learn from others' experiences. And to apologize when one has made a mistake. Engineering has a long history, and with that history comes many entrenched norms that are not always beneficial. But as a discipline, engineering prides itself in solving problems and impacting the world for the better. Let's move forward focusing on our aspirations to make the world a better place for everyone.

*To my parents and biggest cheerleaders, Luis y Maura. To my sisters and best friends, Karen y Cárol. And finally, to my nephew and teammate, Ian. Oh, and my loyal pup, Crosby. Thank you for all your sacrifices, support, and unconditional love. Los quiero mucho!*

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# Chapter I: Introduction

## 1.1 Motivation

Engineering education in the United States has grappled with the issue of representation from its inception, but in the last few decades, there has been a more concentrated effort to improve diversity, equity, and inclusion in the field of engineering [1], in particular for minoritized students, or students from racial minority backgrounds. The goal of representation has been to have the demographics of students in the field be representative of the demographics of our nation. Yet, even though we have seen numbers fluctuate for different minoritized groups, either decreasing or slightly increasing, overall, participation rates for underrepresented students remain low as seen in Table 1.1 [2]. With the recent June 2023 Supreme Court ruling of Affirmative Action [3] as unconstitutional when using race for college admissions, the slightly fluctuating rates are at risk of decreasing even more without this institutional support structure. It is critical, that as a field, we continue to promote representation. Fortunately, in recent years, the engineering education community has shifted its focus beyond increasing numbers, to addressing inclusive environments at the systemic level. Having a diverse student body representative of the general population is a good thing. But creating an inclusive environment, a space where there is equitable access to resources and participation and all students experience a sense of belonging, is what will sustain the change of representation within the cultural norms of engineering that reproduce underrepresentation. When taking into consideration Kimberle Crenshaw's warning that "tokenistic, objectifying, voyeuristic inclusion is at least as disempowering as complete exclusion" [4], as a community, we should acknowledge the harm we can reproduce if we do not implement inclusive practices with a critical lens.

This dissertation work is focused on understanding barriers to inclusion in engineering education at the college level in the United States. This dissertation work is hopeful, yet critical. Engineering as a discipline is respected for its commitment to making the world a better place. Aspiring engineers often cite the ability to solve problems as a reason for being interested in the field. As technology continues to rapidly develop and become more incorporated into aspects of everyday life, this respect for the field has increased

as well. Along with this rapidly increasing growth, comes an increase in economic development and job prospects. All these aspects of engineering are full of promise. But, as I aim to be hopeful, yet critical, I also want to raise concerns that have motivated this dissertation work.

Table 1.1 Bachelor's Degrees Awarded by Ethnicity from ASEE's Engineering & Engineering Technology by the Numbers [2]

Ethnicity	2011	2012	2013	2014	2015	2016	2017	2018	2019
Black or Afr. American	4.2%	4.2%	4.3%	3.5%	4.0%	3.9%	4.1%	4.2%	4.4%
Hispanic	8.5%	9.0%	9.3%	10.1%	10.7%	10.7%	11.1%	11.4%	12.1%
Other	1.6%	2.0%	2.3%	2.9%	3.1%	3.6%	3.8%	3.5%	4.3%
Asian American	12.2%	12.2%	12.9%	13.1%	13.4%	14.2%	14.6%	14.7%	14.7%
White	66.6%	66.2%	65.7%	65.9%	64.9%	63.4%	62.3%	61.5%	60.7%
Unknown	6.9%	6.5%	5.6%	4.5%	3.9%	4.2%	4.1%	4.2%	3.8%

\*Data on ethnicity does not include foreign nationals. American Indian/Alaska Native (0.4%), Native Hawaiian/Other Pacific Islander(0.2%) and Multiracial (3.7%) are combined under Other.

Underrepresentation in engineering remains a cause for concern, not only for the development of the field but also for the sociotechnical consequences related to the social impact due to the lack of representation in the process of technological developments. If engineering is to remain a hopeful discipline intended to better the world for everyone, it must face the multiple barriers to representation in engineering. This dissertation work aims to build on already existing critiques of the field, with a focus on power, and the renewed social focus on anti-racism movements and on dismantling systemic racism. Historical and cultural norms in engineering history such as its belief in objectivity, or that as a field, decisions are made based on data and not personal beliefs, and meritocracy, the idea that individual's success is based on abilities, have made it difficult for individuals benefiting from these systems to see how these norms have minimized the problem of underrepresentation. At the same time, the strong reliance on positivists perspectives, relying on scientific evidence, have led the field to solutionist ideas that prioritize technological solutions, believing that solely increasing the numbers of underrepresented students would create sustainable change. The reality is that underrepresentation is a social issue. As engineers, we have little training in understanding complex social systems that present multiple subjective perspectives.

In order to understand the culture and norms that have prevented the increased and continued participation of underrepresented students in engineering, one important aspect to look at is the engineering classroom, and more specifically, what inclusion or exclusion looks like in the classroom. A classroom is

an important aspect for engineering students, not only because that is where they are learning from their professors, but they are also building relationships with peers, and other instructional staff. They are also building their engineering identities [5] The classroom is the center of learning.

For this dissertation, I have looked at the lived experiences of engineering faculty doing inclusive work in their classrooms in order to provide implications to support their practice. From there, I have created co-designing spaces for students and faculty to discuss inclusive practices to counter exclusive behaviors they have either experienced or witnessed. Both of these lines of work looked to name barriers to success of efforts to create more diverse and inclusive environments, in order to leverage these observations to provide resources to support both students and faculty who are already working to create change to their engineering communities. Beyond providing support for inclusion, this work also includes better methods to name power with a focus on power in engineering spaces.

## 1.2 Research Questions

This section presents the research questions that informed the work for this dissertation. Because this work is representative of a group of research studies and results, below I outline how each research question maps to specific studies. Study 1 and 2 each have their own chapters, Chapters 3 and 4 respectively. The rest of the dissertation is developed through study 3. Following the research questions, I connect how each study led to subsequent questions.

- RQ for Study 1 and 2:
  - **What is the lived experience of faculty incorporating DEI practices in engineering courses?**
  - **How might we support faculty looking to incorporate inclusive practices?**
- RQ for Study 3:
  - **What affordances does co-design provide to support engineering students and faculty working together to create situated DEI practices at their universities?**
  - **How do engineering students and faculty understand and make sense of power dynamics in their environment?**
  - **How might we leverage the naming of invisible power dynamics to enact change?**

The first set of research questions arose from the desire to understand the landscape of what inclusive engineering education already looked like in practice. Current literature in engineering education has pre-

viously focused on ways to support underrepresented students through pre-college outreach and recruitment efforts, admissions policies, formal supplemental programs, and financial aid [6]–[8]. These efforts have helped increase diversity in these spaces. Previous work has also looked at causes for the low recruitment and retention numbers, particularly using deficit-based perspectives that focused on improving the student, as opposed to improving the system. Closely related to this line of work is research that looked at ways to foster belonging and how belonging was correlated with motivation [9]–[12]. These studies made an argument for increasing a sense of belonging to promote retention. Additionally, several scholars have already been looking at incorporating feminist perspectives and critical studies to the way engineering has been taught [13]–[16]. Although there were several papers calling for a change in how engineering education research on diversity and inclusion was done, there was no work done on the lived experiences of engineering faculty actually doing this work. Findings relevant to the research-to-practice cycle and motivation for change in implementing new pedagogical practices was the closest line of work related to the lived experiences of faculty [17], [18].

In this dissertation work, the two studies looking at lived experiences of faculty highlighted the need for community support in this work, the reality that doing the work of diversity and inclusion is hard. And finally, that doing this work takes time and effort, requires vulnerability, and most importantly, it requires going against norms. In addition to these findings, one pattern that arose was the impact of identity on how educators became interested in being intentional about addressing inclusion in their classrooms. Oftentimes, unless someone had explicit experiences with exclusion as connected to particular identities, it was necessary for people to learn about experiences of exclusion from others that had had those experiences. Having to learn from others was particularly important for those with more privileged identities, given that they had not experienced exclusion as often for particular identities. This pointed to how power structures benefited some and negatively impacted others. Two concepts also became critical when thinking about how to support educators trying to adopt more inclusive practices. One was having to develop their Integrity of Practice or the ability “to explain and justify decisions about teaching and learning activities to his or herself as well as to students, colleagues and institutional and other policy makers

[19].” Additionally, in understanding the tension between positivists perspectives and subjective experiences of inclusion, I presented a need for educators to be more critical when asking “did it work?” and go beyond and ask questions more like “did it work for my students?” and “does it work for this context?”.

The second set of research questions were developed from another gap in the literature. Little research looked at student and faculty conversations about issues of inclusion and underrepresentation. Researchers asked questions representing one-sided perspectives of how students or faculty contributed to inclusion or felt excluded, taking away from the reality that exercising power requires more than one actor, or social interactions. Because this was missing from the literature, I began to look at co-design, or a cooperative, collaborative, community-based approach to solving problems, as a possible method to have students and faculty interact on these issues. Co-design as an approach also allowed the research team to observe the nature of these power-laden interactions. Additionally, because of the emphasis on positivist ways of knowing in engineering education, it was important to understand how engineering students and faculty conceptualized power dynamics, particularly in their environment. Participatory research, specifically co-design allowed several affordances: it created a collaborative space, it created a focus—design something, and it called for the acknowledgement of power dynamics, emphasizing the expertise of each stakeholder based on their personal experiences. The focus was on problem-solving, a skill engineers enjoy practicing, but this focus also allowed participants to discuss issues of exclusion and think about ways of solving some of the problems. Although the literature on co-design described these commitments for the process, Research Question 3 reflects the need to pilot this method within the context I planned to use it for.

Once I piloted co-design sessions with students and faculty, I designed a longer engagement with students and faculty in order to answer Research Questions 4 and 5. In these engagements, students and faculty were able to share experiences of inclusion and exclusion in engineering spaces, examine their own identities, and begin conversations on ways to create more inclusive environments in engineering education. In observing students and faculty having conversations about exclusion, I documented how

they approached conversations of power, what they were comfortable discussing, and some limitations to this practice.

After this study, both faculty and students discussed the uniqueness of being in a space where students and faculty could openly have conversations about inclusion. They also shared reservations on the possibility of larger scale conversations of this nature. Overall, the study reiterated the importance of learning about power structures, reflection on one's exercise of power and that of others, and finally, thinking of ways to take action. This sustained engagement shows promising ways for students and faculty at different institutions to engage in similar conversations, where they can explore barriers to inclusion together and discuss ways to create change. This type of engagement can help in creating a culture, where talking about and acknowledging power dynamics and privilege is acceptable, in hopes of creating more inclusive spaces for all.

### 1.3 Dissertation overview

This dissertation is organized as follows: In chapter 2, I discuss the related works for underrepresentation in engineering, including previous approaches to understanding the causes and the impact of engineering culture and norms that contribute to the slow change in issues of representation. I also discuss how power as a phenomenon has been understood and how it contributes to the *slowness* of change within engineering culture and norms. I introduce the method of co-design as conceptualized for this work. Finally, I also define some key terms used throughout this dissertation.

In Chapter 3, I share the paper that came from study one, and provide a reflection on how that work led to the direction of this dissertation and how, looking back at it now, I understand my findings with more perspective and experience. This chapter includes the finding that the lived experiences of faculty implementing inclusive practices reveals that doing this work of diversity and inclusion is hard. This finding continues to come up in following studies in this dissertation. This chapter also presents the finding that educators doing this work often find communities doing similar work, whether it is within their department, institution, or the broader engineering education community. The third finding is that, in developing inclusive

practices, faculty learn from personal experiences or from those of others, what instances of exclusion look like and the importance of addressing these instances.

Similarly, Chapter 4 provides the same retrospective-style look at the paper resulting from study 2, a reflective engagement with an educator implementing an inclusive practice in their classroom. Additionally, this chapter includes how these findings impacted the direction of my dissertation work. This chapter highlights the findings related to the importance of educators finding their “integrity of practice” and broadening the question of “what works?” to be more specific to their students and context. Both chapters 4 and 5 are connected back to the overall dissertation in the concluding chapter.

Chapter 5 discusses the methods used in the final study of this dissertation, the sustained engagement of students and faculty co-designing inclusive practices for engineering education environments. This chapter outlines the study design, describing the post and pre-interviews, activities for the three co-design sessions, and reflection activities. Included in this chapter are the pre and post interview questions and reflection prompts the participants answered. This chapter also includes the data collection methods and the different types of data collected, including participant demographics. Finally, the chapter details the data analysis methods and process used to conduct thematic analysis on the data and how the data was triangulated to confirm credibility.

Chapter 6 presents the results from the two iterations of this study, ordered into three sections: Understanding of Power in Pre-Interviews, Identity Exploration, and Looking towards Change. This chapter presents the themes that resulted from the analysis from specific data sources, including the pre-interview, the artifacts from the co-design sessions, and the post interview. Data for the students from both cohorts are analyzed as a group and the faculty data from both cohorts are also analyzed as a group, separate from student data to find commonalities among peer groups.

Chapter 7 provides discussion of the results. In this chapter, the synthesis of the results shows that that overall, students and faculty can easily articulate an understanding of power in their engineering environment. Additionally, I discuss what contributes to the invisible nature of power, specifically for engineering education spaces, both because of the common conceptualization of power as negative and as something that is possessed, and because of the multilayered analysis possible from one short interpersonal interaction. In the final section I discuss important areas to focus learning, in order to make conversations about power easier to have. I also discuss potential points of personal reflection to help see structures of power and our own role in how power is exercised. Finally, I briefly discuss the importance of taking action in order to change structures of power.

Chapter 8 provides a review and conclusion of this dissertation work, encouraging the engineering community to appreciate the slowness of this work and to engage in more conversations with their community members. This chapter summarizes how this body of work advances the conversation of creating more inclusive spaces in the engineering education community.

## 1.4 Contributions

There are three types of contributions from this dissertation: empirical, methodological, and theory-to-practice. The following sections describe each contribution.

### 1.4.1 Empirical Contributions

The empirical contributions include an understanding of the lived experiences of faculty incorporating inclusive practices and an exploration of student and faculty understanding of power in their engineering education environment. In order to support faculty incorporating inclusive practices, it is important to acknowledge how hard it is to do this. It is important that developing an integrity of practice is a constant process. Becoming more inclusive requires constant reflection, questioning of norms, and an ability to recognize when a mistake was made in order to right the wrong. This includes going against the norm of thinking there is one correct way to teach and learn and that what works for one person, should work for everyone. Faculty also need support, at different levels, to do this work. This includes support from leadership and support in learning from others who are more experienced in doing this work. It is also helpful

for faculty to have opportunities to learn about experiences of exclusion they might not face, based on their marginalized or privileged identities.

This work also provides insights into how engineering students and faculty articulate their observations of power dynamics in engineering spaces. Students feel the constant evaluation of their competency or intelligence by their peers as a way hierarchies are formed that impact who makes project decisions or who is seen as valuable members to study groups or as lab mates. Students are also aware of the impact faculty can have on their futures with grades, letters of recommendations, or even connections to opportunities. For faculty, the tenure system has a big impact on how they approach their roles as educators, researchers, and colleagues. Those with tenure have the ability to exercise their power in negative ways with considerably less risk of consequences to their jobs. Additionally, faculty are aware of their role as educators and the ability to exercise power that comes with that role. Findings from this work show that it is unclear how faculty understand the difference their role as faculty makes on how students perceive and interact with them, particularly how identities of student and faculty affect this perception and interactions.

### 1.4.2 Methodological Contributions

The methodological contributions include using an “over-time” interview approach to document lived experiences in real-time and the use of co-design as a way that allows participants to learn from each other and observe power while learning about power. In using an “over-time” approach, detailed in Chapter 4, I provide a way to document lived experiences in real time, as opposed to the common method of documenting lived experiences with interviews, requiring people to share from memory. This is a promising method as engineering educators continue to implement new inclusive practices and explore what practices work for their context.

The second contribution is around creating a process that considers power dynamics between students and faculty in co-design sessions, specifically for designing diversity and inclusion practices. I do this by developing the use of co-design as a method for observing power dynamics. Traditionally, co-design and other participatory design methods have been used as the process for conducting research, with the artifacts resulting from the co-design sessions analyzed as data. In this dissertation, I do both. I design an

environment for co-design, which allows different stakeholders to come together to work on finding a solution to a problem that affects those present. Because power dynamics are a normal part of interactions, pointing out the power dynamics and acknowledging the different expertise and perspectives brought by the different stakeholders at the very least acknowledges the difference in power. I am able to see in these sessions how power is exercised and ceded by participants, while they discuss the broader question of inclusion in engineering education spaces. The participants themselves also have an opportunity to reflect on their observations of power as connected to their identities.

### 1.4.3 Theory-to-Practice Contributions

The final contribution includes translating theories of power to practical applications. This work utilizes power frameworks to help make engrained cultural norms and subtle interpersonal interactions of exclusion more visible. I do this translational work by analyzing participant data, including interviews, reflections, and design artifacts, with Patricia Hill Collins' Domains of Power framework [20]. In doing so, I provide ways to make sense of what students and faculty are naming as instances of power dynamics specific to engineering education contexts. Using the Domains of Power has been pivotal to understanding power in general, but one addition this work does is translating this knowledge of power to a context of engineering education, where power is difficult to see, discuss, and understand, due to the norms that perpetuate the same power structures. Therefore, this work ties specific aspects of engineering in which power dynamics are particularly difficult to see. I also elaborate on what "invisible" means in the context of power. This aspect adds to our understanding of power, as a phenomenon that exists and works at a systemic level but is reproduced or disrupted by individuals. This contribution also points to a need for future work understanding the difference between how students and faculty discuss power and the mismatch by how frameworks of power describe power dynamics.

Finally, an important aspect of this work is the centering of marginalized voices as a way to provide unique perspectives of exclusive practices. Much of the work around DEI centers on educating others about history and terminology. None of this is a bad thing in itself. But we see that educating others does not always translate to creating inclusive practices. And still there are people who do not feel that this work is important or even necessary. In highlighting the voices of those that continue to have experiences

of exclusion in engineering spaces, I de-center the white, male experience, and center that of other, much needed voices in engineering. Other work exists that documents student experiences of exclusion, but one question that remains is, how can these stories be used to impact change. It is often easy to blame others for behaviors that we ourselves are also replication. Through this exploration of power dynamics, I add to the literature supporting inclusion efforts through systemic change in engineering education. Yet I also propose there is more work to help faculty relate to student experiences from students that are not theirs.

## 1.5 Limitations

The work of this dissertation comes with limitations. One of the more noteworthy limitations include the focus of a large, 4-year, public, Predominantly White Institutions (PWI), for the final study. Other participants from study one and two came from primarily 4-year Institutions as well but varied more in the size and demographic make-up of the institution. Another limitation of this work is each of the participants' views on DEI efforts. Many of the participants self-selected to participate in each study, all which clearly acknowledged an interest in creating a more inclusive engineering education environment. The snowball sampling and word of mouth efforts used to recruit participants limits the types of views presented here. Even though I tried to mitigate this by advertising the study widely, I had to resort to recommendations when few participants enrolled. Similarly, I myself have only attended 4-year PWI institutions, limiting also my perspective and experience to these cases as a minoritized student.

# Chapter II: Literature Review

This chapter introduces key terms, provides an introduction to theoretical underpinnings in this work and reviews related work that informed and shaped this work including work in engineering education research, understanding power as a phenomenon, and in co-design for research. Section 2.1 starts with defining key terms.

## 2.1 Key Terms

### 2.1.1 Diversity, Equity, and Inclusion

Diversity, equity, and inclusion have become buzzwords in the past few years. Because of this reality, it is important to be clear in the definitions being used when using each term. For this dissertation, these terms go together. Each word on its own does not provide a full picture of what is required to meet the criteria it is meant to describe. Diversity means having different identities and cultures represented in one space. Different ways of thinking and being. But diversity on its own does not create a space where these differences create the same opportunities for everyone in that space. Equity addresses this reality. Equity is the idea of making a space equitable, not equal for everyone in a space. It means providing appropriate resources for different needs in order to give everyone a fair chance of succeeding in that space. Equity acknowledges that with diversity comes differing needs and therefore different structures to support these needs. Finally, inclusion ties both concepts together. Inclusion means creating a space where everyone feels like they belong and not like they are "other". Inclusion means that diversity is valued. Inclusion sees differing support structures as a benefit for all, not an unfair advantage for some people to succeed and not others. The differences are valued, welcomed, and people are excited to see everyone succeed, because they realize it is all for the greater good. Together, these terms create a space for people, for a community, to thrive.

### 2.1.2 Power and Power Dynamics

Power is a ubiquitous word, but the phenomenon of power is complex and difficult to grasp. Power can be defined as **the capacity or ability to direct or influence the behavior of others or the course of events** [21]. Here, we assert the following characteristics of power. Power requires more than one actor,

but those actors can be individuals, systems, or even inanimate objects— it is a relational phenomenon. Although power has been characterized as something that can be exercised [22], possessed [23], or experienced, for this work, power will focus on something that can be exercised and not as something that can be possessed. Power can be observed when one actor acts on another. Additionally, power is inherently neutral but can be used either in a positive or negative manner. This conception of power is often difficult to embrace given that power tends to have a negative connotation, as related to dominating, oppressing, and violence [24]. But, power can also be a productive phenomenon, such as empowering, leading, and directing [23]. Power is socially constructed, therefore one's ability to exercise it can change from one moment to another, depending on what other actors are present in the same space.

Because of these characteristics of power, here we explore the phenomena by looking at power relations and power dynamics, examining how power affects interpersonal interactions. Power relations refers to the interaction related to the exercise of power while power dynamics refers to power as it happens in context. Power can also be analyzed from the perspective of the individual exercising it, or from the perspective of the individual experiencing it. Through the exercise of power, social and cultural norms (positive and negative ones) can be reproduced or disrupted. Power is socially constructed, therefore one's ability to exercise it can change from one moment to another, depending on what other actors are in the same space. In having conversations about power, it is critical to be aware of what definitions of power one is using. Because of the complexities of power, in addition to these characteristics, this work uses different understandings of power to create a new framework that provides a more comprehensive model for engineering education research.

### 2.1.3 Identity

Identity is a key term for this dissertation. In this work, identities specifically refer to socially ascribed identities that affect how one experiences the world, including the privileges and marginalization that comes with each. Models such as the Identity Wheel [25] and the ADDRESSING Model [26], focus on specific identities that have been recognized as impactful in society. To give an idea of these identities, the ADDRESSING Model lists the following identities: age, developmental disabilities, acquired disabilities, religion, ethnicity, sexual orientation, socioeconomic status, indigenous group membership, nationality, and

gender. Understanding identity is important for several reasons. First off, it relates to DEI because it describes one way diversity is represented, and ways in which these identities have been systematically affected, as shown by previous work [27]–[30]. Additionally, identity plays a big role in how one exercises power and how systems affect people differently, because systems are usually designed with majoritarian identities in mind.

#### 2.1.4 Intersectionality

Intersectionality as a term comes from Black feminist scholarship. Kimberlé Crenshaw describes the term from a legal scholar's perspective, pointing that, within the law, identities have been simplified in how people think about, for example, race and gender separately. From an intersectional perspective, the experiences of sexism of white women and black women are different due to the intersecting identities of race and gender, instead of thinking of these experiences of all women experiencing sexism as having the same experience. Similarly, Patricia Hill Collins expands by adding how different Domains of Power, defined in section 2.4.1, contribute to how different identities experience structural or cultural oppression. When considering the experiences of minoritized students, it is important to remember that no one experience can be generalized to others with shared identities.

#### 2.1.5 Underrepresented, Minoritized or Marginalized

In engineering education, multiple terms have been used to describe populations of students that are underrepresented in engineering programs. A common abbreviation is URM or Underrepresented Minorities. Minoritized as a term, as opposed to minority, suggest this status is a “process of student minoritization” that reflects an understanding of “minority” status as something that is “socially constructed in specific societal contexts”. Racially minoritized students in engineering include those with Black, Latinx, and Indigenous backgrounds. Other underrepresented groups include first generation college students, students from low- income backgrounds and women. In this dissertation, I use the words underrepresented, minoritized and marginalized interchangeably. Like minoritized, marginalized is intended to acknowledge the social structures responsible for student success risk factors as opposed to using terms such as ‘at-risk’ students [31]. Minoritized and marginalized provide an asset-based perspective that acknowledges systemic issues that contribute to the low representation of these communities in engineering spaces, as

opposed to having a deficit perspective, that faults the communities the students are coming from or the students themselves, for the low representation.

## 2.2 Assumptions and Theoretical Underpinnings

Presented here are two critical assumptions of this dissertation work. The first is assumptions on the purpose of education, as it relates to understanding the pursuit of dismantling barriers to inclusion in engineering education. Similarly, the second part of this section is insights into a critical approach to education and ideas behind why this exploration into power dynamics is important from a critical perspective.

### 2.2.1 The Purpose of Education

According to John Dewey, “the aim of education is development of individuals to the utmost of their potentialities [32].” The argument here goes that, as educators, as an education system, our responsibility is to help individuals reach their full potential. We cannot achieve this goal if there are different groups of students who are not even reaching our engineering classrooms due to social barriers. If students do not feel like they belong, helping them reach their best potential becomes a secondary concern. Therefore, in order for educators to accomplish this responsibility, part of the goal must be to challenge the system as it stands, to provide this opportunity to those who want to be engineers, yet are not feeling as if they belong in these spaces. This aim of helping students reach their full potential is the undercurrent of this dissertation, as I seek to find ways to address barriers to inclusion.

### 2.2.2 Critical Perspectives in Education

In “Just what is critical race theory and what's it doing in a nice field like education?,” Ladson-Billings articulates the need for using such critical theories to understand inequities in education [33]. Consistent with the idea of learning as a sociocultural process [34], examining cultural values present in education institutions is critical to understanding how to help students succeed. These views are inconsistent with the meritocratic views of education traditionally believed to be true in engineering education, that believe success is due to individual abilities. Additionally, oftentimes, engineering education uses the banking

model [35], where students are expected to listen to and learn from the educator, as opposed to also contributing knowledge from their own perspectives. Part of the work of this dissertation is looking at how culture and identity interact to create minoritization and marginalization through structures of power.

## 2.3 Review of Research in Engineering Education

There are a few threads of work that contribute to this dissertation. The first is work that characterizes the experience of underrepresented students in engineering, usually from Black, Latinx, and Native American communities. The second is literature describing predominant cultural and ideological perspectives that have resulted in underrepresentation in the field of engineering, leading to systemic barriers. The final thread is the complex ways power, as a way to enact change, works through both individuals and systems. Ultimately, by understanding how power works to reproduce or dismantle systemic barriers, I aim to understand how to see power in engineering education in order to address barriers that are reproducing underrepresentation in engineering.

### 2.3.1 Exploring the Issue of Underrepresentation in Engineering

There is a growing trend in engineering education research looking to present the lived experiences of underrepresented students in order to uncover cultural and structural systems that have negative impacts on these students [7], [36]–[43]. Underrepresented students deal with external perceptions from others, which produce stereotype threat and imposter syndrome. Negative stereotypes of minoritized groups are also found in representation of minoritized groups in textbooks. The lack of conversations and understanding of racism [44] and the prevalence of color-blind racism [45] makes it difficult for underrepresented students to feel as if their experiences with racism are valid. Even with conversations of lived experiences, Leydens and Lucena state that these conversations can perpetuate the denial or dismissal with some saying “I don’t see this [racism, sexism, etc.] as a problem [42].” Hearing these experiences of underrepresented groups should help us expect the findings in the Academic Pathways Study, which found that the persistor group, students who stayed in engineering majors from the start of their college careers, had proportionally fewer women and underrepresented minorities than the switcher group, or the group that switched out of their initial major in engineering [43]. Riley suggested in 2006 that often “the goal has

been to help the [underrepresented] student adjust to engineering, to assimilate to its culture and practices, but only a few have suggested changing the field itself, changing the curriculum content, or changing classroom pedagogy and climate [44],” or what can also be called structural changes. One research trend that has helped move this conversation forward is the move to an asset-based perspective, focusing on what underrepresented students bring to the table, leading to changes in the culture of engineering as opposed to the historically common approach of focusing on how to make underrepresented students fit into the culture (deficit perspective). In parallel, the asset-based perspective examines how institutional structures can be changed to prevent unnecessary barriers to underrepresented students. The asset-based perspective is intended to counter the assumptions previously made with deficit-based perspectives. It is critical to understand all of these aspects that contribute to student success, but it is also important to understand how racist structures affect an individual's experience with each of these aspects of their student life.

## 2.3.2 Characterizing Engineering Perspectives

Engineering education is characterized by its positivist perspective and its belief in merit-based success. As a field, engineering also has strong ties to the government and industry. These cultural characteristics create barriers to representation.

### 2.3.2.1 Meritocracy, Objectivity and Positivist Perspectives

Engineering as a field strongly believes it is meritocratic, or that an individual's progress is based on ability and talent, making it difficult for the engineering community to see how privileged aspects of the culture create an “abilities hierarchy” [43]. Because there is a strong focus on technical abilities, the Engineering Sciences, particularly the physical and life sciences, have a privileged place over design, the humanities, and social sciences in the overall engineering curriculum [46]. This focus on engineering sciences, along with the belief that merit does not discriminate, makes it difficult to attribute underrepresentation to structural factors beyond the individual. Combining the realities of low funding for primary and secondary education for those from underrepresented communities, along with the strong emphasis on technical abilities not only creates an uneven playing field because of how opportunities are distributed to students based on schooling privileges before college, it also makes the problem difficult to identify if we

maintain the false reality of equal opportunity. In addition to the strong belief in a meritocracy, there is a strong claim to the objectivity of the field because of its roots in positivist epistemologies. Because math and science are presented as objective, it is difficult to argue against the dominant curriculum which focuses on Eurocentric science histories and examples in textbooks, making engineering a “white field”[45]. The positioning of Eurocentric histories not only becomes normal but are then considered superior [46], given their privileged place in the classroom. This often gives minoritized students the impression that they must leave their identities at the door [42], resulting in those leaving engineering majors being “disproportionately from groups underrepresented in engineering, including first-generation college attendees” [47]. A study from Hewitt has shown that factors causing students to leave science, math and engineering majors were structural or cultural sources [48]. Many studies have documented the experiences of underrepresented students in engineering, many explaining why minoritized students leave engineering majors. Leydens and Lucena highlight the human fact that “we unknowingly make judgements or express preference about a person’s talent, capability, etc., based on characteristics that may be irrelevant to such judgment [46].” Again, acknowledging this fact can seem contradictory in a field with a strong belief in objectivity. But Secules points to how engineering education actually tends to highlight individual abilities and background with its belief in meritocracy [39].

Thinking about issues of racist power structures in engineering education is interesting to study because of the differing epistemologies required to understand these structures. While engineering as a field tends to value technocratic perspectives, such as the technical expertise of individuals, understanding racism from a sociological perspective requires we also value the subjective perspectives of individuals and their experiences in this world. **Both ways are valid ways of understanding the world around us, but because “the nature of truth as objective” is valued in engineering culture, reconciling the existence of racist power structures in engineering becomes difficult for both students and faculty.** Additionally, the understanding of racist power structures in general is quickly growing as conversations about racism become more prominent in the media. The engineering community needs to reconcile the need for different ways of knowing as it seeks to create more inclusive environments.

### 2.3.2.2 Engineering's Strong Ties to Government

Engineering's close ties to industry and government strongly influence the topics and projects explored in courses and again, the type of ideas that are privileged. These close ties are a result of the historic development of engineering, with the field growing because of the increased demand for technical knowledge as the country went through industrialization, and even more so through the series of wars at the international scale in the 20th century. Both government and military continue to be the main source of funding for research and where most job opportunities for engineers lie after graduation. In fact, "the national accreditation criteria are set by assembling panels of corporate executives [44]." Because of such strong ties to government and industry, "it often feels as if the products created by engineers are those that serve the needs of those who can pay [44]." This leads us to the question Lucena and Leydens ask "What is the purpose of engineering? It can be to prepare recent graduates to be change agents and participants in a new social movement with engineering work practice [46]". This statement describing engineers as participants in a new social movement can seem incongruent to the idea of meritocracy, claims to objectivity, and the strong ties to industry. But having engineers see themselves as change agents is important as the field continues to champion inclusion.

Directly related to the close tie to government are the arguments used in support of DEI efforts. The most common argument in support of increasing representation mentioned in academic papers is that representation is important in order to remain economically competitive at the international level [41], [49]. The argument continues, stating that representation helps economically because one, multiple studies have shown that diverse teams are more innovative than those teams that are more homogeneous, leading to higher financial performance. And two, because some groups of people are underrepresented in engineering, then there is a large source of untapped potential that could be reached to fill in the increasing number of engineering and technical jobs. Both of these lines of reasoning see the purpose of education as creating individuals that are a means to production as opposed to John Dewey's insistence on helping individuals reach their full potential.

## 2.4 Characterizing Power

Given the cultural and thus systemic barriers in engineering education that resist the acknowledgement for the need of more inclusive spaces, I include the concept of power as a lens to explore how cultural norms create resistance in everyday interactions. This section includes how the phenomenon of power has been studied in engineering and the primary framework used in this dissertation, the Domains of Power.

### 2.4.1 Power In Engineering

Power as a lens in engineering education has only become more prevalent in recent years. Although scholars such as Donna Riley and Susan Lord have been using this framework for decades, only in recent years has power been used to look at different areas of the community such as research team dynamics, student feedback, a topic for instruction, and to look at differing experiences [50]–[53]. This points to power as a promising lens to continue understanding barriers to inclusion in engineering education spaces.

Power was defined earlier in this chapter. Here is a brief summary before discussing the theoretical framework of power that will inform the analysis of this dissertation. Power again is a ubiquitous word, but when using it critically, it is a complex concept to grasp. For this dissertation, power is defined as **the capacity or ability to direct or influence the behavior of others or the course of events**. It is also something to be exercised. It is inherently neutral but can be used in a positive or negative manner. Because power is exercised, it is a social phenomenon, requiring at least two actors. Power is deeply intertwined within interpersonal interaction, culture, and social structures.

Another perspective of power that has influenced the direction of this dissertation is Michel Foucault's analysis of power. One of Foucault's greatest contributions is his study of power and power relations. Foucault defines power relations as someone acting on someone else's ability to act. This definition of power also implies that at least two actors are required for power to exist and there is also an implied

freedom that is being negotiated. In *Society Must be Defended*, Foucault states that “power is not something that is given, exchanged, or taken back... it is something that is exercised and that exists only in action...it is a relationship of force [54].”

By understanding how power is observed in engineering classrooms, we can learn how to name it, reflect on it, and then exercise it appropriately. Each of these steps requires individual action such as vulnerability, courage, and persistence and group action such as support, collective action, and changing of the status quo. In the following sections, I detail different frameworks that have been used here to characterize my understanding of Power. I will discuss Patricia Hill Collins' Domains of Power.

## 2.4.2 Domains of Power [20]

Patricia Hill Collins' framework for intersectionality includes four different, yet interconnected Domains of Power. These domains include structural, disciplinary, cultural, and interpersonal. This section will expand on the four different levels of Collin's framework. In this framework, race, gender, class and other identities are different axes of analysis within these different domains.

### *Interpersonal*

In the Interpersonal Domain, “power relations are about people's lives, how people relate to one another, and who is advantaged or disadvantaged within social interactions.” This can be seen through the various -isms, sexism, racism, classism, etc. At the interpersonal level, the intersectional makeup of one person places them in different locations within the matrix of domination, as the interplay of advantages and disadvantages of different identities are seen in how people interact with one another. In our work, we use Kathryn Pauly Morgan's Identity Wheel [25] to help students reflect on which identities they are bringing with them.

### *Cultural*

In the Cultural Domain of power, “ideas matter in providing explanations for social inequality and fair play.” These cultural norms include ideas about how to measure intelligence, what activities are considered intellectual, and what counts as science. In the Cultural Domain, we see some cultures valued over others, moving power dynamics beyond individual actors, to a larger social phenomenon. The Cultural Domain helps us describe how power can be understood in a particular context— specifically how one moment in time is affected by the context in which it is happening, and the historical moment in time it is happening. The Cultural Domain reminds us there is an element of time and situatedness relevant to power.

### *Disciplinary*

In the Disciplinary Domain of power, “different people find themselves encountering different treatment regarding which rules apply to them and how those rules will be implemented.” Within different contexts, whether it is at the institutional level, such as higher education, or at the level of a group of friends, there are different rules on how to behave, succeed, and interact. In engineering specifically, this can be seen in how traditionally, there have been lecture style courses where students are listening to learn, whereas in other Disciplinary Domains, like the humanities, discussions are a part of how the learning is done. Other discipline specific rules include how learning is measured, such as exams, projects, like in engineering or even a performance piece, such as in an art discipline.

### *Structural*

In the Structural Domain, institutions have policies and procedures that benefit some and not others. In higher education, these policies and procedures include admissions processes and requirements, defined by the institution itself.

The Structural Domain of power is relevant as the engineering education community seeks to dismantle sites of oppression. But as we see here, it is one of many intertwined layers. This work offers these frameworks as tools to do analysis within and across domains from the individual to the structural within engineering education.

## 2.5 Co-design as an Intervention to Collect Data & Conduct Observations

Having engineering as the context and power as the phenomena to observe, the next question is *how* power will be observed in engineering education. In this work, co-design, a participatory research approach, was piloted and then chosen as an appropriate method to conduct the research. This section introduces co-design.

One definition of co-design is “the effort to combine the views, input and skills of people with many different perspectives to address a specific problem [55].” Co-design includes having stakeholders participate in steps of the design process and can be used as a method to collect and produce data. By using co-design, there is an opportunity to understand the requirements to create a process in which stakeholders with various power relations can work together to create more diverse, equitable, and inclusive environments particularly for those with the least amount of power, in this case, the students, and even more specifically, minoritized students.

One commitment of co-design is having a diversity of stakeholders [56]. The commitments of co-design to have each stakeholder in multiple parts of the design process includes the commitment to taking each stakeholder as an equal contributor of expertise, with expertise coming from each stakeholders’ experience. In this study, the expertise comes from each stakeholders’ role in the undergraduate engineering learning environment. As used in this iteration of co-design, diversity in this study comes from both the role of the stakeholders (educators, student, researcher, etc.) and along different identities including race/ethnicity and gender. Another important aspect of co-design is making power relations visible. All research decisions, from the co-design activities to the data collection and analysis center on making power relations visible to the research team. Finally, in the process of conducting co-design sessions, knowledge is being produced that can be translated to practice. Choosing co-design as a method to observe and produce aligns with the commitment of social justice-oriented research; to create knowledge that can be used in practice.

One aspect of co-design that is critical to note is the *tensions of competing values*. In *Design Justice*, Sascha Constanza-Chock states that design can be both oppressive and liberative [57]. DiSalvo et al. close their book on participatory design and education by saying, “both fields [learning sciences and participatory design] value inclusivity, ideological stances that gives voice to marginalized communities, and actively engage those most impacted by design decisions [58].” I would add that education can also be oppressive and liberative. Given the value-laden nature of both fields, there are bound to be tensions that come up as certain design decisions made in the research study can define which values are being privileged: “what forms of life are our partnerships and designs reinforcing, powering, validating, and transforming? How do particular places, histories, and moments in time shape what is right or wrong and for whom [59]?” It is critical that researchers ensure they “actively dismantle instead of unintentionally reinforce [57]” oppressive designs. In fact, historically, participatory design in the Scandinavian tradition has had “**a political conviction that controversy rather than consensus should be expected around an emerging object of design [60].**”

One of the most commonly discussed issues in co-design is making sure all stakeholders feel empowered and valued. Part of this issue involves noting and addressing power relations, alongside value tensions. When considering the issue of stakeholders, many papers simply state this is an issue that needs to be addressed [59], [60]. Although this is not a simple task, it is important for research teams to facilitate opportunities for stakeholders to build **trust** among each other, appreciate each **other’s explicit and implicit expertise** and allow each stakeholder to see that they are in fact making real design contributions. The researchers have a multi-faceted role that includes facilitating and participating in the process.

## 2.6 Conclusion

In review, this chapter has defined key terms important to this dissertation work, established the theoretical underpinnings used to understand the concept of education, reviewed the state of underrepresentation in engineering and previous approaches to addressing this issue, discussed power and the Domains of Power framework, and finally, introduced the concept of co-design. The next chapter describes a previous study that sets up the foundation for the research direction of this dissertation.

# Chapter III: Previous Work with Inclusive Educators

The purpose of this chapter is to situate previous work with inclusive educators in how it influenced the trajectory of this dissertation work. In this first section, I will discuss what the motivation was for the work, and where I stood in my understanding of the space of diversity, equity, and inclusion in engineering education when writing this paper. Section 3.2 is an exact copy of the conference proceedings text printed for the 2020 American Society for Engineering Education (ASEE) Annual Conferences. Section 3.3 provides a reflection on how this work impacted the direction of my research and how my understanding of the engineering education community has changed since then.

## 3.1 Background in Time

This study with inclusive educators came from my own need to understand why change had been so slow in increasing the number of underrepresented students in engineering. It was my first independent research project and the first exploration of my topic of interest: barriers to increasing the numbers and success of ethnically and racially underrepresented students in engineering. Following the wisdom of my advisor, I decided to start with trying to understand what faculty, who were already known for incorporating inclusive practices in their classroom, were doing. Starting with this approach allowed for a more asset-based view of the engineering education community: what good things are already happening with respect to diversity and inclusion.

Looking at my interview questions for this research study, I can see that I have always been interested in the lived experiences. What is it like for faculty to try to teach in ways that are against the norm? What motivates them to pursue such [noble] efforts despite the lack of incentives? In my mind, if I understood what motivated these faculty members, I would understand how to help others start on the same journey. As one of the student participants in the final study asked over and over again, “how can we get people to care?” I was reminded of my own experiences. To me, hearing that there was no incentive to have faculty pursue inclusive practices did not make sense, personally knowing the suffering that students endure when faced with exclusive environments. Did they need an incentive to help their students? Section 3.2

provides some insights into what can be difficult about introducing inclusive practices in engineering spaces.

## 3.2 Full Paper from ASEE Annual Conference 2020

The section below is the copy of the text from the conference proceedings in 2020. Grammatical errors have been corrected, but beyond that, nothing has been changed and it solely exists as an artifact of that moment. The preceding and proceeding sections situate this work within the rest of the work of this dissertation. The paper reads as follows:

### **A Look into the Lived Experiences of Incorporating Inclusive Teaching Practices in Engineering Education**

#### **Abstract**

This research paper contributes to the field's understanding on how to support educators in creating a diverse and inclusive engineering education environment. Even with many conversations around diversity and inclusion, recruitment and retention of underrepresented students continues to be a concern. Although much has been learned, it is difficult to put into practice the research backed methods to improve the diversity and inclusion of our teaching. Our work looks at the lived experiences of university level engineering educators who have been incorporating diverse and inclusive practices in their teaching. Through highlighting lived experiences, this work seeks to provide insights into the realities and difficulties of incorporating inclusive practices into one's teaching. We used an open-ended interview protocol and conducted a thematic analysis on the transcribed data. We report the range of practices participants discussed, in order to give context to some of the lived experiences. We share realities around three themes: Community Support, Learning from Experiences, and The Work is Hard. Despite the amount of research on diversity and inclusion in the context of engineering education, we recognize incorporating these practices in teaching brings its own set of challenges. Therefore, we must not only understand what diversity and inclusion means, but also the context educators are working in and how they are experiencing this work of incorporating diverse and inclusive practices.

#### **Introduction**

Diversity and inclusion (D&I) continue to be an important topic in engineering education as we seek ways to retain women and underrepresented students in STEM fields at the college level and beyond. STEM lacks the gender and racial diversity that mirrors the American population and there is an increasing need to fill engineering positions in the industry [13]. There have been many efforts to encourage K-12 students to pursue careers in STEM, creating a national movement that includes summer camps, classes, and after school programs [61]. Higher education is starting to look at the institutional level change needed to support D&I efforts in order to attend to the diversity of their student population [62]. While there is a focus in engineering education

research on best practices and a focus on change, there is limited scholarship focused on understanding the “on-the-ground” work of engineering educators working to address D&I in their everyday teaching.

In this research paper, we present the journeys of 12 college level educators who have been identified by peers in the engineering education community as individuals practicing inclusive teaching. These stories are intended to complement a) research that identifies issues of Diversity and Inclusion in engineering and b) research that documents efforts to address these issues. Although there are many studies that seek to understand the issues and explore potential solutions to different D&I concerns, these open-ended interviews highlight stories from the three sub-themes. These sub-themes show that doing work to support D&I requires community support, requires learning from experiences, either one’s own or from one’s students, and that the work can be hard. These stories are situated in three different sites of application for these practices— inside the classroom, outside the classroom, and in one’s Integrity of Practice [19]. After highlighting lived experiences, the research team points to co-design, with students and educators, as a promising methodology for innovation, design, and development of inclusive practices.

### **Related Work**

In this section, we discuss two lines of research related to this study. One line of work has looked at D&I issues broadly, to understand the *cultural aspects* of engineering that marginalize and create issues with retention of women and underrepresented minorities and *how to incorporate D&I initiatives* into engineering education. Similarly, there has been a constant urge to improve the *research to practice* cycle on research related to good teaching practices. Looking at the work of going from research to practice gives us insights as to how to do the same translational work regarding diversity and inclusion practices specifically. Although some may find these findings not novel given the extensive number of informal conversations among educators, there exists little scholarship looking to understand the challenges or lived experiences of engineering educators working to incorporate these different activities and practices like the work by Colcer et al. [63]. We seek to understand what makes it difficult for educators to incorporate inclusive practices.

### **Research on D&I in Engineering**

Diversity and Inclusion in engineering education has received a lot of attention in recent years because of the historical underrepresentation of minoritized demographics in engineering. The literature ranges from looking at macro-scale phenomena, such as the culture of engineering, to micro-scale phenomena, such as students’ engineering identities. Much research explores the cultural and historical contexts of engineering education that have led to underrepresentation [13], [63]. Studies have also looked at the different dimensions of diversity in STEM beyond the gender and minority spectrum [64]. Other studies have looked at how specific underrepresented groups understand engineering through self-efficacy and funds of knowledge [8], [65], and how they experience engineering by looking at specific experiences in engineering research settings, design teams, and other personal campus experiences [7], [36]–[38], [66]. Researchers have also looked at inclusive values of peer educators, engineering identities, and first years’ behaviors [67]–[69]. There has also been work looking specifically at retention practices for underrepresented groups, such as inclusive environments in first-year classes and reviewing the successes

and challenges in this type of work [70]–[72]. Higher education studies have also looked specifically at how to improve teaching in STEM, with different teaching styles such as Project Based Learning. Higher education studies in general, is looking to synthesize all the work that has been done to understand inclusion at the institutional level [62]. STEM undergraduate education is culturally different from non-STEM disciplines in that there are certain norms and practices that are specific to engineering education environments [68], [73], [74]. Even with all of this research around diversity and inclusion, it remains difficult to know what best practices to implement, specific to one’s own context.

### **Research to Practice in Engineering Education**

Another line of work that has been critical to understanding best practices in Engineering Education has been the work looking at both the implementation and evaluation of specific class activities. The work on research to practice cycle tries to understand the ways faculty incorporate good teaching practices from the literature into their classrooms and what constraints faculty have that prevent them from incorporating new practices. Two studies have looked at the role of faculty motivation in the implementation of new practices. These studies specifically use the Expectancy-Value Theory of motivation to understand faculty motivation given that research has shown it is difficult to incorporate well-researched practices into teaching, even with an abundance of research on best practices that contribute to student achievement [18], [75], [76]. But as the need for more diversity persists, we will have to find a way to incorporate good research-based D&I practices into the classroom.

This study in particular looks to understand: What are the lived experiences of educators as they seek to incorporate D&I practices in their own classrooms? And from the insights about their lived experiences, what future work can be done to support more engineering educators in adopting new D&I practices into their classrooms?

### **Methods**

For this study, the data was collected using a semi-structured interview protocol with 12 college educators across 12 different institutions in the United States. Having 12 participants meant we reached data saturation [77]. The inclusion criteria for the recruitment of participants included 1) Teaching experience in an engineering department, 2) Currently working at a higher education institution, and 3) Recommended for having inclusive practices by a colleague. The first three participants were recommended by an engineering education expert on the research team, and the rest of the participants were recruited through snowball sampling [78]. Each interview lasted between 30 and 50 minutes. The semi-structured interview protocol asked participants about their journeys as educators and their inclusive practices. Each interview was audio recorded with permission from the participants. The data was then transcribed verbatim. Using an inductive thematic analysis [79], with reflexive coding, we surfaced semantic themes from the data. The interview included questions such as:

1. What comes to mind when thinking about ways that you support diversity and inclusion in your teaching?
2. Tell me about one practice you wanted to incorporate that did not go as planned.
3. How has diversity and inclusion played a role in your teaching over time?

The entire interview protocol can be found in.

Following the interviews, we collected demographic information from 11 of the 12 participants. Half of the participants had taught at the undergraduate level for over 21 years, 33.3% had taught for 1-5 years, and 16.6% had taught for 16-20 years. We had no participants who had taught for 6-15 years. Participants had taught in classes that ranged in size from less than 20 to over 200. At least two participants had taught in each of the five U.S. regions— Northeast, Southeast, Midwest, West, and Southwest. Six participants identified as Caucasian and four participants identified as either Black/African, Hispanic/Latinx, or Asian, and one participant identified as more than one ethnicity. Five participants identified as female and six as male. One participant identified as transgender. Half of the participants also have or have had roles outside of teaching such as Research Scientists, Department Chairs, or similar roles at the administrator level.

### **Positionality Statement**

Here I address my positionality as a researcher, critical to reflexively acknowledging my stance as a researcher in conducting the interviews and analyzing the data [80]. As a first generation, Latina who has a bachelors and masters in mechanical engineering, I am personally interested in finding ways to create an inclusive environment in engineering education for a diversity of students. These identities impact the analysis of my research because in my own education, there were times when I connected to the material and enjoyed my learning experience, and other times where I was neither connecting to the content nor to my peers in the class. I am committed to understanding how we can continue to teach socially conscious engineers, especially as technology gets embedded into more aspects of everyday life.

### **Findings**

We first present a list of inclusive practices mentioned by at least two educators during the interviews. These practices ranged from being outside the classroom to inside the classroom, and also general teaching mindsets educators tried to have, or their integrity of practice. In the second section, we present thematic findings of what the lived experiences looked like when educators incorporated these practices into their teaching. We argue these examples provide insights into the research to practice cycle for inclusive teaching practices.

### **Inclusive Practices**

Educators shared their experiences in the classroom by answering the question “what are some ways you support diversity and inclusion in the classroom?” They listed out their practices in the classroom, outside the classroom, and mindsets they approached teaching with. **Outside of the classroom**, educators mentioned areas that allowed opportunities to be inclusive. **Inside the classroom**, there were opportunities to create an inclusive environment by how the educators interacted with students and how they conducted themselves when students were present, and teaching was in action. Finally, educators also talked about what things they thought about or considered (**mindsets**), **similar to Integrity of practice**, in that educators had a reason for their practices [19] when doing any preparation or working with students. Practices are found in Table 1 with the following codes:

- **CS- Inside Classroom- with Students**
- **CE- Inside Classroom- by Educators**
- **OC- Outside the Classroom**

- **IP- Integrity of Practice**

Many of the practices listed mirror good teaching practices, which reflects what some participants said during the interviews— the list of inclusive practices and good teaching practices are not mutually exclusive and often overlap. Practices ranged from:

- **high visibility** (OC9: Display artifacts such as safe space stickers posted on the wall, CE2: Share social identities i.e., pronouns) to **low visibility** (CE3: Minimize power dynamics to empower the space, IP1: Acknowledge there is more than one way to teach and learn something)
- **high-stakes** (CE8: Solicit feedback i.e., mid-semester reviews, OC6: Talk with other faculty as a site of inclusion) to **low-stakes** (OC1: Have one-on-one conversations with students, CS7: Allow time for reflection), and from
- **quick implementation** (CS3: Re-arrange tables for group work, CS4: Give multiple students an opportunity to talk) to **time intensive** (CS6: Have holistic evaluation methods, CE7: Make sure the room is set to be accessible for all).

**TABLE I:** A list of practices mentioned by educators, ordered by where these practices took places such as in the classroom, outside the classroom, and in their Integrity of Practice

ID	Practices In the Classroom (with students)	ID	Practices In the Classroom (by educators)
CS1 CS2 CS3 CS4 CS5 CS6 CS7 CS8 CS9 CS10	Create an interactive environment. Create ways to have students connect to the material. Re-arrange tables for group work. Give multiple students an opportunity to talk. Be intentional about how one calls on students to participate. Have holistic evaluation methods. Allow time for reflection. Create student ownership. Create a classroom community. Create opportunities to learn from other students.	CE1 CE2 CE3 CE4 CE5 CE6 CE7 CE8 CE9 CE10	De-center self. Share social identities (i.e pronouns). Minimize power dynamics to empower the space. See students as people and invite them in as they are. Ensure content is accessible (i.e., provide transcripts). Provide different forms of content (i.e., audio, visual). Ensure the room is set to be accessible for all. Solicit feedback (i.e., mid-semester reviews, exit cards). Create content connection to society. Know where the students are at (in learning, in life).
	<b>Practices Outside the Classroom</b>		<b>Integrity of Practice [19]</b>
OC1 OC2 OC3 OC4 OC5 OC6 OC7 OC8 OC9 OC10	Have one-on-one conversations with students. Do outreach on campus or with K-12 students. Do Land acknowledgements. Do course preparation or revamping curriculum. Ensure building accessibility. Talk with other faculty as a site of inclusion. In grading, include meaningful comments. Think of inclusivity in the Admissions process. Display artifacts such as safe space stickers posted on the walls. Advocate for other faculty to adopt inclusive practices.	IP1 IP2 IP3 IP4 IP5 IP6 IP7 IP8 IP9 IP10	Acknowledge there is more than one way to teach and learn. Be aware that it is important to be intentional. Acknowledge the educator’s role in normalizing inclusivity. Be flexible. Think about “How can I support you [the student]?”. Respect your students. Trust your students. Realize things do not need to be taught by the instructor (i.e., can be by students or video). Acknowledge diversity and inclusion is good for everyone not just marginalized groups. Understand that it is everyone’s job to learn about diversity and inclusion.

These spectrums give context to the lived experiences of educators trying to be more inclusive in their practices. Some lived experiences come from one-on-one interactions with students, and others happen to educators when they are teaching a full lecture hall.

### **Lived Experiences**

Besides educators listing out their practices, we surfaced three main themes that came along with implementing these practices: One needs community support, one learns from experiences, and doing the work (of D&I) is hard. The following sections have quotes from participants. Participants are identified as P1 through P12.

#### Community Support

In talking to participants, everyone mentioned their colleagues, either within their department, at their institutions, or in the international engineering academic community, as having had an influence on their work with D&I. We are using the word community as a way of grouping what we heard the participants say.

Participants talked about how their colleagues were a source of encouragement and critique to doing D&I work. Many talked about how they felt supported by their departments and colleagues in their department to implement new practices. A few participants felt their department had a culture that valued D&I either through a departmental effort to revamp the curriculum (P8) or being explicit about the [department's] value of D&I (P2, P6). Department meetings were also sources of tension, where participants were questioned by colleagues about their research in D&I, even if that [D&I work] was what they were hired for (P10) or feeling as though colleagues would not be receptive to conversations about D&I topics in faculty meetings, given previous interactions (P12). P9 mentioned that in the early days of their department, their department was heavily split in terms of those who believed in the importance of diversity [and those that did not].

Another comment around this theme is:

*“At my previous institutions, it wasn’t always so positive. Colleagues asked, “Oh well why are you doing that? Or people trying to make claims that inclusionary practices are just giving things away to folks. That I was dumbing things down or being told that as a female engineer that will, yeah, I could write a grant application in crayon and get it funded.” (P6)*

Other participants mentioned,

*“Other people, more traditional faculty, think [asked], “Is this really needed? Do we really need to go the extra mile here?” (P11)*

Another participant shared his perception of other faculty,

*“[our department is not] side by side with the engineering professors in mechanical engineering, electrical engineering, so on, who, if I were doing all these things in proximity to them would show much disregard and resistance to my views and my practices.” (P3)*

Alternatively, having leaders promoting D&I initiatives also helped faculty make it a priority and

*“Become more active in D&I... the Dean is trying to make this happen (P9)”.*

Not only was the departmental community important to the educators' journey with D&I work, but the campus resources as a whole, also contributed to the overall experience.

Another theme within community participants mentioned was the campus communities they were a part of that got them more involved with D&I. One participant was invited to a committee doing D&I on campus and worked with another engineering department on a grant related to D&I (P8). Another got involved with a group of faculty looking at models for [curricular] change (P9) and similarly, "others joined programs related to preparing future faculty and teaching focused faculty (P11)." One stated the importance of “finding my own people around some of these [D&I] values (P2).”

Finally, beyond an institution, the larger network of engineering faculty nation or worldwide also impacted individual's D&I practices. Two faculty mentioned how there was less support before, meaning at least a decade ago, stating,

*“D&I was not even in the vocabulary (P3)”.*

*“What has changed are the leaders in D&I practices...I follow their insights. I don't consider myself a leader in the [D&I in engineering education] field. I consider myself a follower (P7).”*

More than one participant mentioned going to workshops and conferences such as the American Society for Engineering Education (ASEE) and Frontiers in Education (FIE), where they could talk to and learn from colleagues across campuses about their current practices. The communities' educators are a part of, at the departmental, campus, or international level, can be both an encouragement or hindrance to one's work with D&I, independent of the feelings being perceived or real.

### Learning from Experiences

Another salient theme came about when educators discussed why specific D&I practices were important. Educators mentioned learning about the importance of D&I practices from personal experiences, from specific interactions with students, or general interactions with students over the years.

Two overall responses emerged when participants were asked to think about their D&I practices over time. The first was thinking about the times before they even began to think **intentionally** about D&I. More than one participant expressed “*always being open minded (P8)*”, or that “*[D&I] was something they valued when they first started [teaching] (P6)*” and another acknowledged being “...clueless [about D&I having grown up] in an all-white rural community (P9).” P3 mentioned,

*“In the first 10 years I was oblivious to diversity and inclusion in my classroom. I believe I acted inclusively, but no attention was paid, no value was put on it, and there were no attempts to build on it.”*

The second theme educators talked about was their personal experiences in the education system that influenced their adoption of D&I practices. Participant P5 said,

*“[My] value of inclusiveness developed from typically being the only black female in a lot of my classes, teams, and various educational experiences...so I know what it is to be excluded or not be thought of...in what happens in the classroom or program.”*

Similarly, participant P10 mentioned *“I live it every day, microaggressions... it’s a reminder that other students are also the target of it.”* And yet another mentioned,

*“I’ve had experiences in the past where I work up the courage to say something...the instructor’s response [made] me feel really terrible (P1).”*

The same participant said,

*“to me personally it is important because I understand from my own education and experience that not everyone learns the same way (P1).”*

Each of these personal experiences highlighted the importance of D&I practices for these educators.

We also heard about how interactions with students influenced D&I practices. Educators shared stories of specific incidences that led them to adopt a new practice. One story mentioned how their program's rule of  $1/x$  came about. Students are expected to contribute and participate “ $1/x$ ” percentage of the time, with  $x$  being the number of students in the group. This was intended to create accountability for those who tend to take a lead and motivation for those who are quieter in discussions. This practice came about one time, when a student was dominating a conversation and was unaware of his dominance. He was a non-traditional student, obtaining this degree after a previous career, so it was important to give this particular student a chance to speak, but also allow other students the opportunities to contribute.

Another example was an experience with a Rudolph the Reindeer electronics project abroad. It was intended to be fun, until the faculty member realized, while talking to a student, that the student, coming from a different religious background, had no idea who Rudolph was. This led the professor to think about other assumptions they had been making when creating content, about what was knowledge that everyone had or could connect to. From then on, when planning new activities, this educator makes sure to think through assumptions she might be making.

Faculty also mentioned learning and gaining an understanding of D&I from general classroom interactions with their students. When one educator started being vocal about their identity in the classroom, they noted that *“female students began to explicitly say it helped them [the female students] for me to speak openly (P4).”*

Another faculty mentioned the impact of teaching at an institution that was culturally different than their alma mater.

*“ Students have a lot they are dealing with...I didn’t see that as an undergrad or grad because I went to a very different institution...[it is important to] be willing to learn a lot and a lot about people when you are trying to be inclusive...if the students don’t tell me first hand [about their experience], the default is to assume (P12).”*

One participant who had previously taught high school students talked about acknowledging that “K-12 experiences vary enormously.” Another mentioned how the first institution he taught at, he “worked with underprivileged students from inner city backgrounds...[and] first generation students.” He mentioned having no idea what he was doing, but he learned from the experiences.

Each of these experiences illustrates that D&I practices of educators are impacted by their previous experiences as students, with specific incidents that have led to the creation of a new teaching practice, and by understanding the diversity of students specific to their institutions.

### The Work is Hard

Eleven of the twelve educators talked about how incorporating D&I practices was a personal endeavor for a variety of reasons. This section describes several reasons, supported by quotes, that unpack why D&I work remains challenging for practitioners.

Being an educator is a very public role. In being intentional about D&I practices, more than half of the educators talked about having to be transparent and vulnerable with the difficult nature of the work. One participant mentioned,

*“Everybody... studies and agrees it’s [D&I Work] hard to do... we just have to keep working at it (P11).”*

Other participants talked about this work being difficult to accomplish.

*“You can do x, y, and z, but it still doesn’t mean you’re perfect... you’re never going to be perfectly inclusive (P1).”*

Another participant was talking about the opportunity they had of starting a project-based curriculum and said,

*“it was an exciting opportunity but it was a tremendous burden...empowering people to go into professional life... something I could not lecture on (P3).”*

More than one shared their thoughts on how they felt they were doing with incorporating D&I practices.

*“When I read your email, I thought I could be doing more (P12).”*

Participant 12 also said that their personal D&I *“practices are very minimal.”* Similarly, two other participants said, *“I’m not very good at it [D&I], it’s self-defeating (P9).”* and *“It’s been a learning curve (P6).”*

Doing D&I work requires accepting that it will be difficult to do. P5 added,

*“When introducing these [D&I] topics, there is a lot of explaining and background information that is needed to help engineers and the engineering community think about these [D&I] concepts.”*

More than one person acknowledged the difficulties of incorporating D&I practices due to systemic constraints. One participant mentioned,

*“It’s hard because it really is a systemic problem... Until the community pays attention and makes it a priority...it’s going to be tough to get large-scale change (P11).”*

Another educator mentioned the stigmas around depression and anxiety. If faculty could not talk about their own mental health issues without worrying that colleagues would then consider their future ideas bad, how could they help students overcome those difficult experiences themselves (P6)? And finally, one faculty mentioned having to *“emancipate myself and the students from the rules of the classroom (P4).”* There is a cultural way of doing engineering education. In doing D&I work, some practices may be counter cultural.

Finally, more than one faculty mentioned being targeted for being outspoken about the need for inclusive practices. The following happened many years ago. One participant mentioned feeling psychologically targeted and feeling as if there was intentional “character assassination” due to being outspoken.

*“Some faculty colleagues who were really invested in those [non-inclusive] rules, did not like that, nor did some administrators, because I was starting to openly speak about these discriminatory practices that people were engaged in, including administrators saying, this is not consistent with our policy on nondiscrimination.”*

Similarly, another participant mentioned that, because of their work with D&I,

*“those [faculty] who believed in rigor thought that I was not serious. They would go to deans and complain about me. They literally made up stories about me.”*

We also heard more current stories and experiences. For example, a participant mentioned,

*“They [other faculty] don’t understand it [the need for D&I work] because they don’t believe it [microaggressions] and it is my everyday experience.”*

We also heard about faculty being afraid of doing D&I work because of the risk of not receiving tenure and because of the way students and colleagues would react. This was someone who had been told many times that there was a “right way” to do things to be an engineer.

### **Limitations**

There are limitations to the work due to a few factors. The participants we recruited were either in their early stages of their teaching career or beyond 16 years of teaching. This makes the data rich in that most of our participants have many years of experience, but we are missing stories from educators who are either up for tenure or just beyond their tenure process. Educators at this time in their careers are the ones that still have years ahead of them to try new practices. We also only have a couple of participants who have experience teaching at an R1 institution. Many engineering programs are housed in R1 institutions, therefore it is important for future work to explore the experiences of faculty at R1 institutions. Additionally, interviews as a methodological approach surface educator's perceptions of applying best practices to their work. Future work may explore practices in-situ and/or compliment educator's perceptions with student perceptions. Similarly, the questions used in this protocol lead to specific answers. Having questions explicitly asking participants to define diversity and inclusion could provide data related to faculty definitions of these terms. There is an opportunity to do more research with educators who have been teaching between 5 and 15 years. This also leaves a gap in understanding how educators who have inclusive practices, yet do not see themselves as actively being inclusive, are similar to these 12 educators on their early journey of intentionally being inclusive.

### **Discussion**

Data from this study agrees with examples of good practice from the literature [75] and highlights some of the lived experiences and difficulties of incorporating new practices into one's teaching. Some might ask about the value of these findings given the lack of novelty in the results. The question then becomes, if we have the answers with previous work about why incorporating new practices into engineering can be difficult, then why are issues of inclusion still prevalent? This study goes one step further in that it highlights that developing inclusive practices has its own set of difficulties when being incorporated by educators, such as receiving resistance from either students or colleagues. The lived experiences emphasize that having inclusive practices is a collaborative experience. The work requires support from the communities one is teaching in. Educators learn which practices are relevant to their classroom by interacting with and learning from students. Finally, it is personally hard work, in that it takes courage and can get personal. Although these findings may not seem novel, it is important to listen to the stories of those who are navigating and addressing D&I to: 1) inspire others 2) learn from their mistakes and missteps and learn about 3) supporting educators through institutional change.

Achieving a diverse and inclusive environment requires constant reflection and iteration on one's way of doing things, especially since each student comes with a unique set of experiences, and each campus culture, and even department culture, is different. As researchers and practitioners continue to create solutions to the problem of diversity and inclusion in engineering education, we offer one possible solution to this issue. We suggest co-design as an opportunity for faculty and students to think through aspects of change that can promote diversity and inclusion in engineering education, whether it be in the classroom, outside the classroom, or the educators integrity of practice. Co-design in this context is defined by Marc Steen as a process of collaborative design thinking, or as a process of joint inquiry and imagination [81] There is already work on small scale implementation of students contributing to designing curriculum [82]. This study reports positive results in this innovation, where students are helping educators with this

lofty task. Co-design as a method is promising in that it affords different perspectives and motivations yet encourages ethical considerations and a shared understanding of the design outcome [81]. This method also acknowledges the power dynamics that can arise from different stakeholders working to design together [81]. In future work, we will have educators, students, and researchers working together to design solutions to the difficulty of creating inclusive practices and environments in engineering education. As a discipline, engineering education has used co-design to do curricular innovations on smaller scales [56], and at times it has been conducted with educators and researchers, but not necessarily with the target students [83]. Co-designing with participants with different power relations requires that “in order for them [co-designers] to take on this role [of experts], they must be given appropriate tools for expressing themselves [84]”. With educators being in a position of having limited time to plan and implement new practices in the classroom, co-design provides an opportunity for educators to share the burden with students, who share expertise about what works for them or not in a classroom. As we continue to build on co-design as a method to create new inclusive practices, it is important to remember Ellsworth critique of "empowerment" and "student voice", warning researchers and educators of that the knowledge students and educators bring can be “contradictory, partial, and irreducible [85].” As Michel Foucault would say, discussing truth requires courage. Co-design offers a powerful solution that creates dialogues between people with differing power relations, but as we have seen from the educators highlighted in this project, approaching inclusion with courage helps us move towards our goals for a more inclusive future in engineering education. For future work, we plan to do studies to understand the student perspective on inclusive practices in hopes of designing balanced co-design opportunities for students and educators.

### **Conclusion**

This paper discusses 12 college-level educators’ lived experiences in trying to incorporate diverse and inclusive practices. This work is important because of the recruitment and retention issues of underrepresented students in engineering education, including women and students from minoritized groups. Not only do we document different practices of inclusion these educators mention, but we also discuss the community support educators receive in doing this work, how educators learn from personal experiences and those of their students, and finally, how doing this work of incorporating diverse and inclusive practices can be hard. In the discussion, this paper proposes co-design as a method to aid in the creation of new diverse and inclusive practices. Not only does co-design allow for various stakeholders to be a part of the design process, but it also affords opportunities to discuss how to navigate some of the complexities that can come about from individuals with different roles in the design process i.e., educators who will put into practice what is designed and students, who will be on the receiving end of the design. Co-design as a method for developing inclusive practices reinforces the idea that diverse perspectives are welcomed in engineering education. As the world continues to become dependent on technology, it remains important that we support the success of a diversity of engineering students. In order to have future engineers representing the voices of a diversity of communities, we must find ways to recruit and retain these students and support educators in doing the same in the classroom.

### **3.3 Reflecting and Connecting Across the Years**

As seen in the paper above, the three main findings from this study were as follows: (1) faculty depended on community support to do this work., (2) they had specific examples of exclusion, whether they faced it

personally, witnessed it, or had heard about it from someone close to them, and remembering these experiences informed and motivated their inclusive practices, and (3) most mentioned the work being hard, whether it was because they had to be vulnerable at times, with their students or because they had to admit to themselves and others when they had made a mistake (something guaranteed to happen when being inclusive, given that we are always learning what it means to be inclusive to others). These three takeaways were critical in moving toward co-design, or some sort of participatory research method, where people within the engineering education community, however that was to be defined, could support and learn from each other. I also knew that these sessions had to include multiple stakeholders, whether that was faculty, administrators, graduate students, undergraduate students etc.

What I did not know yet was how power was affecting these faculty. I did not have the language to see how power was playing out for them. I could not see that it was hard because many resisting the change to more inclusive classrooms were not aware that the cultural norms of how engineering has been taught and the environment created were decisions made long before they were faculty, but that they could decide for things to be different. When faculty mentioned how much of a difference it made when their department chair was supportive of their efforts, I did not realize how much weight their role as chair had and how we, as people, really take into consideration different identities when deciding on who to listen to. As I was looking towards the next steps of the research to continue finding answers, I was thinking about what different ways people were could learn from each other's experiences. Whose experiences should we include? How could we create communities to support those looking to create more inclusive practices? The next chapter details the next study in an effort to understand more about the process of incorporating inclusive practices and how doing reflective check-ins served as community support.

# Chapter IV: Previous Work with Inclusive Educators

## 4.1 Background in Time

The purpose of this chapter is to situate previous work with one inclusive educator trying out an explicit, innovative inclusive practice in their classroom and how this study influenced the trajectory of the work of this dissertation. In this first section, I will discuss how this opportunity came about, the motivation for the work, and where I stood in my understanding of the space of diversity, equity, and inclusion in engineering education. Section 3.2 is an exact copy of the conference proceedings text printed for the 2021 American Society for Engineering Education (ASEE) Annual Conferences. Section 3.3 provides a reflection on how this work impacted the direction of my research and how my understanding of the engineering education community has changed.

The opportunity came about when a faculty member in my network wanted to have reflective conversations about a new inclusive practice she was inspired to try in her classroom. This opportunity seemed to be a perfect continuation of the previous work. I had spent time talking to several faculty with a history of being inclusive, and now we had a faculty member who wanted to start being more intentional in creating a culture of inclusion in her classroom. I had met this faculty member once before, but she and my advisor had years of experience working together. This opportunity also came about during the COVID-19 pandemic, allowing zoom reflective conversations be a reasonable way to conduct research.

## 4.2 Full Paper from ASEE Annual Conference 2021

The section below is the copy of the text from the conference proceedings in 2021. Nothing has been changed and solely exists as an artifact of that moment. The proceeding sections situate this work within the rest of the work of this dissertation. The paper reads as follows:

### **Inclusivity Meter: Tracing How it Worked and What Was Learned**

#### **Introduction**

Engineering education as a field continues to explore how to create more diverse, equitable and inclusive environments. In particular, the nation's continued polarization brings the issue to the forefront of society. In this research paper, we present the implementation of an inclusive intervention that "worked." We explore the different ways in which one might conceptualize what works and what does not work when evaluating different practices. We note that engineering education would benefit from a critical perspective when the need to change an approach is identified.

Here we present the narrative of an educator implementing a weekly reflection activity, the Inclusivity Meter (IM), that allows students in a senior capstone course to communicate how included they felt in their teams or in the overall class that week. Through the narrative, we highlight the conversations that happened as the educator reflected on the work in her classroom with the two other authors. The conversation themes highlighted include the motivation for trying this new activity, concerns throughout the quarter about student response rates, and two cases that surfaced issues of inclusion, prompting further discussion.

After recounting this narrative, we dive into a discussion on how the engineering education community might continue to discuss what works, particularly for understanding differences in evaluating what works with technical content versus what works for diversity, equity, and inclusion efforts. This paper adds to the conversation as the community continues to support initiatives to address issues of diversity and inclusion at different levels, from person-to-person interaction in the classroom to systemic level efforts and to evaluate the success of these initiatives.

## **Related Work**

Witnessing experiences of exclusion. A growing body of scholarship helps us bear witness to the experiences of marginalized engineering students. In 2007, Foor et al. shared the story of Inez, a student who is "first generation college attending, economically disadvantaged, [and] multi-minority female [86]." More recent contributions have brought to the fore the experiences of black, male students [39], international students grappling with mental health issues [40], and students with disability [87]. Such accounts provide a foundation for understanding what needs to be addressed in order to move from exclusion to inclusion.

Approaches for promoting inclusion. In addition, a growing body of work offers potential actions or practices that can be pursued in order to work toward inclusion. For example, a recent blog post for the ASEE Commission on Diversity, Equity and Inclusion [88] summarizes some of their own work on the experiences of marginalized students and offers three kinds of actions that those in engineering can pursue to promote inclusion (rather than marginalization). The specific actions are shown in Figure 1.

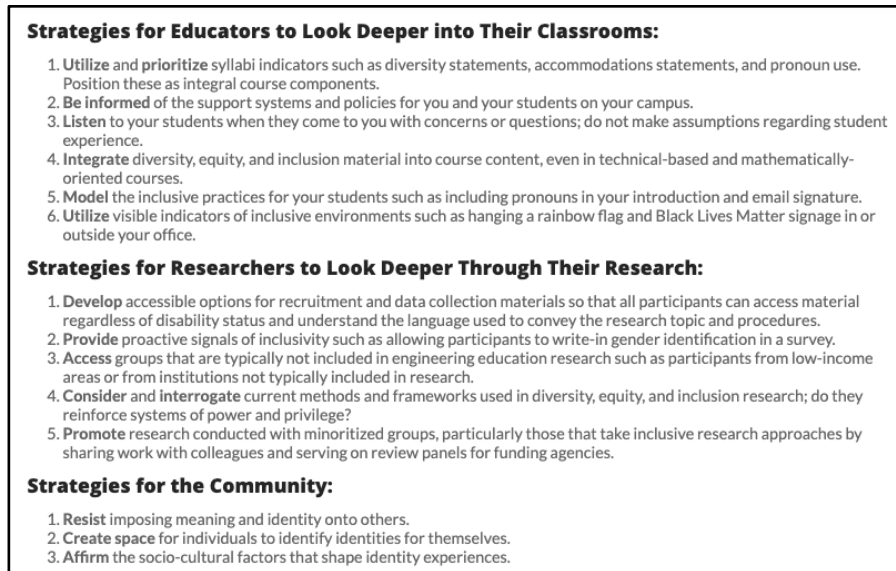


Figure 1. Strategies for addressing inclusion in engineering education [88]

Mejia [89] also provides a set of potential actions or practices that can be pursued. While her list is targeted exclusively at educators, the practices do include those that go beyond activity in the classroom. In comparison to the list provided by Secules and McCall, Mejia’s list has a different origin in that it is the product of interviews with educators and the list is the set of actions that were mentioned by the educators in the interviews. For comprehensiveness, Mejia’s set of practices is included in Figure 2 below.

These two collections are just some of the many possible actions, activities, strategies, and practices that could be leveraged by those in engineering education to advance inclusion. How might we understand what is offered? In Mejia’s case, for example, the practices are those that individual educators spoke about because they have found the practices to be valuable. In Secules and McCall’s case, the practices are being proposed based on their expertise and wisdom. In design terms, these practices represent the beginning of a solution to a “how might we” question in the form of “how might we promote inclusion in engineering education.” Seen as the beginning of a design process, we can think about what is potentially not yet answered.

Designing vs. implementing approaches? If we see these ideas as the beginning of designing for inclusion in a classroom, what types of questions might we ask about such inclusive practices? If we are not simply implementing DEI practices, but designing these practices into our course, what might we question as we build on assumptions that the world is socially constructed, and that the status quo is reproduced in many ways. Work in the area of design-based research offers a particular framework for thinking about these questions. In particular, Sandoval has proposed the conjecture map as a way to think systematically in order to connect the *embodiment* of an intervention through its *mediating processes* toward its *outcomes* [90]. Guided by these ideas from Sandoval, we could ask the following questions about any one of the ideas presented above.

- Outcomes: What could count as success or the intended *outcome*? Is it as straightforward as more inclusion of marginalized groups? What are variations in how we might articulate the outcomes? Are there additional outcomes?
- Mediating Processes: What do we know about the *mediating processes* by which success can come about? Are there intervening steps? Moreover, if an intervention is deployed over a period of time, what trajectory might be involved? How might the intervention change over time? How might the sense of important outcomes change over time?
- Embodiment: Perhaps even more basic is the question, what *embodiment* would a working intervention take? What constellation of artifacts are needed? What discursive events and practices need to be implemented? What specifically needs to be done to enact a particular idea locally?

ID	Practices In the Classroom ( with students)	ID	Practices In the Classroom (by educators)
CS1	Create an interactive environment	CE1	De-center self
CS2	Create ways to have students connect to the material	CE2	Share social identities (i.e pronouns)
CS3	Re-arrange tables for group work	CE3	Minimize power dynamics to empower the space
CS4	Give multiple students an opportunity to talk	CE4	See students as people and invite them in as they are
CS5	Be intentional about how one calls on students to participate	CE5	Ensure content is accessible (i.e. provide transcripts)
CS6	Have holistic evaluation methods	CE6C	Provide different forms of content (i.e audio, visual)
CS7	Allow time for reflection	E7	Ensure the room is set to be accessible for all
CS8	Create student ownership	CE8	Solicit feedback (i.e. mid-semester reviews, exit cards)
CS9	Create a classroom community	CE9	Create content connection to society
CS10	Create opportunities to learn from other students	CE10	Know where the students are at (in learning, in life)
	<b>Practices Outside the Classroom</b>		<b>Integrity of Practice [4]</b>
OC1	Have one-on-one conversations with students	IP1	Acknowledge there is more than one way to teach and learn
OC2	Do outreach on campus or with K-12 students	IP2	Be aware that it is important to be intentional
OC3	Do Land acknowledgements	IP3	Acknowledge the educator's role in normalizing inclusivity
OC4	Do course preparation or revamping curriculum	IP4	Be flexible
OC5	Ensure building accessibility	IP5	Think about "How can I support you [the student]?"
OC6	Talk with other faculty as a site of inclusion	IP6	Respect your students
OC7	In grading, include meaningful comments	IP7	Trust your students
OC8	Think of inclusivity in the Admissions process	IP8	Realize things do not need to be taught by the instructor (i.e can be by students or video)
OC9	Display artifacts such as safe space stickers posted on the walls	IP9	Acknowledge diversity and inclusion is good for everyone not just marginalized groups
OC10	Advocate for other faculty to adopt inclusive practices	IP10	Understand that It is everyone's job to learn about diversity and inclusion

Figure 2. Practices for addressing inclusion in engineering education [89]

In formal DBR (design-based research) studies, the conjectured relationships are identified ahead of time and the research involves collecting data to see if the relationships happen in the hypothesized way. Before such formal DBR work, there needs to be a way to imagine and build the conjecture map. This work connects to understanding the mediating process of implementing an inclusive practice, not necessarily the outcomes.

This focus on asking critical questions is intended to illustrate a gap in the research on practices to support inclusion. We currently have few studies that focus on detailed accounts of the enactment of practices put in place to support inclusion goals. The current study is intended to address this gap in the research. Such research, in general, represents a way to move an approach from possible practice to evidence-based practice.

“From does it work” to “What does it mean to work.” In an educational theory paper, Gert Biesta examines key assumptions about evidence-based practices that might not be applicable to all learning situations. In Engineering Education, Donna Riley has connected Biesta’s work to ABET evaluations and how epistemological differences affect how learning might be assessed [91], [92]. Biesta differentiates using evidence-based practice in education as a technical rather than a moral judgement or assessment of learning. He says professional judgements in education are ultimately value judgments [93]. These professional judgments that happen in practice are directly in tension with the technocratic approach from researchers who present findings as “what works” from a decontextualized perspective. In practice, educators have to ask what works for them, their students, their classroom, etc. This of course is often contradictory to the practice of technical research, which requires a positivist epistemology to arrive as close as possible to a generalizable truth, and sincerely ask “what works.” In summary, Biesta aims to encourage education researchers and practitioners to be aware of which perspective they are viewing research from: a technical one, when solutions are considered as the best way of doing something and/or a cultural one, when solutions are evaluated within a specific context. Bringing these ideas alongside the ideas of design-based research presented above, we can interpret phrases such as the “best way of doing *something*” and evaluating solutions “within a specific context” as pointing to the need to interrogate *outcomes*. In other words, what does it mean for something to work. In the following section, we provide details on the specific context in which the Inclusivity Meter is used.

## **Context**

The narrative of the Inclusivity Meter is specific to one classroom practice but is embedded in a larger department wide effort to become more inclusive. NSF Revolutionizing Engineering Departments (RED) program awarded the Mechanical Engineering department of Seattle University a grant in 2017. The goal of this five-year project is to build a culture that fosters students’ engineering identities. Many changes have been made to the curriculum and courses throughout the curriculum so students could experience real-world engineering with practicing engineers. Engineering design courses for senior design projects provide students not only the opportunity to work with industry engineers on real-world design problems, but also the possibilities to learn the highest level of professionalism. In the past couple of years, notable changes in Engineering Design courses include using industry-like terminology and helping students take ownership of their project planning, as documented in previous work [94]–[96]. These changes aimed to simulate the practical working environment in industry. However, even with these changes, the department continued to see some students and faculty, specifically from underrepresented identities, in senior design teams experiencing discrimination. These recurring incidents called for more actions related to the awareness of diversity, equity, and inclusion issues, which could eventually lead to a more diverse and inclusive culture beyond the classroom, and into industry.

Beyond department wide initiative, there were a few conditions in place that created an appropriate environment for this relatively simple activity, the IM, to be implemented. The educator scaffolded conversation around inclusion in multiple ways. She was also aware of her limitations, as someone who was interested in promoting inclusion in her course but did not have enough previous experience with creating inclusive spaces. From here on, we will refer to the educator as Dr. YH.

### *Scaffolding a DEI Intervention*

In an effort to virtually build a community in Fall of 2020 that addressed issues in diversity, equity and inclusion, the Dr. YH took the following actions in an Engineering Design course:

1. Included a DEI statement in the syllabus. This statement was discussed in the first class session. This action was a part of a new department wide effort to include a DEI statement in the syllabi.
2. Agreed on the practice to all turn on the camera/microphone to say “Hello”/“Goodbye” to each other when we began/ended our meetings. This practice was to address issues related to meeting virtually on Zoom.
3. Each student team developed team norms and team contracts. Teams revisited their team norms constantly as the quarter went on. This was a new and intentional practice added to all engineering senior design programs to address team dynamic issues that occurred in the past.
4. Used Canvas Discussion board for various subjects including design thinking, engineering ethics, and implicit bias. Students constantly replied to other’s posts and shared knowledge among themselves on the board. This was a common, but intentional practice.
5. Created a dedicated Microsoft TEAMS site for all senior design teams to communicate virtually. This was a common practice, but more important during the virtual quarter.
6. Met with each team throughout the quarter to identify any changes in team dynamics. The educator asked “how are you doing” each time.
7. Used the "Inclusivity Meter" to check in with students weekly, which provided an avenue for students to reflect and voice their concerns using an anonymous Microsoft FORMS survey.

Additionally, two practices to scaffold the inclusive environment developed while the quarter was already in session, in response to student feedback.

8. Adopted MURAL ([www.mural.co](http://www.mural.co)) to collect comments and questions during status check-in presentations. After each presentation, there was a two-minute “quiet time” for everyone to post their comments/questions on MURAL, and the presenting team could select a couple of questions to answer on the spot. Students felt they could voice their opinions more freely using MURAL and had received more in-depth feedback from their peers and faculty than without the use of MURAL.
9. Hosted a virtual conference at the end of the fall quarter so students could present their achievements. All sponsor liaisons attended the virtual conference and were deeply engaged in discussions with student teams.

Again, for this paper, the focus is intervention number seven, the Inclusivity Meter, a weekly reflection activity with two questions: “How included did you feel?” and “Are there any additional comments you would like to add?” The reflection activity was not tied to grades in the course. Even though the Inclusivity Meter is the focus of this paper, these other practices come up throughout the narrative, pointing to the interconnected nature of scaffolding an inclusive experience.

### **Approach**

This study uses narrative analysis to discover the patterns of conversation between the instructor and the other two authors. The researchers met bi-weekly to debrief on the implementation of the Inclusivity Meter. The instructor was asked to generally elaborate on the question “How is it going [with the inclusivity meter]?”. Follow up questions were asked in order to have the educator clarify or expand on specific examples. Five of the six sessions were video and audio recorded. The research team took notes on the conversation in all six sessions. These multiple sources of data contributed to the team’s effort to establish credibility of the data. Because this study focuses on the experience of the educator, the responses to the reflection activity have not been analyzed. Only the instructor had access to those responses. To analyze the 6 sessions, the research team looked for repeated topics of conversation in order to produce the narrative. The topic of “what works” surfaced from the narrative themes found in the interview notes and led to transferable results, which other educators can learn from and consider in their own situated context.

### **Positionality**

In the spirit of Secules et. Al [97], we document how the positionality of the researchers impact the work using the following categories: research topic, epistemology, ontology, methodology, relation to participants, and communication. The first and third authors are advisee and advisor respectively. Together, they explore topics of reflection and diversity, equity and inclusion and are primarily qualitative researchers with a background in engineering. They are in a Human Centered Design & Engineering department, where different ways of knowing are valued, and specifically, lived experiences are seen as rich sources of data. This positionality influenced our approach on centering the educator and her experience to understand more about the learning curve with implementing inclusive practices in engineering classrooms. With no formal training in DEI related work, the educator gained more knowledge about inclusion by engaging in deep discussions with the researchers. The educator herself felt this accumulation of knowledge helped to further her commitments to promoting inclusion.

### **Findings**

Looking across the six sessions, a few topics became prevalent in the conversation. Here we present what was discussed thematically: Discussions Around the Educator’s Motivation, Discussing the Inclusivity Meter, and Discussion of concurrent (in vivo) DEI Issues. The first theme was related to issues of *motivation* that surfaced for the educator as she sought to make sense of how her new practice was contributing to, or not, to the inclusiveness of her classroom environment. The second were *conversations* that explicitly mentioned the Inclusivity Meter activity. And the last were detailed descriptions of situations related to inclusivity that arose *tangential* to the conversations around the Inclusivity Meter. In the discussion we connect these conversations to the question around figuring out if the practice worked.

### *Discussions Around the Educator's Motivation*

The educator's motivation and questions about her motivation were documented throughout the six sessions. The first session detailed how the idea of the Inclusivity Meter had come about and why she decided to try it out. She had been in a department meeting discussing their RED Grant, when one of the authors, an advisor on the project, commented on how some students said they felt excluded from their team meetings and their voice was not heard after a discussion around students' senior design experiences. The advising author suggested trying a short survey every week that just asked if each student felt included in their meetings. Dr. YH liked the idea and thought it was a tangible and easy enough way to incorporate an inclusive practice into her classroom. She had previously seen the effects of exclusionary actions in her classrooms, both among students and directed towards her and was eager to do something to address the issue in the upcoming quarter. Dr. YH had personally heard about student experiences in senior design of feeling as if they were not being treated fairly, not feeling included, or not having their voice heard. Some students even felt discriminated against. She wanted to go beyond having statements or rules in the student handbook because having these rules had not done much in the past. "How do we make it stick? How can we make engineers aware of building a more inclusive environment for themselves and others, and consider that we are all a part of this? [How can we ensure the students] carry [inclusivity] with them to their workplace when they graduate?" she pondered. She recalled that one year, these rules were not enough because some students had still felt discriminated against, therefore she wanted to do more. And despite the strong motivation to do something about it, in the same session she discussed her own reservations. "I am concerned about not being qualified to host this type of activity. What if I see something and need to respond right away?" She continued, "I still feel like there is so much to learn and don't want to mess it up because it is so important." I "have the anxiety but still do it [practice inclusion], anxiety from poking into people's minds." Beyond conversations around her own motivation to implement the IM, conversations around the effects of the IM were also common.

### *Discussing the Inclusivity Meter*

There were two main ways the IM appeared in discussion. One was when changes were made to the activity. The second was around the students' response rate. There were several changes made to the IM throughout the quarter, each with a specific reason behind it. Each discussion of change was either preceded by or followed by questions by the educator around what could be some reasons students were not all responding. This concern is consistent with Dr. YH's commitment to making sure this DEI practice was helpful in "making it stick." The changes included:

1. Responses to the IM were changed from being anonymous to the class, but not anonymous to the educator to being fully anonymous. During week 5, there was time set aside specifically for completing the IM questionnaire during the status check-in, where individual teams met with the instructor instead of spending time outside of class working on it. This change was continued during the weeks there was a status check-in scheduled for teams.
2. Finally, the last questionnaire focused on how included students felt throughout the quarter, not just for that week.

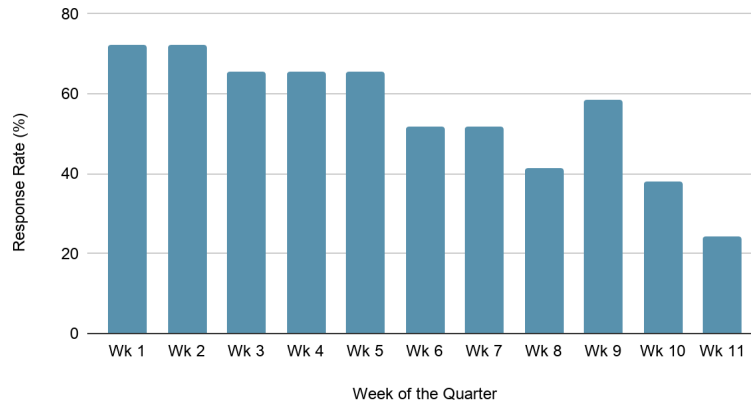


Figure 1: Response Rate to the Inclusivity Meter Over One Quarter. The response rates reflect a class size of 29 students.

From the educator’s perspective, a few main questions arose related to the response rate to the Inclusivity Meter. The first was related to how students perceived the activity. As shown in Figure 1, the response rate peaked at 75% the first week, and slowly declined to about a quarter of the class in the last week. Dr. YH thought she had stressed the importance of students filling out the IM, but she questioned whether or not students agreed with the importance of it. This led to questions around students who never engaged. It was difficult to know whether it was the same students not engaging or if those who did participate every week alternated, given that the IM was fully anonymous for most of the quarter. If it was the same students not participating, she wondered how to pull them in. She also wondered why those that did participate were motivated to do so. Did some students feel this was not important for this setting?

Related to these questions on response rate were conversations on the comments on the IM itself, which for the most part, were positive. The educator tried to make sense of what students were thinking by looking at the written response. There were comments around the team working well and about progress on technical parts of the project. Although the educator had heard about people dominating the conversation in some teams, these concerns were not reflected in the IM reflections. There were also a couple of comments for the IM and against it. One student suggested that the IM be used in other classes. But another student said that they understood the need to focus on team dynamics, but that they did not like to [focus on that] themselves. Instead, they would rather dive into technical content.

Other weeks she wondered how to quantify the work, how to incentivize students, given that it was optional. She mentions there were some weeks when there were a lot of exams going on, and externally, there was a lot going on with the pandemic and the 2020 presidential election. In session five, she realizes that the quarter is coming to an end, but that it does not signify the end of her work of trying to create more inclusive spaces in engineering classrooms.

#### *Discussion of concurrent (in vivo) DEI Issues*

The conversation around the IM with Dr. YH and the two other authors also led to other conversations about other diversity, equity, and inclusion issues that happened tangentially to the IM. The first case arose in Session 2. Dr. YH shared she had received an email from a capstone student. The workshop topic that week had been “Understanding Microaggressions” as applicable

to their project teams. The email was two-fold. The student was suggesting that faculty and students in other classes should also have this workshop. The second part expressed the students' concern after a different faculty member had made a comment about this particular workshop, saying he had attended last year so he did not have to be there this time— giving the student the impression that the workshop was not that important. The student mentioned she was glad she went, despite the comment from her professor.

After receiving this email, Dr. YH felt conflicted “I don’t know what to do. Any suggestions are appreciated,” she shared with the research team, remembering a tense discussion she previously had with this particular faculty member related to diversity and inclusion. In session 3, the conversation continued. She had an update after having talked with the other faculty member. She felt the conversation went better than expected and both of them had come to the conclusion that one should constantly reflect and should be in conversations with other students and faculty around issues of inclusion. Nevertheless, finding the right way to approach her colleague and address her concern had been stressful. From this experience, she learned that it is important to continue the dialogue, even when one does not feel comfortable doing so. She felt that the department’s discussion on the DEI statement had improved this professor’s willingness to engage in such conversation. More importantly, as shown in this case, she felt the IM had made students more willing to share their thoughts on diversity and inclusion with her.

Another issue that came to light tangentially to the inclusivity meter was about a student who had not attended team meetings for about 3 weeks and had not been responding. His teammates expressed concerns about his well-being. She discussed how to handle the situation with other faculty. Some thought they should take the “realistic” approach [and tell him he had to retake the class]. Putting herself in the shoes of an advisor, she thought she would want to find a way to help him. Especially since this was a three-quarter sequence course and having to redo this first one meant he would have to stay an extra year. Dr. YH considered how this should be addressed, given that every student has their own complex identity and set of experiences. The student, who was a nontraditional student, had been really honest about his absence once the educator got in contact with him and requested accommodations for him to make up his work. Dr. YH discussed possibilities with him and his teammates and helped the team move forward with their work. Situations like this had not been flagged in the IM, but deserved extra attention from the educator as a student-specific case of inclusion.

Overall, the educator expressed feeling fatigued about the general workload throughout the quarter. But she also felt a tighter bond with students even in the remote learning environment. She felt the IM had made students more willing to share their thoughts and feelings with her as shown in the two cases mentioned above. Now that we have presented the narrative of implementing the IM, we dive into understanding why naming what works is important.

## **Discussion**

As the resulting narrative shows, our educator, Dr. YH decided to try a “small but a little risky” inclusive practice. The practice was incremental in that it did not take too much time to develop or implement and was relevant to the course content. Previous work shows that creating inclusive spaces is difficult because it requires an “authentic sense of value and belonging [64].”

Dominant engineering culture often reproduces the idea that an engineering classroom is an objective space. The reality is that students and educators bring their own opinions, experiences, and cultures into engineering learning spaces, and these identities cause normal tensions to arise. Our narrative shows that this small, incremental practice created varied learning opportunities for the educators, students, and community, that were at times comfortable and at other times full of tension. As we continue to advocate for creating inclusive spaces, we discuss two ideas in response to dealing with the tensions that will arise when creating inclusive spaces: redefining our understanding of “what works” and finding our “integrity of practice.”

### **What works? When? For who? For what purpose?**

The first idea to discuss is changing our thinking around defining “what works.” Dr. YH spent some time in all of the reflection sessions discussing the response rate, worried that the decreasing rate each week was an indication that the Inclusivity Meter was not working. In fact, a student comment in the IM specifically mentioned that since there had not been 100% participation in any week, they wondered whether they should still use the IM in class? In Biesta’s paper, he differentiates between evaluating what works, as in what is effective, versus evaluating what works for what, meaning that defining what works includes questions about who is deciding what works, and what are they deciding it works for? In doing so, we examine different ways to measure whether a new inclusive practice is working or not. Biesta explains how education researchers and policy makers tend to favor a technocratic model to evaluate the effectiveness of educational means and techniques with the growing interest in evidence-based practice. By focusing on the technocratic model, education researchers, policymakers and practitioners forget that “ ‘effective’ crucially depends on judgements about what is educationally desirable [93].” This leads to more questions such as what works for these students, what works in this context, what works in order to achieve these learning outcomes. By looking at the conversation the educator and research team had, we can see that we cannot answer the question, “did it work?” by looking at the student response rate or even by looking at student responses in the Inclusivity Meter, which tended to be positive. Instead, we ask different ‘did it work?’ questions. We ask, did it work to disrupt what conversations happen in engineering classrooms? Did it work as a signal to students that the educator wants to create inclusive environments and is committed to DEI efforts? Did it work as an effort to further the cause of revolutionizing an engineering department? In this paper, we answer these questions from the perspective of the educator.

Yes, the IM worked. Although Dr. YH has been an engineering faculty for more than a decade, this was the first time in her class she asked how her students felt on a weekly basis. As engineering faculty, we often focus on technical content in our classrooms and prefer quantifiable results. The tendency to evaluate success as such showed up when Dr. YH first implemented IM and her attention was mainly on the response rate. It was not until later when she realized how the IM helped her own growth in carrying out more challenging conversations with her colleagues and students. With the IM, she created a channel to engage with students in a way that did not exist before, and she felt the connection to students’ feelings she may not have gotten otherwise. The IM was only a simple exercise, but it helped Dr. YH face her own feelings of insecurity around DEI in engineering and opened her views to the breadth of the DEI work possible to introduce in her classroom.

### **Integrity of Practice: Rationalizing Decisions**

In moving this idea forward, we explore what it means to develop an integrity of practice around inclusive teaching practices for educators. Similar to evaluating what worked, educators themselves need to build confidence in knowing that the inclusive practices they implement produce the learning environments and outcomes they intended. Young and Irving believe that an educator's Integrity of Practice enables the educator “to explain and justify decisions about teaching and learning activities to his or herself as well as to students, colleagues and institutional and other policy makers [19].” As the educator shared more about her experience with the Inclusivity Meter, she was able to articulate the reasons behind tensions she felt and the way she addressed them. This points to the need for self and community reflection as we continue to develop and understand inclusive practices. By incorporating the Inclusivity Meter into her classroom, Dr. YH was able to name the reasoning behind why she would continue using the inclusivity meter in following quarters of senior capstone. She would use it again because she believes it can spark more conversations about inclusivity among her students and colleagues and help her further reflect on her efforts in promoting DEI.

If we continue to evaluate inclusive practices as we evaluate the learning of technical content, such as the laws of thermodynamics, it will be difficult to gather quantitative data, because like leadership skills, skills around inclusion are social skills that need to be adapted to each context. In figuring out how we are defining what works, we are able to articulate our reasoning for having specific practices. Metrics such as the response rates and content of the IM reflection responses still informed the team about how the IM was going. In fact, we know that changes will have to be made to the IM in order to get closer to the learning goals desired, the changing culture, and growing awareness of DEI. But if we had just asked, does it work, these metrics would have led us to believe that it did not work, without a nuanced interpretation of the situation.

### **Limitations**

The limitations we would like to highlight about this study include the fact that we only have the perspective of the educator. Of course, the findings are still relevant as an individual case study. Future research could be enriched by documenting the perspectives of students and even colleagues through interviews. Additionally, because the presence of the data collection impacted the actions of the educator, and in fact led to some of our key findings, we know this practice would have looked different without these reflective conversations. Part of the reason the IM worked was because Dr. YH was reflecting on her thoughts and actions and problem solving with the research team as she encountered tensions. These reflection sessions were intentional, but we acknowledge that the outcomes would have been different if we were only studying the IM meter and not the process from the educator's perspective.

### **Conclusion**

In conclusion, this narrative study gives us an opportunity to see the process of implementing an incremental inclusive practice in an engineering classroom, the Inclusivity Meter. Our work contributes to populating a conjecture map in terms of connecting a design embodiment (the inclusivity meter) to the mediating processes (our detailed description of the impact over time) and finally the outcomes (our discussion of different ways in which the inclusivity is understood to have worked). Through discussions around this activity, we explore how the engineering educa-

tion community can continue to have conversations about what inclusive practices work, especially more nuanced conversation around who they work for, what they work for, and in what context they work in. As Dr. YH discussed her practice with the research team, she was able to explain her reasoning for trying out the practice, the motivations behind it, and the tensions she encountered. The situated conversations allowed for the research team to discuss the many ways the IM worked for this specific context and allowed for the educator to articulate how the IM met, or not, her learning objectives. This work encourages the engineering education community to find new ways to define how an inclusive practice is working for a specific context, as a supplement to a quantitative approach.

### 4.3 Reflecting and Connecting Across the Years

Again, the findings here mainly centered around what it meant to be “successful” in implementing an inclusive practice and how trying this new practice helped the educator develop her integrity of practice, where her reasons for incorporating inclusive practices were solidified as she had positive experiences with the practice and as she was able to work through challenges and fears by having a sustained engagement with a new practice. In re-reading the document, the focus on the fears and anxieties that the educator expressed, without critically examining the structural barriers, was a missed opportunity to challenge these power structures.

First off, this engagement gave me an opportunity to see the three themes from the first study surface again. Doing this work is hard. There were a few moments when the educator had to have difficult conversations. One was having a conversation with a colleague about a dismissive comment they made about attending an unconscious bias training in front of students, who were also required to attend. She has a positive relationship with this colleague, yet a student let her know about his comment and how it almost made her consider not attending the training, although technically required. Here, we see that this colleague was unintentionally undermining diversity and inclusion efforts with a comment he probably saw as insignificant. But small comments like this, from a person in a position of authority, reiterates the culture in engineering that says diversity training efforts are not important, particularly when we often think of ourselves as doing objective work. The educators’ identities also impacted the situation. Her colleague was a white male and more senior than she was. She is a woman of color. And so even these seemingly small differences in power dynamics made a huge difference. With respect to the question of whether or

not the practice worked, I can now see how coming from a culture of quantitative reasoning, and objective, black and white answers, she would want to know whether or not this worked and why she kept focusing on the participation numbers. During the reflective conversations, I knew that this was attributed to the ways of knowing that are valued in engineering spaces. What was not foregrounded in the analysis in the paper was the interconnected nature of power.

From this experience, I was able to see the different forms that “hard” could take for educators looking to try new inclusive practices. I also saw how her having these reflective conversations with the research team helped her work through anxieties she was having. She could practice the conversation she would have with her colleagues, and she could also confirm whether or not what she thought could be a problem she should address really was a problem that needed addressing. We all benefit from receiving validation when considering whether or not we should have a difficult conversation. The research team also shared our own experiences and perspectives and learned from each other. Finally, through these reflective conversations, we were literally learning from her experiences. We provided our own experiences and perspectives. Structurally, the department was already working to incorporate more inclusion efforts all around, so she had the leadership support to explore this interest. One important takeaway for me was the significant difficulty of doing this work alone. And also, there are so few opportunities and incentives for faculty to learn from each other about teaching practices and pedagogy. This is a structural barrier that will continue to be an impediment to the success of inclusion efforts if not addressed. Fortunately, there is work being done to establish communities of practice around diversity and inclusion efforts for engineering faculty.

Several factors arose that continue to impact why faculty are hesitant to try new inclusive practices, when they themselves are new to understanding diversity, equity, and inclusion. The first was how to know whether or not something was an effective practice, particularly in a space where evidence-based practice is the epitome of good teaching. The second was integrity of practice, and having faculty feel confident that there is learning going on from trying new practices, despite the learning not being quantifiable

nor even predictable. In developing an integrity of practice, faculty are encouraged to reflect on their practices to make connections from the new experiences with these practices.

The educator in this paper notes questioning the success of her new practice, yet details conversations she is having about DEI because of her commitment to this new practice. She also sees students sharing more personal experiences with her, given the existence of this new practice that signals to students she cares about these topics.

Having done this work, I was inspired to continue looking at co-design as opportunities for students and faculty to discuss their environment, share experiences, and work together to create change. This educator was motivated at the end of the process, to continue incorporating inclusive practices. She had a supportive community to walk with her through hard times she encountered with her intervention and was able to exchange ideas about how to handle different conversations. Although her practice did not work as intended, it did work to develop her integrity of practice with inclusion.

# Chapter V: Research Methods

This chapter details the research methods used, including the study design and research question for the final study of this dissertation. It also includes the data collection process, demographic information of participants, and the methods used for data analysis. The section starts with an overall description of the context for the studies.

This dissertation study takes place in a 4-year, large public university that is a Predominantly White Institution. The primary researcher is situated in an interdisciplinary program within the College of Engineering. Participants, both faculty and students are recruited from within the College of Engineering. The institution is located in the Pacific Northwest, where conversations of diversity and inclusion are encouraged.

## 5.1 Co-design

In order to understand this work, it is critical the reader understands the philosophical assumptions made by this research including its ontological, epistemological, axiological, and methodological assumptions [98]. Embedded in social justice theories seeking to bring about change in engineering education, my philosophical assumptions are as follows: marginalized individuals bring unique perspectives that can speak against hegemonic views; it is their lived experience we can learn from. Within this research, the participants, research team and I grapple with what we believe to be our own values and how those values interact with the values that are a part of the engineering discipline. Finally, this research is done through participatory methods that include engineering students in the process, from research design to data analysis. The rest of section 5.1 describes how these philosophical assumptions inform the design and implementation of the study.

### 5.1.1 Study Design

The final study for this dissertation was designed to be iterative. As a part of this study, there were two engagements, or series of activities the participants were a part of. The first engagement was intended to inform the design of the second engagement, both with the workshop format delineated in Fig 5.1. A co-

hort of about six engineering students and four faculty were recruited to participate in an extended engagement workshop that included a pre and post co-design session interview (individual), three 90-minute co-design sessions (cohort), and a reflection prompt submission (individual) after each session.



Figure 5.1: Two subsequent studies follow this workshop model. The first iteration informed any changes to the second iteration of the workshop.

### 5.1.2 Research Questions

The following research questions informed each section of the study design:

**RQ:** How do engineering students and faculty understand and make sense of power dynamics in their environment?

**RQ:** How might we leverage the naming of invisible power dynamics to enact change?

### 5.1.3 Semi-structured Interviews

A semi-structured interview protocol was developed for pre and post interviews, intended to last, on average, 30 minutes. Participant interviews were designed to collect the participants' understanding of power before and after the extended engagement. The pre-interview in particular, was designed to capture the student and faculty understanding of power before engaging with the rest of the study. The pre-interview questions were piloted with both engineering students and faculty and iterated on as suggested. The semi-structured interview protocol included the following open-ended questions:

#### Pre-interview Questions

1. Tell me your story on how you decided to study/ teach Engineering?
2. When you hear the word "power dynamics" what interactions between people come to mind? (in general or in the classroom)
  - a. no answer is wrong—we are interested in what you have to say.

3. What is one example of problematic power dynamics in the classroom you have encountered and how did you problem solve?

Post-interview Question:

1. What are 3 takeaways from this workshop?
2. What was the most surprising thing you observed about power dynamics?
3. After this experience, what do you see as the role of [the conversation around] power dynamics in engineering spaces?

There were follow-up questions based on participant responses in order to have participants expand on their perspective regarding each question and the examples they chose to illustrate their thinking.

### 5.1.4 Co-design Sessions

In this section, I discuss the two engagements that happened for this portion of the dissertation work. The first set happened in Fall 2022 in person, and the second set happened in Spring 2023 on Zoom. Both had a similar overall format, but slight changes were made to improve the second iteration.

#### 5.1.4.1 Fall 2022 Workshops

Appendix A includes the detailed agenda and materials used for the workshops. Overall, each session started with participants coming in, grabbing their lunch box, getting a name tag, and settling in. In the first session, the group did introductions among ourselves, sharing names, pronouns, roles (faculty, student, researcher), and answered an ice breaker question. The ice breaker question was “if you could make any animal cat-sized, which animal would you choose and why?”. This question was chosen to make the tone of the workshop less formal. I then introduced the research project and some terms relevant to the conversations we would have, as pictured in Figure 5.2. From there, we moved into the first activity, which separated students and faculty for a chance for each group to brainstorm experiences of exclusion, either experienced or witnessed, in a way that helped participants develop rapport among their peers. Developing rapport first among peers was particularly important as I remained cognizant of the realities of power dynamics between the two groups. Sharing experiences of exclusion requires a level of vulnerability that is not always possible to do when there are others in positions of power present. Additionally, stating the question as “experiences of exclusion, either experienced or witnessed,” gave participants the agency to decide on how much personal information to divulge. The second activity had each

group share back a summary of their conversations and then the conversation was opened for discussion among all the participants. As the facilitator of the workshop, I told the group they were free to discuss and ask each other questions, in order to develop a better understanding of each other and their perspective on inclusion. This discussion was left as open-ended and unstructured to give the research team an opportunity to observe participant dynamics. At the end of the first workshop, participants were given a link to the Google Form that had the reflection prompt they were to answer before the next session.

## Concepts

**Co-design:** The problem of exclusion in engineering education is a problem that needs to be solved together— with students and faculty.

**Exclusion:** Sharing personal experiences and observations of exclusion can help us identify and address these problems.

Google/Oxford dictionary: **exclude**- deny (someone) access to or bar (someone) from a place, group, or privilege.

**Power:** Often times has a negative connotation, but one can use their power to influence situations for the positive. Power dynamics are constantly occurring.

Google/Oxford dictionary: **power**- the capacity or ability to direct or influence the behavior of others or the course of events.

Figure 5.2: Relevant concepts defined for participants in Session 1.

Session two included grabbing lunch, a warm-up activity around personal experiences of exclusion and inclusion in engineering, a conversation on how the group could address these experiences, an activity with the identity wheel (Figure 5.3), and finally, the link to the reflection prompt due before the next session. The warm-up activity allowed participants to come back to the mental space of inclusive and exclusive practices. The conversation following this activity started to move participants towards problem solving, in a way that grounded them to their own experiences of both inclusion and exclusion. Following these solution-oriented conversations, participants went back to the identity wheel from their first reflection, and shared one identity that was salient to them in engineering spaces specifically, including what about that identity made it salient in engineering spaces. We then closed the session.

Session three was planned to include grabbing lunch, warming up with a conversation around the identity wheel as it related to power, and finally the co-designing of inclusive practices. In practice, session 3 kept the same outline but encountered a few issues. The food was late, pushing back the timeline as we waited. We proceeded to start the session 15 minutes late, and then took another break when the food got there to eat. We also had one participant on Zoom, who was traveling but still wanted to participate in the last session. We were also in a different classroom due to scheduling. The effects of this were that the participants had limited time to discuss and co-design solutions, which was the main focus of the workshop. Participants then scheduled their post-workshop interview.

#### 5.1.4.2 Spring 2023 Workshops

Many of the activities in this second workshop were replicated from the first workshop. Some differences included their virtual nature, and due to this, instead of participants sharing a meal at the start of the workshop, they were sent GrubHub gift cards so they could get a meal on their own, especially since the workshops were held around lunch time. This affected the rapport building as participants did not have the opportunity to have informal conversations as they ate their lunch. Other important differences included participation rates. Although we had five enrolled participants, each session only consisted of four participants. The missing participant changed each session, but this did affect the development of rapport among the participants.

Some smaller changes to the workshop included the following:

##### Co-design Session 1:

- Because the sessions were on zoom, when students and faculty brainstormed exclusive experiences with their peers, each group went into a different zoom room. In the first workshop, participants separated into groups but remained in the same classroom.
- Instead of using physical post-it notes, participants used a virtual workspace (Google Slides) and therefore were able to see each other's ideas easily.

##### Co-design Session 2

- One important difference here was that, when participants had the discussion around possible ways to address exclusion, I wrote up their ideas on the virtual post-it notes. In the first iteration, I encouraged participants to make note of their ideas, but it was a big

cognitive task to ask of them— to participate in the discussion while also keeping notes. Therefore, we have notes of the ideas discussed in the second iteration, but only video data of the first.

### Co-design Session 3

- One big change was the in-session reflection. Participants filled out another Google Form with reflection questions. In the first iteration, the reflection was hand-written. Participants were asked to identify their marginalized and privileged identities on the identity wheel. Many of the participants in the first session added an additional label (neutral or a combination of privileged and marginalized) because they could write in an answer. On the google form, participants could check all that apply but did not give participants an opportunity to write in their answer. This change affects the ability to compare these data sets.
- The co-design prompt changed to address the threads of the conversation from the previous sessions. Instead of creating policies to add to a syllabus, participants were asked to create policies to be implemented college-wide to promote inclusivity.

## 5.1.5 Reflection Prompts

### 5.1.5.1 Fall 2022 Workshop

Participants received a link for a Google Form with a reflection following the first two sessions, which they were asked to complete before the start of the following section. Participants answered a third reflection prompt in the third session as well. The prompts for each session were as follows.

“Please provide a summary of Workshop #1”

“We each have identities that contribute to privilege and others that are non-dominant identities in society. Choose at least two identities from the identity wheel (Fig 5.3) that you felt were salient in the co-design session. How did each of these identities contribute to your feelings of empowerment and/or disempowerment in the co-design session?”

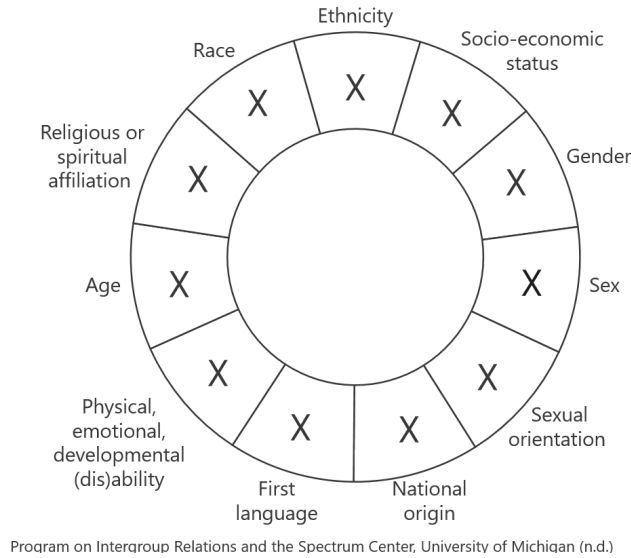


Figure 5.3 Identity Wheel used during co-design sessions and for the reflection prompts [99]

Following responses from session 1, we changed the first prompt to say the following:

“Provide a summary of [Session] #2. Please also include your own thoughts and perspectives in the description. Where did you see power dynamics and how did you react during the session?”

Question two remained the same for the second reflection. In session 3, we had participants reflect during the session. The Identity Wheel was modified (Fig. 5.4) to address a concern that participants were conflating age and role, especially about the faculty. The prompts were as follows:

“In different contexts, aspects of our identities play out differently. Identity wheels are often used to reflect on which identities are dominant or privileged, and which ones are marginalized. Look through the identity wheel and think about, in general, which identities are privileged (P) or marginalized (M) within engineering. Reflect on the following: Pick one identity that made you feel empowered in these sessions? How might you use this identity empowerment to help others feel empowered? (we will be sharing our answers)”

“Pick one identity that made you feel disempowered in these sessions? Can you think of something that might have helped you feel more empowered? (we will be sharing our answers)”

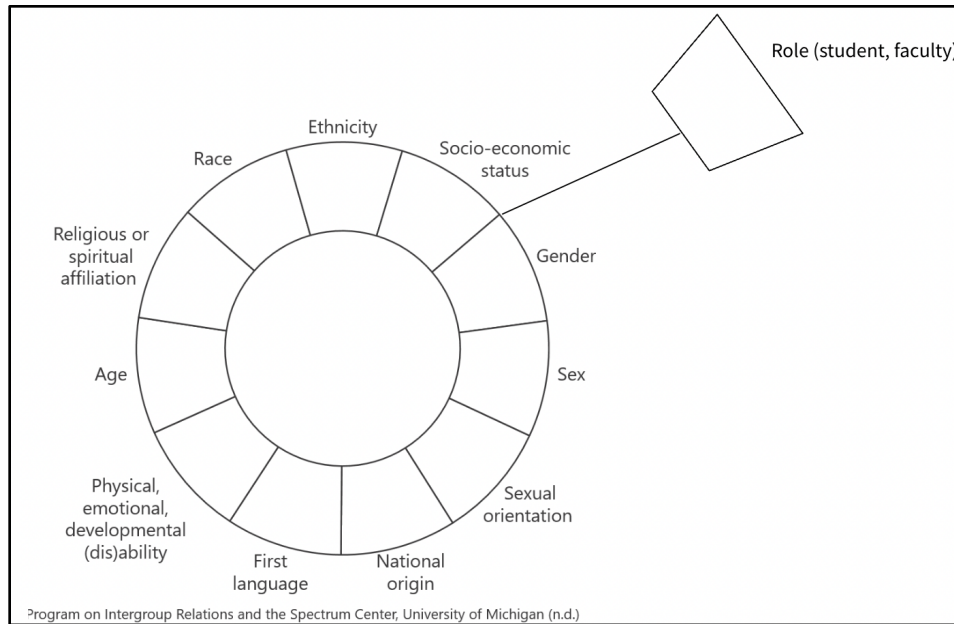


Figure 5.4: Modified identity wheel used in Session 3.

### 5.1.5.2 Spring 2023 Workshop

There were a few changes made to the reflection prompts in the second iteration to address both concerns and the change in modality (in-person versus virtual). For the first reflection prompt, the question about providing a summary was changed to the same one as the one from the second reflection, given that it was too broad of a question. The second change was to the third, in-session reflection. This change is detailed in section 5.1.4.2, related to the affordances of changing to the Google Form typed reflection.

## 5.2 Positionality

An important aspect of qualitative research, especially in engineering education is for the researcher to acknowledge their positionality [97]. My perspectives are from a first generation, daughter of immigrants, heterosexual, cis-gendered Latina, who was born and raised in Los Angeles in the low socioeconomic bracket. I am also a traditional college student (attended college between the ages of 18-24), lived on campus, and had a full scholarship. I was brought up in a Christian household that primarily spoke Spanish but adopted Spanglish as my sisters and I got older and learned more and more English in school. I

have a bachelor's and master's degree in mechanical engineering, and this dissertation is for a doctorate degree in Human Centered Design & Engineering.

In my engineering education, I have had both really amazing experiences, and others that left me questioning my own worth as an individual. It was during college that I first experienced major depression. Because of such a dualistic experience, I set out to research and understand why it was that so many of my friends who were underrepresented minorities in engineering had similar experiences in their undergraduate engineering education. It is with this perspective, one grounded in experiences of marginalization, but also one supported by hope in the field of engineering to develop solutions that make a better world, that I approach my research and teaching in engineering.

## 5.3 Data Collection

This section details the recruitment process, participant data and demographics, and how data was collected for the interviews, videos, reflections and design artifacts.

### 5.3.1 Recruitment

The initial goal of recruitment was to have 4 faculty and 6 students participate as a cohort experience. These numbers reflected an effort to balance power. Example emails and consent form are available in Appendix B. The recruitment emails included information about the process—students and faculty collaborating on inclusive practices, but detailed information regarding the observation of power was only included in the consent form. For **Fall 2022**, the initial priority was to recruit participants from one department, in order to be able to provide a contextualized analysis of the data. Emails were sent to the faculty mailing list, and I had made a connection with the department's committee on diversity. Unfortunately, despite many emails and asks from leadership, I was only able to recruit five participants of the seven total, from this department. The other two participants were still in the college of engineering. The overall demographics for these participants can be found in Table 5.1. For faculty, recruitment material was promoted by the department's diversity officer, targeted emails were sent to those I was encouraged to reach out to, due to their known interest in diversity and inclusion efforts, and one last email was sent on behalf of the department chair. For student recruitment, there were emails, which included a flier, that were sent

through the advising mailing list, through some of the larger classes, and through a couple of classes specifically on diversity and inclusion topics in engineering. One thing to note about this group of participants is that we had two faculty participate and we had one doctoral student who had experience as an instructor of record participate in the role of a faculty member. Impacts of this addition are noted throughout the results section. Finally, we had one faculty member who participated in the pre-interview and the first hour of session one but was unable to participate in the rest of the study. This faculty member's data is excluded from analysis because of the short time in the study.

For **Spring 2023**, the goal remained the same in terms of numbers for recruitment. This time, the recruitment efforts focused on students and faculty who identified as Black, Indigenous, or Latinx. The recruitment efforts remained primarily as email efforts. Emails were sent to identity-based engineering professional clubs, programs supporting underrepresented students in engineering, and through some departmental Slack channels. For faculty, in order to reduce the possibility of tokenizing anyone, recruitment emails were sent to department chairs to share with their faculty. In addition to this, I asked faculty and administrators if they knew of colleagues that identified as such that I could contact directly. From this effort, we recruited two faculty and three students, whose demographics are listed in Table 5.2. One important thing to note is how stark the reality of underrepresentation becomes when you are searching for faculty of color. There were 10 departments, and even though each department has over 20 faculty, some departments had as little as 1 faculty that identified as either Black, Indigenous, or Latinx.

Once participants expressed interest through a Google Form, they were asked to schedule a pre-interview on Calendly, a scheduling site, and sent the consent form. Participants were asked to read and sign the consent form before the first interview. Student participants were also provided \$120 compensation for their time at the end of the study.

### 5.3.2 Participant Data

Table 5.1 and Table 5.2 list the demographic data for the participants in workshop one and two, respectively. All participants are in the field of engineering. Due to the small number of participants, details for

departments are not given due to the potential loss of anonymity. One thing to note is the last column in each table, “Self-Identified Privileged Identities.” Although our demographic survey only asked about gender and racial/ethnic identity, one reflection activity asked participants to fill out the identity wheel, writing in privileged or marginalized for each identity, within the context of engineering spaces. The identities listed on the wheel included, Race, Ethnicity, Sex, Gender, Sexual Orientation, Religious or Spiritual Affiliation, National Origin, First Language, Socioeconomic Status, Age, Physical, Emotional, or Developmental (dis)Abilities, and Role, as in student or faculty. These identities were not of focus for our study but are important to understanding our participants and their experiences. Additionally, pseudonyms use the following convention. Names that start with the letter “F” are faculty members, while names that start with the letter “S” are students. Participants from the first workshop have the letter “a” as the second letter in their name and participants from the second workshop have the letter “e” as the second letter in their name.

Table 5.1: Participant demographics from workshop one.

Participant	Gender Identity	Race/ethnicity	Year/Years Teaching	Self-Identified Privileged Identities (out of 12)
Sam	Male	Asian	Fourth	7
Sandy	Female	Asian	First	6
Sawyer	Male	More than 2 Races	Third	9
Sarah	Female	White	Fifth	9
Fanny*	Female	White	<5 years	8
Fay	Female	White	20+ years	9
Fatima	Female	Asian	<5 years	6

\* Fanny is graduate student who has served as an instructor of record therefore is coded as Faculty

Table 5.2: Participant demographics from workshop two.

Participant	Gender Identity	Race/ethnicity	Year/Years Teaching	Self-Identified Privileged Identities (out of 12)
Sebastian	Male	Latinx	Third	7
Selena	Female	Latinx	Third	6*

Serenity	Female	African	Third	4
Felicity	Female	Black	<5 years	8
Felix	Male	Latinx	<5 years	11

\*Selena was not present during the activity. Based on conversations throughout the study there are 6 identities which I am unsure of whether she identifies as privileged or marginalized, therefore the max number of privileged identities is 6.

### 5.3.3 Interview Data

The interview data for both the Fall 2022 and Spring 2023, was collected through Zoom video calls. Participants were asked to sign up for a time slot. Once they signed up, an automatic email was generated that included a calendar invitation and the link to the Zoom call. In the pre-interview, once participants signed up for an interview, they were sent the consent form, included in Appendix B, to read, sign, and email back before the start of the interview. For the Fall 2022 data, the Zoom transcripts were checked for correctness and remained as the data source. For the Spring 2023 workshop, the Zoom audio recording was exported to Otter.ai, a speech transcription service using artificial intelligence to transcribe the audio. This transcription was better than the automatically generated Zoom transcription but was still checked for correctness. Each participant did a pre-workshop and post-workshop interview, each taking approximately 30 minutes long.

### 5.3.4 Co-design Sessions & Reflection Data

The co-design data for the Fall 2022 workshops included video-recorded sessions of the in-person co-design session, paper copies of sticky notes, and reflection prompts collected from both Google Forms and one collected in writing. The sticky notes were transcribed onto digital sticky notes. The sorting of the sticky notes by participants was kept the same in the digital format, making sure the sorting on the digital file matched the sorting in pictures taken during the sessions. Finally, the written reflections were also transcribed and put into an excel sheet. The research team kept track of who wrote each reflection by having participants write their participant code, which included the initial of their last name and the last four digits of their phone number. For the sticky notes, we kept track of who wrote each note based on the color marker they used. All sticky notes from each session were the same color.

The co-design data for the Spring 2023 workshop was slightly different, given the sessions were done virtually, instead of in-person. The sessions were recorded on Zoom and the Zoom transcriptions were reviewed for accuracy. The sticky notes were all digital on Google Slides. I tried to keep the original set of ideas and the thematically organized ideas separately to keep track of how participants manipulated and negotiated the data. Participants were instructed to choose a font color that they would keep for the rest of the sessions, in order to keep track of who wrote which idea. The reflection prompts were all on Google Forms this time around, given the fully virtual mode, and were therefore simply collected on the exported Google Sheet created from the form.

## 5.4 Data analysis

In this data analysis section, I will describe how the research team analyzed the interview transcripts, reflection responses, video recordings and transcripts, and the design artifacts, or sticky notes created by the participants. All the data was used to triangulate on the themes that arose.

As soon as data collection was complete for the first cohort, a team of researchers was assembled to explore the data through a quarter-long research group. Five undergraduate and graduate students and the lead researcher looked at the data through different lenses. Each researcher was assigned a participant's set of data to analyze. First, researchers read through the pre and post interview transcripts, making notes of any interesting quotes. In the second read-through, participants separated the transcripts at the sentence-level, giving codes to each. In the third read-through, participants named instances of power with one of the four Domains of Power. In this iteration, researchers often discussed how one instance of power could be described from the perspective of different Domains of Power, seeing how the Domains of Power are interconnected. Once researchers had familiarized themselves with the data, they created a participant narrative, highlighting what participants emphasized throughout their interviews. Researchers then paired up and conducted a comparison of their two participant responses. Although this data analysis was only the beginning of what became a different process, it helped in highlighting themes across participants and in providing conversations about what the different perspectives of participants looked like, to the same interview question. Researchers had one week to make each pass on the data. At the

end of the week, each provided a summary of their analysis and then as a group, we had conversations about similarities and differences. This process helped me, the primary researcher, see the data from more than one point of view. This process also allowed me to “see” the overall data after having collected it all.

Once data collection was complete for both cohorts, the data went through a different process of analysis. Although there were multiple ways the data could have been analyzed, I decided to group student data from both cohorts for analysis and faculty data from both cohorts. Each cohort had salient identities that were often the topics of conversation, such as gender for Cohort 1 and Race or Ethnicity for Cohort 2. Although I could have done data analysis within each cohort, I decided to do data analysis between cohorts, in hopes of finding patterns among a diverse set of participants, among their peer groups. I compared student data among itself and faculty data among itself. This role, either student or faculty, was one identity that impacted the type of examples participants used to answer interview questions. Faculty often thought about their job requirements when it came to interacting with colleagues and with doing research and teaching. Students talked about their experiences with peers and faculty. Although this choice to do comparisons among peer groups was made in order to get a wider representation of student specific and faculty specific roles, it does provide limitations as to what kind of analysis can be conducted. For example, although gender was a common identity that was brought up among students and faculty, the decision to analyze the data by peers makes it difficult to compare the data across peer groups. Along with gender, race, ethnicity, and socioeconomic status also cannot be compared across peer groups. The rest of this section describes how the data was compared within each group.

### 5.4.1 Interview Transcripts

For the final results section, interview transcripts were grouped by stories, or groups of text related to the same example the participant shared. First, each sentence was placed on a separate sticky note and grouped according to what answer they belonged with. Each story was then grouped and given a thematic name, first looking at all the data for students and then proceeding to the faculty data. Examples of thematic names specific to the student data included “groups”, “peers”, and “lab group”. These stories all

related to stories of power dynamics related to peers. Once this process was completed for each participant, themes were bubbled up. For the pre-interview, I first looked at the answers related to what students and faculty thought about when they heard the words “power dynamic” to find themes of how participants characterized power dynamics before the intervention. The rest of the interview included examples of how participants saw power in their engineering education environment. Again, themes surfaced according to similarities across student or faculty stories. From looking at the resulting themes, I made connections to what students were saying as seen through the framework of the Domains of Power. A similar process was followed for the post-interview data. This data was analyzed in two parts. I first looked at participant responses to takeaways and then I looked at the rest of the interview to surface themes. I looked at participant takeaways across all participants and looked at student and faculty responses separately for the rest of the interview responses. Section 5.5.3 describes how trustworthiness was built within the data collection and analysis process.

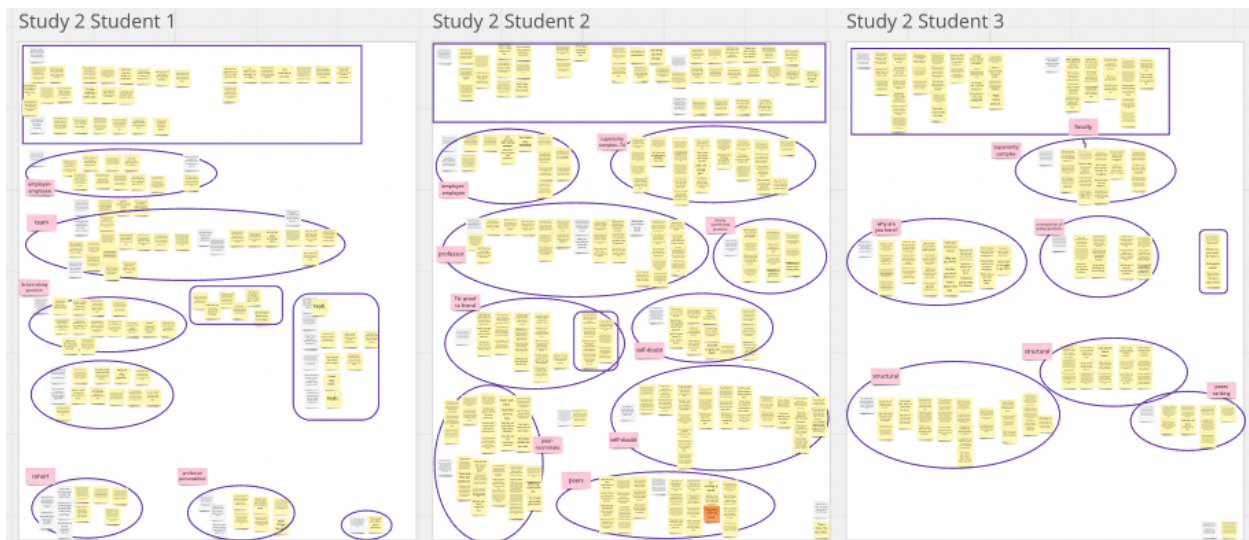


Figure 5.5 Interview data sorted by stories.

## 5.4.2 Reflection Responses and Design Artifacts

Design artifacts included various sets of sticky notes, either physical or digital, that participants had used to brainstorm ideas. These ideas were organized using different themes to find patterns. At the end, participant ideas were sorted by which participant wrote the idea and then themes were found around what participants within and across workshops said. Reflection responses were analyzed in a similar format,

keeping student and faculty data separate. Because reflection responses were question specific, I organized the data by looking at which identities were most salient to participants and then which aspects of the sessions they talked about, in order to see if there were patterns around which moments in the co-design sessions were most salient to multiple participants.

A note on video recordings: Video recordings have only gone through preliminary analysis and therefore are not included in this dissertation.

### 5.4.3 Trustworthiness

According to “Quantitative, Qualitative, and Mixed Research Methods in Engineering Education,” the research criteria for quantitative and qualitative research is different, which is particularly important to note in the field of engineering education where researchers are more comfortable with quantitative research methods but are increasingly exploring qualitative methods needed to understand more sociocultural phenomena in the field [100]. Using these authors’ focus on Lincoln and Guba’s understanding of qualitative research criteria, I will explain how I looked to create trustworthiness of my qualitative study using credibility, transferability, dependability, and reflexivity. Together, these different ways to account for trustworthiness of the study point to the overall commitments of qualitative research, which is to present the voices of individuals, acknowledging the interpretivist nature of how the research is presented in the final write up. The researcher is a biased agent, doing their best to present the data and noting how personal bias influences the representation. I include my positionality statement in section 5.2 in order to address some of the biases and perspectives that influence my own work as a researcher in this study.

*Credibility* is establishing that the results are credible or believable [100]. One of the reasons we collected multiple sources of data from the co-design sessions was to bring credibility to our study by triangulating the themes from the various sources of data, including the interviews, video data, and the final artifacts. During the data analysis, the primary researcher included several other researchers in the sense-making process. Throughout the process, seven other researchers participated in doing data analysis, mostly through directed research groups. I have also done member checks [101], in order to give participants the opportunity to review and correct any misrepresentation of their data. Few changes to quotes were made,

with recommendation of the participants, for conciseness. One thing to note is that although we have video data of the sessions, that data has not been thoroughly analyzed to add additional supporting information. None of the results represent video data and mostly focus on interview and reflection data. Even then, many of the conversations from the sessions are reflected on by multiple participants.

*Transferability* is the applicability of research finding to other settings, achieved through thick description, or abundant interconnected details [98]. For this study, I analyzed one way of conducting the co-design process in order to make recommendations for others interested in using similar methods to think about more inclusive spaces. Each instance of a co-design session brings its own context and dynamics; therefore, this instance cannot be replicated exactly the same anywhere else. But the goal of this study was to find themes to inform the design of other co-design sessions, therefore the development of a thick description of each context is included throughout this chapter. With this context in mind, resulting themes can be transferred to another context, with the knowledge of what differences there may be. According to Creswell, “details can emerge through physical description, movement description, and activity description... through describing the general ideas to the narrow using strong action verbs and quotes [94].” For example, detailing the context and content of the sessions, as detailed in the introductory section of this chapter (context) and the workshop materials in Appendix A (content), helps highlight how this specific workshop structure has certain affordances for co-design.

*Dependability* relates to the accuracy and consistency of the data. For this study, several steps were taken to account for dependability. First, there was a semi-structured interview protocol established. Although different follow up questions were asked, the core set of questions were asked to all participants. As a research team, we collected interview, reflection, and video data in order to document the occurrence with multiple data sources to ensure consistency. I, the primary researcher was present at each session and conducted all the interviews, and had another researcher help in each session with facilitating and observing. Both researchers checked-in after each session to reflect on the sessions. Data was transcribed and double checked for correctness to verify the data was transcribed correctly. The research team also did constant comparison of the data from study one to find similarities and differences between

participant responses. Finally, if the transcript seemed incorrect, researchers double checked the audio to confirm accuracy.

*Reflexivity* is how researchers examine their own biases and make them known [102]. Given the nature of the phenomenon (power) and the theoretical underpinnings of critical research, having researchers practice reflexivity throughout the research process was important for this study. This includes questioning the intentions behind each research question, and being intentional that the research activities the participants engage in align with the objectives of the research questions and do not cross any unnecessary boundaries. Through the data analysis, whoever was a part of the research team then had to write their positionality statement, and during check-in points, share any biases that came up for them when conducting analysis. Reflexivity was critical in the study design as the research team decided on what questions to ask participants, not only in the interviews but also the reflection questions. Additionally, the sessions were set up to build in terms of how much personal details were required for participants to share. In each session, participants were reminded that they were free to share as much or as little as they wanted to. This point was emphasized often given the awareness of the power dynamic in any research study between participants and researchers.

# Chapter VI: Results

## 6.1 Introduction

This chapter presents the results from the data, in the following order: **Section 6.2 Understanding of Power in Pre-Interviews**, **Section 6.3 Identity Exploration**, and **Section 6.4 Looking towards Change**. These sections organize the results from the data into several sub-themes, by section. Section 6.2 is intended to pull out the different ways students and faculty saw or experienced power dynamics in their environment, particularly in engineering education spaces, before participating in the workshops. This section is separated into student and faculty perspectives. Section 6.3 presents data on how participants' identities surfaced before the workshop and throughout the workshop as the connection between identity and power was presented in the reflection and workshop activities. This section also expands on how participants' understanding of their own identities and relationship to power changed throughout the workshop. Section 6.4 begins to surface ideas of change from the participants, including ways this type of intervention could be successful as a future practice. At the end of each section, I provide a connection between the themes that surfaced and the Domains of Power. Finally, section 6.5 summarizes and concludes the results.

## 6.2 Understanding of Power in Pre-Interviews

This section describes the perspectives of both students and faculty on power dynamics, when asked explicitly what interactions they think about when they hear the words "power dynamics". If their first examples were not related to engineering education, they were then asked to think about examples specific to this context. In making this section, I am hoping to show what participants thought about power before their experience in the workshops. There are limitations related to the fact that I asked participants unstructured follow-up questions, therefore there will be an unknown amount of influence from those questions. When I asked questions that I know directly impacted the examples they give, in this section, I explicitly mention that I asked those questions. As a reminder, the overall questions all participants answered included:

1. Tell me your story on how you decided to study/ teach Engineering?
2. When you hear the words “power dynamics” what interactions between people come to mind? (in general or in the classroom)
  - a. no answer is wrong—interested in what you have to say
3. What is one example of problematic power dynamics in the classroom you have encountered and how did you problem solve?

## 6.2.1 Students’ Understanding of Power in Pre-Interviews

### 6.2.1.1 Power Overall

Students gave varied examples of power. Outside of academics, students pointed to employee-employer relationships (Sebastian, Selena), or coaching relationships (Sarah). Others (Sandy, Sawyer), said people have power when they have more experience. In employer-employee relationships, Sebastian suggests that upper management makes decisions without understanding the “*nitty-gritty*,” sometimes making decisions that do not always make financial sense, for example “*not allowing anyone to do overtime, saves some money... well now their manufacturing rate gets cut by like, you know, 30% has a way bigger deal.*” Selena gives the example of speaking up against a manager and how “*obviously, their voice is stronger, and you [the employee] seem very minimal.*” She continues, “*since they've been there longer, or like, they have one reputation that's well known compared to like, their employee, the person below them...all employees [are] replaceable.*” Sarah thinks of her current position as a swim coach, she thinks of the “*manipulation*” that can happen, based on what she learned from her most recent child-abuse prevention training. Selena, Sebastian, and Sarah give examples related to roles associated with authority, such as a manager and coach. Sandy and Sawyer’s idea of more experience is consistent with how the rest of the students discuss the power they see in engineering education spaces, focusing more on experience.

### 6.2.1.2 Power and Peers

All students, when thinking back to their engineering education environment, think about power dynamics with their peers. Students talk about both group experiences and one-on-one interactions, whether this is a project team, extracurricular activities, or even in-class discussions or office hours.

Common in both Workshops was the idea of power dynamics in group work or team settings. Sam brings up the idea of “uneven work distribution.” He goes on to say that the power dynamics that arise for those that do less work include:

*“They might be afraid to speak up in terms of project decisions, or you know, if they're not being treated fairly, I think they might not speak up as much.”*

Sam also mentions feelings of “competency”, whether that's with English or engineering skills, that impact the power dynamics. He also mentions bias and how peers with “*racial or demographic biases*” make choices about who they work with, how they communicate, and or how they treat others.

Sandy is in her first quarter of college, but already brings an idea of knowledge as a source of power. She says “*usually a team leader will have more knowledge on a project than the average team member.*”

When asked explicitly about seeing power dynamics in college, she recalls attending a meeting for an engineering student club. She says:

*“It felt like that usually the older students, like the juniors and such, were super, not in charge, but were definitely a lot more. Um, I guess in more leadership...but I think that's probably just due to them knowing more than younger kids.”*

When I asked how she felt about this power dynamic, she says, “*the power dynamic wasn't bad at all...I'm [just] thinking about that type of stuff, and I find it interesting. So even though no one said anything, it kind of felt like they were taking the lead.*”

Sawyer shares a story of a frustrating experience when there was “no power dynamics”. He says:

*“It's honestly best to have power dynamics and like within students, because in the lab group, for example, it's really nice to have someone who's like a team leader, kind of who is in charge of making sure the deadlines are on time that people do their work, that the work is submitted, and that the group contract, whatever is complete.”*

Here, Sawyer is connecting power dynamics to leadership.

One of Sarah's quotes that stands out is:

*"if you don't set yourself up as like the smart one in the group like you're never going to get back to that, if you don't and initialize like 'this is who I am,' um, you can have trouble with people giving that power back...you should assert yourself early on"*

She is forthcoming with how she interacts in a team, and yet, setting herself up as the "smart one" is consistent with how other participants talk about who has the power—it is those that are competent, have more experience, and knowledge that are perceived to have the power. She also gives an example of asserting herself in her technical communications class, where she was a senior and the other students were either first or second years.

Finally, Sebastian also shares an example of a group project. He shares a recent team experience where his team members automatically assign a different team member the part he is also interested in working on. He mentions that the team is aware that this particular team member is a part of the club that is known for "*always [being] in the machine shop.*" Although he mentions that it "makes sense to a certain extent" to assign someone with "more [relevant] experience," he continues sharing the story:

*"So, it's automatically assigned, automatically assigned the role. And I just feel like I mentioned having some experience before, but I think it's very easy to see here like, well, they can see him having the experience, I just haven't had any time to really show it."*

Sebastian has machine shop experience from an internship, which he brought up with his team, but he says if "*I hadn't mentioned that I don't think... I don't know if they'd be as comfortable letting me go [on that project task].*"

As seen throughout student examples, perceived experience, competency, and knowledge play a big role as to who is able to exercise power and take on the leadership roles in teams.

Selena and Serenity, both women of color, do not mention team dynamics in their pre-study interview but do mention other kinds of experiences with peers and power dynamics. Selena relays the story of one of her friend's roommates who *"was pressed [by] the fact that my friend was also in the same school as her without the same"* grade point average (GPA) and college entrance exam scores. Selena expresses feeling mad because this other student was able to afford resources to do well, while her friend made it to college *"against all odds."* This roommate would also say *"racist"* and *"belittling"* things. When this friend gets a good score on a math test, the same roommate says, *"I didn't know you were academically driven like that."* Selena continues to share some of her own experiences. She has had peers comment *"you only got in because you're Mexican...they needed a quota"* and remembers it being *"so hard to hear the first two years being here [in college]."* She continues with a different story about a specific peer whom she had a couple of encounters with. She specifies that these experiences of power dynamics start to occur more when she starts taking introductory math and science classes specifically for engineering students. While in lecture a student asks the professor a question. She says the student says *"...the TA couldn't answer. I was hoping I can get like a legitimate answer from you."* The professor proceeds to answer the question. As the professor finishes, Selena turns to the student and adds *"also, don't forget about" x,y, and z.* Her peer responds and says *"oh, I didn't ask you."* To her, this student *"ranks"* people in his head. In another instance, this same peer is in office hours. She notes her peer is talking to the white students, not the other students of color present. She jumps into the conversation he is having, and he gives her the *"nastiest look, like disgusted with my...existence,"* and says, *"I don't remember asking you about that."* She continues and explicitly says, *"power dynamic mostly comes from white people."*

Serenity also mentions very specific experiences of peers exercising their power against her, many similar to Selena's experiences. She starts off by saying that *"being an engineer...just S.T.E.M in general, people have like a superiority complex."* Generally, she says, *"it comes out in how they talk to you and who they form groups with.... And it's just so much easier for you to just be that, that one kid with nobody."* In relaying this, she also mentions the need for a support system. She then moves on to grades

and says, "grades, really signifying how good you are, what kind of person you are." In sharing this, she also mentions imposter syndrome and how "*comparison truly is the thief of joy.*" She continues to say:

*"it's best to keep your grades to yourself, because once you say it out loud, people will put you on the little hierarchy that they've made in [their] mind, and they will treat you as so even if they don't think they're doing it."*

She remembers receiving comments like "*I can't believe you study so much and still did so bad.*" she continues to say that "*once they know what [grades] you get, they wouldn't, they wouldn't even offer you to study with them anymore.*" She continues to describe what the culture of Science, Technology, Engineering, and Math (STEM) is to her: "*STEM degrees are mainly white...so if you're anything other, you [have] got to be as good or better*", "*I have to prove why I'm there*", and "*they [white students] can just, you know, they can just be engineers...but I can't just exist and do what I want to do.*" From the stories shared by Selena and Serenity, we see that women of color can have a similar experience of exclusion in engineering spaces.

When thinking about peer interactions, several students mention ideas of good leadership or what a good project team feels like. Sam mentions he has "*definitely learned to speak up for myself over the years, and you know, ensure that you know things are fair and to everyone's own strength,*" and continues to say, "*that's the best way to finish your project.*" When I asked Sandy if she had experienced anyone using their power to help, she mentions "*it's really helpful when someone talks to you and is like, hey, do you have an opinion?*", or when others "*allow people to do the tasks that they're best at,*" or "*let people do the tasks that they really want.*" She continues to say this will let people have a "*better time on the team.*" Sarah also shares an instance on her capstone team when she decides not to assert herself, but the alternative is that,

*"other people, spoke up more quickly, but I definitely made like an active choice not to speak up first... because it was through the same lab that I work in, and [I] was kind of willing to like take the back seat because I felt like I maybe had more opportunity to do that in the future...And so I*

*wanted to make sure that if someone else did not even have a baseline interest in doing something, that that's not what they ended up doing...because we were going to be spending a lot of time doing this stuff, and if people are interested in what they're doing, they're gonna have better results."*

Here, we begin to see students think about when talking about what a good leader or team looks like.

### 6.2.1.3 Power and Educators

Most students also shared experiences with power exercised by their educators, whether this happened during lectures, office hours, or working in research laboratories.

Sam has a strong perspective on what power looks like. He says:

*"I believe students most if not all, students, know when they are being treated fairly or not, and if they are being spoken to in a right way or not, and to allow something to take place, you know, is, you know, partially because of power."*

He continues by saying,

*" some of the students potentially might think with the professor, someone who does have power, they might not have the right even to speak up in fear of, you know, retribution of any like consequences and in that case I would say they allow that... those kinds of events to take place....they [faculty] have control over, you know, **grades, outcomes, you know, extensions, you know, or other opportunities recommendation letters**"*

Although this interpretation is very direct, Sam is not the only one who has this perspective. Although Sarah brings up this perspective when asked about a time someone used their power to help her out, the implications are similar. She says,

*“I research with some of the professors, and I'm at the point of very much need to be applying to jobs and I will leverage him and his sort of power in that research space, hopefully to get a job... and that kind of thing definitely benefiting from that power dynamic, I guess.”*

Here, both students are pointing to the influence faculty have over future opportunities for their students.

Sawyer begins to share his idea of power by describing educators. He says,

*“Especially in the classroom, I'd say a professor, or a TA have more power over the students, because they **know** a lot more, especially those like engineering, definitely **know more** engineering material... someone who has **more experience** than the other people around them.”*

This idea of power is consistent with what students have mentioned about who has power in peer group interactions. He also talks about respect, something many of the students share when talking about how they interact with power. He shares the story about a Teaching Assistant (TA) he had, and how *“he [the TA] really didn't know what he was doing.”* Sawyer continues sharing,

*“He was confused, but he was trying to teach everyone. I guess he had more power than, I guess all the other undergrads, but it wasn't effective, and it wasn't like we could just tell them, hey, can we please do something else that's more, that would help us to learn better.... We kind of wanted to leave at the time... We can't really do that, because I mean he's like a TA, it would be kind of like disrespectful to walk out on him.”*

Each of these examples show that students make decisions based on their awareness of the power dynamics at play, whether that is with faculty or TA's.

On a different thread, both Sebastian and Selena share an example of a peer asking a question during lecture, and the professor responding in a condescending way. Sebastian's example is,

*“...earlier in class, we touched on a topic, And we, a friend kind of asked a clarification question on it...assuming we want to know more, he [the professor] kind of explained that over again, but*

*the way he responded in almost the same way....he was a little... condescending is a strong word to use, and the thing is, but it definitely just felt I feel like he was trying to instead of trying to understand where we're coming from and then trying to crack that last line of thought he just kind of just tried teaching us from scratch again."*

Sebastian tries to make sense of this professor's response by saying the conversation was "nuanced" and used "pedantic terms," therefore he can see how it can be "very easy to misinterpret what one another's trying to say," giving the professor the benefit of the doubt. Selena's example is:

*"The student was asking him like, a serious question...He [the student] was like, Oh, I'm trying... I'm confused about this. And [the] professors like, how are you confused about this, like, this is your major, like, this is like, you should know this, you know? And after that, the student didn't feel comfortable anymore asking questions and didn't feel like he was safe enough to go to the professor."*

This example also demonstrates faculty exercising their power to put students down, when students are trying to understand the subject material better. She continues to share a different example during office hours with a teaching assistant. She describes him as being "standoffish" making her not feel "safe to ask questions." She continues saying she got a sense he had a "superiority complex." She continues,

*"I asked him a question. And he would just like slide in comments, you know, but he wouldn't say it directly, like, 'Oh, you're stupid.' ...just comments like, 'Oh, if you can read from lecture, then you will know that blah, blah, blah. Oh, if you did the lab correctly, then you would understand that' you know what I mean? I'm like, okay, first of all, I'm not a PhD student, feel me? Like, I'm asking you. So, I'll be like, okay, I'm not putting up with this at nine in the morning."*

This interaction leaves Selena upset, as she decides she's "not putting up with this as 9 in the morning." Finally, Serenity shares a similar but unique perspective, in that she is sharing a story of her going to a faculty for help herself. She says,

*"I've had experiences where if I'm struggling academically... people are always like, professors, whatever, whoever was like, if you're struggling, come talk, come talk to me, you know, and my whole life, even in high school, like taking these classes, I don't particularly like speaking with professors, or anybody higher, because most of the time, it's a very uncomfortable situation, or it can become like that really easily. I was struggling in chemistry. And I went to my chemistry professor. And I was honest, I was like, I'm struggling .... And instead of, sort of offering words of wisdom, he was like, questioning my motive. He said, 'I don't understand why you're struggling?'"*

She wonders if *"they don't know how to handle this"* because she is *"their only black student"* coming to *"talk about things."* This section shows that students are aware that faculty have power, not only because they are the ones with the knowledge on the course material, but also because of the impact faculty have on students' access to future opportunities due to grades or letters of recommendation. Particularly for students of color, having a professor who makes it more difficult for students to ask questions continues to place the burden of learning on the students themselves. Students of color mentioned specific instances of microaggressions and racist interactions more than the non-students of color. The next section gives us insights into what kind of power faculty are thinking about.

## 6.2.2 Faculty's Understanding of Power in Pre-Interviews

The most common example faculty gave of power dynamics was of the dynamics of tenure within the academic system. Faculty also discussed examples of the faculty-student dynamic. Finally, the faculty of color have more specific details about how they see and feel power dynamics in academic spaces. Due to the sensitive nature of this topic, I will not identify which faculty mentioned each example in the first section, Power in the Tenure System.

### 6.2.2.1 Power in the Tenure System

The first example from one faculty is that, in their role as teaching faculty, they have *"no power."* They continue to say, *"my department has treated me well compared to a lot of the stories I hear about non-tenured faculty over the years."* They describe their role as non-tenured track faculty as *"second-tier, or lower class."* This faculty says they feel that when having to make decisions about changes to their job,

they have to “*either take it or leave...just do my job...If I don't like what I'm doing, if I don't like what I'm paid or how much work that I do, or the situation, then **my choice is to find something else**,*” alluding to the fact that until recently, contracts were year-to-year.

Another faculty talks about how in meetings, they feel the power dynamics when considering whether or not to speak-up on an idea they believe should not be moved forward with. They mention “*hesitating*” and feeling like they “*have to play [their] cards carefully.*” They continue, “*somebody who feels like they're on a different end of the power dynamic **would not hesitate to speak up** and to voice their opinion.*” This faculty also mentions that since the teaching faculty position is new, “*There's not as much awareness about what the expectations are, what sort of scholarly activities the chair should support and what's kind of extraneous to the department of support.*”

The next faculty has a wide view of power. They say, “*power dynamics in institutions exist by design, you have sort of a hierarchy built into systems,*” a comment consistent with what students described regarding hierarchies. This faculty lists out different hierarchical roles such as “*employer-employee, manager-employee, advisor-advisee, or professor-student.*” This faculty continues,

*“From the top, academia is a very hierarchical institution, you go from, like Dean and Provost to maybe Department Chair, or I guess Associate, to Department Chairs... to Associate to Assistant Professors to Postdocs to grad students to undergrads.... there's a whole spectrum of bosses along the way.”*

This faculty continues, “*luckily, on the professor side, once you get tenure, some of that power dynamic pressure dissipates a bit, because you have more job security.*” They continue to talk about the tenure system and says,

*“On the operational side, as an assistant professor, you have associate and full professors **voting on tenure** for you eventually. So, there's some level of politicking that needs to happen. You need to play nice with everyone and make sure people generally like you and are on your side.”*

This professor continues to say that they themselves have not “*felt the pressure strongly.*” They attribute this to not being “*a very confrontational person, So I don't think I would naturally make many enemies. I **don't speak up very much.** Just maybe another issue.*”

Finally, another faculty member says,

*“One interesting kind of power dynamic shift that I have been dealing with for the past couple years is because I am pre-tenure, right? There's obviously a power dynamic between me and tenured faculty. And you know, like my department chair, right, because they are in a large part **controlling** whether or not I get tenure, right and also like, you know, many other people. So, there's that situation where I'm on the kind of lower end of the power dynamic...”*

Several other faculty specifically mention the power dynamics with their department chair. I heard “*it really all comes down to who the chair is... and what they think.*” Another faculty says, “*... there's some pressure to get along with tenured professors if you're untenured. Just again, because they **decide on your future.** And so, there's that dynamic. The same for the chair.*” None of the faculty in either workshop had tenure, therefore it is important to keep this in mind when reading the rest of their responses. It is also important to think about how different responses would have been from tenured faculty. Of course, all faculty in the study spoke about power and students, whether or not they talked about how they exercised their own power with students. We see how they make sense of this power dynamic in the next section.

### 6.2.2.2 Students and Power

Faculty-student interactions are a huge part of engineering education. In this section, I will share faculty specific quotes. Faculty often mention ways they interact with students, sometimes explicitly saying what they do to reduce the power dynamics. One important note that will be of importance in this section is that one participant coded as “faculty” is actually a doctoral student who has served as an instructor of record several times, meaning she was the instructor for a course, and essentially the professor. I will start with examples from her interview.

#### **Perspectives of a Recent Grad**

Fanny is our “student-faculty” participant. She has a unique role in that she is still a student and close enough to her time as an undergraduate student, that her examples often come from her time as an undergraduate student herself. She also mentions the tenure system briefly, saying “*I think there's also probably power dynamics between, like more junior and senior faculty as well, and those faculty that are trying to get tenure.*” Many of her perspectives organically include the language of diversity, equity, and inclusion, yet are still influenced by the engrained history and culture of engineering. She starts off talking about power dynamics in general in academic institutions:

*“The first thing that comes to mind is like student versus faculty power dynamics, where obviously the faculty is the person in the position of power. I'm thinking of this like, mostly at an undergraduate level right now but I know that this is also true for graduate students, and in that case, like you might have a power dynamic between, like a graduate student and an undergraduate student, or like a postdoc and a graduate student or faculty.”*

She then relays a story about a professor she had while in her undergraduate studies. She starts off by noting, “I don't really have specific examples for [this University], because I feel like as a graduate student, a lot of the times you, we have more power than an undergrad.” She describes the structural issues that allowed this faculty's behavior to continue.

*“There was one professor I had in particular that was **so mean to students** when they went to **ask him for help**...This is probably 2017-2018, but I still feel like this was something that **was not talked about as much** until post George Floyd. There were numerous microaggressions, or bias things that could have been reported I mean, there's obviously like course evaluations, but the problem was I went to a really small school so this particular faculty, I had in the spring quarter as well, so like you couldn't actually speak your marks [on the] evaluations in the Fall, because it was [a] ten person class, and you were going to have him again in the Spring.”*

She continues with specific examples of this faculty's actions. Once, when she thought she had done poorly on an exam, she went to speak with him before the grades went out. She wanted to know how she could do well in the class, knowing there were still a couple of exams left. His response was: “*Okay, well,*

*let's just see how bad you did"* and proceeded with *"grading my exam in front of me and just **berating me** for every mistake I made for about forty-five minutes to an hour."* After leaving his office, she says she felt "so powerless in that situation, and, **like I had no control over my own education.**" She then remembers another interaction she had with this professor the following quarter, where she had to go pick up her graded homework from him, and as she's there, he flips through her assignment and says, *"I would have given you a much lower score on this than what the TA gave you."* She mentions how comments like these lead to feelings of disempowerment for students. She then continues to share her own approach to teaching.

### **Faculty Practices**

She starts off by sharing about a program she was a part of that was intended to help her learn teaching skills. She shares one activity that they did where the participants role-played a student and faculty interaction, where a student is asking for an extension. The scenario goes as follows:

*"The purpose of this was as the instructor, to practice saying 'no' and basically saying like 'no, this isn't a policy that we have'...but it was really **frustrating** in that role-playing situation to be the student, because it was like you just felt kind of powerless of like, oh, okay, well, like, I feel like I'm offering like a pretty reasonable case here, and then...regardless of how you shake it, like the instructor and the person in the position of power is **continually saying 'no'.**"*

Here, we see the frustration she feels in the role as a student, but even though she feels this frustration, she still believes that this is a good practice, as the training suggests, since "a lot of the times, if you **accommodate** every single student, it's just a ridiculous amount of time on the instructor's part, which also makes sense." We continue to see this tension as Fanny describes her own teaching practices. She says,

*"I think what I've tried to keep in mind during the shift [from student to instructor] is how I **felt** as an undergraduate, and things that would have really helped me succeed in classes...or resources that I didn't have. But then it's hard, because as an instructor, it's like, oh yeah, I really want to implement this, but then it's like, oh wait! But the time it takes to implement that is like not something I necessarily have the first time I'm teaching a class."*

This is a tension many faculty are familiar with. Having enough time to implement practices that would improve a course. She also mentions trying different office hours times so that more students can have access, yet it is still the same students making use of the time. She mentions balancing what is “helpful to students” and yet is “not a huge drain” on her time. Finally, from her experience as an instructor she learned that she could use her making a mistake during lecture as a “**humanizing**” moment, which she says also helps with **being more approachable**. This practice also **normalizes making mistakes** in the learning process.

Felix also talks about ways he tries to “**come off as disarming to students**.” He makes jokes, uses language to downplay the positions of power, and uses polls to create spaces where students can participate anonymously and **take the pressure off speaking-up** in front of a group. He does all of this because of his awareness of students’ hesitancy to speak up or answer in class, to avoid getting something “**wrong**” or coming off as not “**knowledgeable**”. Another observation Felix has is that, when interacting with students, “**they’re not able to be their open authentic selves**.” He points out the shift in power when “*going from the PhD student to the professor.... I’m not a friend anymore, necessarily, I’m an advisor, or a boss, or whatever you want to call it.*” He mentions that it’s different for each student. “*Some students are just like open books; you can talk to them... they don’t feel the power dynamic as strongly.*”

Fay says that the biggest thing that comes to mind when thinking about power dynamics “is *the fact that they [students] won’t talk, they won’t ask me questions because I’m this professor.*” She adds that she thinks she is pretty friendly, so she attributes this student behavior to power dynamics. She goes on to describe **different methods she has tried to get students to communicate with her**, like the Zoom chat feature, Zoom office hours, think-pair-share, poll everywhere. She even mentions how the classroom layout affects how students participate.

Fatima is also aware of the power dynamics between students and faculty. She says, “*There’s kind of this power dynamic...the students always think there’s like this intrinsic sort of regard that of like fear*

**or intimidation**, or like role models where they look up to people in their [faculty's] positions.” She continues by saying her mentors have always taken the approach that,

*“They’ve never used the sort of power dynamic **to just issue directives** to students...If anything, they are always going to support personal professional development...they are, extremely supportive of students working towards career goals and **empowering** women and underrepresented minorities.”*

Although she does not share personal experiences of power with students, she is aware of how other faculty members are aware of and try to mitigate the power dynamic. Felicity shares how she establishes her leadership in the classroom while also being aware of the power she can exercise. In a class for juniors she says,

*“there, I do have the students call me ‘Doctor’ or ‘Professor’ just because there’s, again, being a minoritized faculty, there’s already, I think, a bit **of bias and imbalance** in the power dynamic, especially compared to a lot of older white male faculty in my department.”*

This practice helps create a learning environment where students are “**aware that she’s in control**” but that it is still a “**welcoming and inclusive space**.” She reiterates that she is “*the leader and facilitator of their education, and there just needs to be a certain level of respect there.*” In the following section, we see how there is a different level of awareness for each faculty member, about how much impact their decisions have on the lives of students.

### 6.2.2.3 Awareness of Impact

Faculty have different levels of awareness of the impact of their power on students. Felix says, “*I think it was always kind of in the back of my head as an undergrad where, you know, professors **control your grades**, which then **controls** a little bit of your future direction. They’ll write letters of recommendation for you, which can help to sway admission or rejection into certain institutions,*” as he thinks of ways to mitigate this power dynamic. He also makes the comment that faculty “*obviously control their [students’] grade, which controls maybe minor aspects of their future, but in the grand scheme, it’s not quite as big.*”

Even though Fanny also has a lot of awareness of this power, she make a similar comment when deeply considering a student's ask to round up their grade from a 3.7 to a 3.8, she decides that she does not think *"that's going to impact their future that much and ultimately like they didn't deserve to get that grade because they didn't perform at that level, you know, like they could have attended more office hours, or they could have asked more questions."*

Overall, faculty are well aware of the power relation that exists between them and students, and yet struggle to find ways for students to feel comfortable asking questions and being themselves. Yet, we see from student perspectives that faculty do not always exercise their power in a positive way. We also see that even the faculty with the best intentions can underestimate the effects of their power on the lives of students.

#### 6.2.2.4 Power as Embodied and Identity Based

Finally, one theme that arose from the faculty of color was the reality of identity as it interacts with power and even the embodied feeling when experiencing someone else exercising their power in a negative manner. When asked what they thought about when they heard power dynamics, one faculty said, *"not so much what I think of, but I guess **the feeling it's very uncomfortable, a little bit like I turn inward and kind of freeze up.**"* Two faculty sharing about how power relates to identities, shared *"I guess there's also power dynamics between people or individuals that are **constructed societally.** So like, male-female power dynamics, race-based power dynamics, society tends to privilege certain groups over others."* Another faculty shares, *"When I think of power dynamics, I think about **space and expressed identity...** that really depends on both expressed and hidden identities as well as the folks involved in the power dynamic.....like, under what contexts? Under what space?"*

#### 6.2.3 Connections to Domains of Power

At the conclusion of each section, I will provide a summary of how the themes in each section connect to the Domains of Power. In the following sections, I will make connections between student and faculty understanding of power in engineering spaces and how those ideas of power connect to the framework of Domains of Power.

### 6.2.3.1 Interpersonal Domain of Power

Both students and faculty clearly discuss that experiencing power is interpersonal in nature. Some salient themes in these interpersonal relationships are that students are constantly evaluating their peers on their perceived intelligence. Some other terms related to intelligence mentioned by students include experience, competence, being smart, and knowledge. This constant evaluation is particularly important to note because of how intelligence has historically been erroneously shown to correlate with identities such as race/ethnicity, gender, age, and language, such as accents, among other identities.

Educators also note the impact of identity on the power dynamics in the classroom. Fay, Fatima, and Felix share their awareness that students act differently, do not participate, or have a fear towards faculty because of their role. Fanny still has vivid memories of one of her professors exercising his power to intimidate and humiliate her. Respect as a way of interacting and exercising power came up a couple of times in this section, and we will see this continue in other sections.

Faculty feel the influence of power mostly within colleagues, with the main source of stratification coming from those with tenure. With tenure comes job security and the ability to influence non-tenured faculty's future in the department. An individual's status of tenure impacts how they interact with their colleagues.

Culturally, engineering has maintained the idea of meritocracy, or that certain individuals are naturally gifted at math and science, which allows them to succeed in these spaces. The engineering community's strong belief in objectivity only makes it more difficult for the community to critically evaluate its engrained ideas of intelligence because it is hard to identify how unconscious biases affect our decisions and judgments. Traditionally, positivist ways of knowing have also been favored. This affects everyone, but with students coming from communities of color that value different ways of knowing, it is difficult, both for their peers to appreciate the value in their different ways of knowing and sometimes difficult for the students themselves to translate this knowledge to these engineering spaces. This belief in objectivity also impacts our ability to critically assess our tenure and promotion process, without considering how preferences or biases really do affect the process. Because of this cultural belief, it is important that both students and

faculty learn to be reflective of their practices, being able to note how their biases and preconceptions are playing out in their decision-making process.

### 6.2.3.2 Disciplinary Domain of Power

One common theme that arose from students' understanding of power is that faculty have control over possible future opportunities, whether this is with grades, letters of recommendations, opportunities to do research, or connections in industry. Faculty are the ones who have the most influence over these consequences for students. **Faculty need to realize the weight of this reality and responsibility.**

Culturally, engineering continues to put getting a job in industry or in government as the epitome of becoming an engineer. Therefore, as long as we continue to keep this goal, students will continue to need to get the right grades, and the right opportunities to remain competitive in these industries and if they want to pursue graduate school. Faculty's ability to exercise their power over their students' futures remains impactful as long as success is correlated with the prospect of entering industry and academia.

Peers can also exercise their power in determining **who gets to belong** in these spaces. Students are the ones gatekeeping who makes decisions and who gets to do what in project spaces. Of course, these are negotiations within team environments, but there are consequences that impact how these decisions are made. There are dire consequences for not belonging. If a student does not fit in, they are not asked to join study groups, they are ignored by other peers in office hours, they are not invited to join class groups. In team situations, those that do not belong do not have as much influence on the direction of the project or even the work they are able to do. And so, the question becomes, who gets to belong in engineering spaces?

Engineering culture has historically privileged white, male, middle class students. As this idea of what an engineer looks like is reproduced through who are in positions of power or whose work is highlighted in course materials, students reproduce these narratives by choosing or gatekeeping who gets to belong.

And with belonging comes the set of privileges listed above, and more. As Serenity expresses, those that belong “*can just, you know, they can just be engineers...but I can’t just exist and do what I want to do.*”

Faculty are also impacted by how they must act in order to remain in those positions. Oftentimes, faculty’s behavior is influenced by whether or not they have tenure. If they have tenure, they have job security and can, at best, pursue their interests, and at worst, allow their biases to impact those with less privilege such as non-tenured faculty or students. Those without tenure must “play their cards” carefully. If they speak up against inequities, are they seen as troublemakers? Will their futures be secured? They also do not have influence over the careers of tenured faculty.

Faculty also have the power to implement disciplinary actions with students. Although there are general policies at the university, college, or department level, faculty have a lot of agency as to how to implement these policies in their classroom. Faculty can choose to do things well or keep doing things how they have always been done, which in engineering, has been to cater predominately to white, middle-class cis-gendered males.

### 6.2.3.3 Structural Domain of Power

Students are operating within structures that are in place and they have little control over. For example, as project-based learning continues to be a standard practice in engineering, working in teams is a guaranteed part of an engineering education. Help-seeking is another normal part of engineering education. Office hours are an expected part of success, not accounted for in the credit or unit allocation of time. Due to the culture of rigor, usually students are expected to learn material independently. This aspect of engineering education means marginalized students have to interact with educators, whether or not those educators are aware of their discriminatory comments or behaviors.

Faculty are also operating within existing structures. As seen above, the tenure system has an impact on what faculty spend their time on (i.e. research, teaching, or service), how they reproduce or interrogate

existing barriers for students or other faculty, and how much of an impact dismantling problematic systems have on their careers. Another interesting structural reality is the amount of power of the chair has, particularly over non-tenured faculty. Their jobs are at the hands of the chair, not only regarding tenure, but also what faculty, particularly non-tenured faculty, are able to spend their time on.

Finally, engineering has a long history of underrepresentation, misogyny, and racism. This history impacts how individuals interact with each other, who consequences apply to and how, and finally, these ideas are reproduced in how engineering education is structured.

## Section 6.3 Identity Exploration

Section 6.3 explores the artifacts left behind by the participants, including ideas they wrote on sticky notes, either virtual or physical, and the reflections they wrote for each session. Unlike Section 6.2, this section is organized by session, and then includes student perspectives first, followed by faculty perspectives. As a reminder, both iterations of the sustained engagement included three co-design sessions. Similar to Section 6.2, this section ends with a connection to the Domains of Power.

### 6.3.1 Session 1

In session 1, students and faculty brainstormed, among their own peers, instances of exclusion either witnessed or experienced. Both groups then shared what each group discussed and had a chance to ask each other clarifying questions. In their reflection, participants were asked to share a summary of the session and to also read about the identity wheel and shared which identities were most salient to them in the first session. In the second cohort, Serenity joins the study after Session 1.

#### 6.3.1.1 Students

As students brainstormed instances of exclusion they had either experienced or witnessed, they often shared some of the stories they had shared in the pre-interview related to power dynamics. In Workshop 1, Sam writes ideas about forming groups and different reasons students are left out that way, having unequal access to information and resources, and power dynamics that arise in groups and how that relates

to students having limited ideas or ability to participate. He also notes the potential to feel excluded during class work if the student is not competent in the course material yet. Sandy's ideas are more general and include statements such as "*When someone doesn't have a certain thing, so people **exclude** them from whatever they are doing with that thing.*" She also mentions basing "*everything off of intelligence.*" and **discrimination** towards someone with "*different looking/smelling food*" or because of "*where they're from, race/ethnicity.*" Sawyer writes down statements related to "*excluding ideas not worth trying,*" not being able to register, and not being included in a group during class discussions. Sarah also mentions exclusion in class environments when students are not called on, being excluded from a lab group when it has reached maximum capacity or not being able to sign up for a class or quiz section because it is full. The ideas tend to be around forming groups, access to resources or courses, and participation impacted by quality of ideas, competency, and intelligence. Even though Sandy has general statements, she explicitly calls out racial discrimination.

Ideas brainstormed in Workshop 2 are generally different from those in Workshop 1. One thing to note is that the first session in Workshop 2 only had two students. Sebastian writes down "*difficulty networking*", "*imposter syndrome*", and being misunderstood or having people say, "*we covered this in class.*" Selena also writes examples of dismissive comments, peer superiority complex, imposter syndrome, and TA's looking down on her because of her gender.

In the reflections from Workshop 1, Sam, Sawyer and Sarah mention faculty. Sawyer mentions finding it interesting to hear from faculty, Sarah mentions feeling empowered by sharing the female identity with the "*more powerful*" individuals in the room, and Sam shares feeling disempowered by the same phenomenon because he identifies as male and decides to mostly listen throughout the session. In Workshop 2, students share more insights about the presence of faculty. This is most likely because the reflection question for Workshop 2 was modified to include, in addition to a summary, "*your own thoughts and perspectives in the description. Where did you see power dynamics and how did you react during the session?*" Sebastian says,

*“What surprised me the most was how there were a lot of similar experiences between students and faculty. For example, finding the best **support** from people within our own community. Or how sometimes we **just accept** these events as the norm/become **resilient** to it in order to just move on with our life.”*

Both students in Workshop 2 included that it was “*nice*” or “*interesting*” to hear that the faculty brought up conversations related to inclusion with other faculty. Selena mentions liking “*the diversity in the faculty and facilitators, I **felt more comfortable** talking about my experiences and hearing others.*” These comments point to the importance of having shared identities with those in power, and the need for diversity in the professoriate.

When sharing salient identities in this session, all students from Workshop 1 mention age. Some relate age to being younger than the faculty and a couple relate age to being either younger or older than their peers. Three of the four students mention gender, pointing out that only female identifying faculty were present. Sam acknowledges that generally, males are privileged in engineering but still having the mismatch in gender (relative to most participants in the workshop) becomes a source of disempowerment. As mentioned earlier, Sarah feels empowered by this gender dynamic in the room. The last salient identity mentioned is socioeconomic status (SES). Sandy mentions that SES was talked about often in the conversation but no one discussed their own SES.

Both students in Workshop 2 mention Ethnicity/Race as a salient identity. To Selena, having the shared ethnic identity with the other student made her feel at ease. Gender is also salient, and again, she appreciates the diversity in the session as a whole. Sebastian mentions how often his ethnicity has been “*called out for no real reason*” in his experience in engineering, and yet other times, he has felt isolated when he cannot find others with this shared identity. He also connects his SES with being first-generation and how that has led him to ask very specific questions and felt people would get tired of his questions, compared to not getting tired when being asked questions specific to the sciences.

We see throughout the sessions that age and gender are the most salient identities for students in Workshop 1 and race/ethnicity and gender are the most salient for students in Workshop 2, giving us insight into the role of shared marginalized identities in these spaces.

### 6.3.1.2 Faculty

Faculty observations from the session include Fay's note that "*the students' first question to our faculty group was where we got our examples from – our experiences or what we saw in the classroom.*" Faculty from both Workshops notice that there is overlap between the faculty and student list of experiences of exclusion. In addition to this point, Felicity notes that the students in Workshop 2 "*were **also wanting feedback and insights from faculty about their use of power in interrupting/disrupting the acts of exclusion, which most likely came from feeling disempowered.***" Fay notes that "*Students also talked about how there might be preconceived intelligence,*" which she interprets as a form of imposter syndrome and considers having conversations about this topic in her classes. Fanny observes that in the joint discussion, "*A lot of the discussion centered around clarifying points from the faculty and students.*" Finally, Felix points to the power he observes in his session for Workshop 2,

*"It was clear that there was a perceived power difference (or at least experience difference) between the faculty and student groups, but that didn't seem to hinder the conversation. It may have been the acknowledgement that power imbalances exist and that we were there to address them that helped the conversation progress. It also helps that there is no active imbalance at play in the workshop, i.e. . . . grades."*

In both workshops, faculty members bring up different ways faculty in general create instances of exclusion for students. Common ideas of exclusion in both Workshops included **a lack or representation in classroom examples, ignoring students, particularly female identifying students, or embarrassing students due to being shy or a language barrier, the unfair division of roles, and faculty not being aware of or wanting to acknowledge identity-based differences among students.** In Workshop 1, there was a focus on students feeling left out when forming groups, sometimes based on identity (e.g.,

age, first language), financial capital, and social capital barriers to extracurricular activities. In Workshop 2, faculty mention instances of exclusion such as racist comments made by professors in class and instructors either shying away from or ridiculing ideas of inclusiveness.

Generally speaking, when faculty list instances of exclusion, the onus is put on the faculty or structural barriers such as financial need, but only in Workshop 2 do faculty explicitly write “*instructors*” or “*professors*” do or do not do “X”, exclusive action. One term that stands out from Workshop 1 is “*blind spots*,” which continues to come up in conversations and reflections.

In Workshop 1 reflections, all three faculty shared that gender was a salient identity, in part because all of the faculty were female, an uncommon thing in engineering spaces. Fay mentions age, particularly in a field that values older, white men’s new ideas, but not necessarily, older white women’s ideas. Fay also points out that the identities by which she is empowered add to her **feelings of comfort** in different spaces. Fatima shares that race, in conjunction with gender, is salient because “*others make assumptions about her and look down upon her based on this in engineering spaces.*”

In Workshop 2 reflections, both faculty members chose race as a salient identity. Felicity noted that race is salient throughout the conversation in general and Felix noted that as a white-passing man, these are the most privileged identities. He mentions the positive side to having these identities is that he can share from these perspectives, but that he does find himself trying to distance himself from those identities during the session.

### 6.3.2 Session 2

Session includes sharing personal experiences of exclusion and inclusion. Participants then sort these into the brainstormed ideas from session 1 and start to have discussions on how they might address these instances of exclusion. They also share an identity that is salient to them in engineering spaces. Felicity was absent for session 2 and Serenity did not complete the reflection from session 2. The data

includes artifacts i.e., sticky notes, used for brainstorming and reflection submissions. Again, in this section I will separate findings by students and faculty.

### 6.3.2.1 Students

The instances of inclusion and exclusion shared by students have some similarities. All students from Cohort 2 and half the students from Cohort 1 share an experience of inclusion, where others wanted to include them in their group. Sawyer mentions students in his lab **asking** him to “*join their study group.*” Sandy says, “*when you’re starting to pull back and **someone notices and pulls you forward.***” Serenity says, “*being included in group activities in labs,*” Sebastian adds “*when **people want to work with me,***” and Selena says, **being welcomed** into a group “***without feeling awkward.***” Sam shares a considerate act from a faculty member and Sarah mentions a conference she attends with her capstone team.

The instances of exclusion shared vary a lot. Sarah and Sebastian both wrote that not knowing someone in industry made them feel excluded. From Cohort 1, Sam feels excluded when a classmate has more information than him on an assignment, Sandy mentions having an idea “**skipped past,**” Sawyer mentions his lab group having a **meeting without telling him,** and Sarah also adds not having a group to talk with during class discussion. From Cohort 2, Selena mentions feeling like she **can’t contribute** to a conversation and Serenity mentions **no one at work willing to interact** with her.

In the reflections from participants from Cohort 1, gender is the most salient identity for all participants. Again, Sarah is empowered by this, but Sam is getting increasingly “disempowered” by this dynamic. He says,

*“The group consisted of mostly female individuals, who were discussing how they were marginalized and excluded from STEM multitudes of times in their careers. I felt that it was very difficult and disempowering during this conversation and did not contribute to this portion of this conversation even though I had experienced marginalization and exclusion as a non-white individual.”*

He also attributes this lack of empowerment to age and experience. He says,

*"I felt that this part of the conversation had power dynamics in the conversation, where the voices of faculty were weighted due to the nature of their **position** as well as their age. Students **participated less** in conversations, and I felt that it was **harder to speak up** in this conversation as well. However, there were still opportunities to speak and have discussions during this workshop."*

He feels like there are still opportunities to speak, but they are limited. Sarah makes a note of this dynamic as well and says, *"That same wealth of women's experiences/input meant that it felt like some of the power was in our hands, and the guys got much more quiet. I tried at one point to draw one of them back into the conversation, and he definitely shared some ideas that really sparked my own ideas."*

Sam, Sandy, and Sawyer share that age is salient for them. Age is salient for Sawyer because of the conversation around how "older professors are a big problem since if they are unwilling to take part in improving power dynamics in the classroom then little to no change will be seen." Sarah says race was salient in this session because, *"the discussion and some of the specific examples that other folks mentioned definitely hammered home that I have privilege in my race."* Sawyer notes that *"everyone picked either gender, age or race because those are the most related to power dynamics in the classroom"* and concludes that *"From our small sample size, addressing these identities and understanding them better is the key to how we see power dynamics in engineering."* He is aware of the limitations of the "sample size," but is starting to note the connection between identity and power.

From Cohort 2, Selena's reflection is short. Race and gender are salient, but she is left with her observation, *"I noticed how **negatively affected** students are from the power dynamic on campus. It gets to the point where students are more inclined to **brush off** these incidents than speak up or go against those in power."* She writes that she does not feel disempowered by the [dynamics] in the meeting but "mostly from thinking about the experiences when we talked about them aloud." Sebastian's reflection adds, *"One thing that stuck out to me was how easy it was to recall some of the negative experiences in detail, compared to some of the positive ones."* One main focus of his reflection is how his SES and family's national

origin has impacted his experience as a first-generation college student, in short, he says, “*my family's background made it (feel) harder to match the same accomplishments as my peers.*”

Overall, students grapple with power dynamics in the session, making sense of previous experiences with power dynamics, and exploring how their own identities and others' impact everyday interactions.

### 6.3.2.2 Faculty

Examples of instances of inclusion for faculty revolve around being invited to non-engineering activities, receiving encouragement to apply to graduate school, getting involved in student groups and being commended for a job well done at work. Instances of exclusion included having to walk 15 minutes round trip to the women's bathroom at a manufacturing internship, being told by male peers “*women have to prove themselves,*” and not “*fitting in*” at conferences.

In Cohort 1, age and gender are the most common salient identities. Fatima mentions SES because of the conversations around workplace discrimination and Fay mentions feeling empowered not only by age and gender but also by her race. Although Fatima's reflection is short, the following statement supports what Sarah and Sam have been feeling, “*I did notice a power dynamic occur between students and instructors during the discussion.*” Fatima does not say more but both Fay and Fanny mention in their reflection how often gender was brought up. Fay says “*I also found the commonality of **gender unifying** in this situation. I am curious if the students felt empowered or disempowered by this session.*” Fanny says, “*gender was brought up a lot,*” but this made her feel “*empowered to share how my gender has played into people's (both professionally and personally) perception of me as an engineer.*” She also comments “*it is incredibly important and special for younger female students to see an older female faculty,*” which is consistent with Sarah's feeling of empowerment based on the shared gender identity. Another common observation between Fay and Fanny is that, when sorting experiences of inclusion, “*examples could go in more than one place and/or if other people might put them in different groupings*” based on individual identities and own experiences. Fay proceeds to discuss intersectionality in her reflection, wondering if “**you don't feel marginalized by one of the “identities” do you even understand that it can create**

**these power dynamics?”** and finishes her thought by saying that talking about “this” makes her **feel vulnerable**. We see here the faculty trying to make sense of the tensions that came up with the benefits of shared identities for those participants who also shared them but the potential downside for those that did not share the identity.

In Workshop 2, Felix is the only faculty present during this session. He mentions age and SES gives him more confidence in voicing his opinions, but again, makes it more awkward when asked to “*reflect or identify privilege.*” Yet, he is still able to listen to students carefully during the sessions. He notes how “*The students in the group reflected on how **many of their identities were sources of exclusion both from faculty and their peers, and noted how constant this sense of exclusion was.***” This supports the feelings of “*hopelessness*” mentioned by students in their reflections. One common thread in the conversation was “*getting people to care more,*” about the effects of exclusion. The conversation also focused on how to address these issues and two takeaways for Felix were that when exclusion happens, these issues should be reported and that a third-party mediator should be involved. The pressure of “*doing something about it*” should be taken from students or those being affected.

Identities continue to become more apparent in the group conversations for each faculty participant.

### 6.3.3 Session 3

Session 3 is unique in that the participants do an in-session reflection and then spend the rest of the time brainstorming and writing down ideas for creating change. In the following section, I will first dive into the reflections, students first and then faculty, and then I will look at the artifacts of ideas. Because the final recommendations for change are more of a conversation, instead of individual contributing ideas on sticky notes, I detail the results and speak generally about themes in the recommendations. For Cohort 1, Fatima joins on Zoom as she was traveling. For Cohort 2, Selena is absent. The reflection questions are as follows:

- Pick one identity that made you feel empowered in these sessions? How might you use this identity empowerment to help others feel empowered?

- Pick one identity that made you feel disempowered in these sessions? Can you think of something that might have helped you feel more empowered?

### 6.3.3.1 Students

In Cohort 1 age and role are what contributes to feelings of disempowerment, both which are similar in nature. Sawyer and Sam feel that because of these identities, their voices are not heard. Sam suggests using more anonymous ways to share experiences of exclusion. Sandy is still very aware of how young she is compared to the rest of the participants. And Sarah says these identities make her feel disempowered because she is leaving the university soon. She does say she can still take what she learned in these sessions because it is applicable outside of this context. Despite experiencing frustration with the role of his gender in this session, Sam still says he is empowered by this and will use his *“privilege to lift up the voices of marginalized individuals.”* Sawyer is empowered by his SES because he feels fortunate to be able to attend college without any financial worries. Sandy felt empowered by her first language since everyone spoke the same language and she says it is difficult to connect with her grandma, who speaks broken English.

In Cohort 2, Felix is disempowered by his ethnicity, but has found that finding others that share his identity has helped him feel more empowered, welcomed, and at home. Serenity feels disempowered by her age because professors make her feel incompetent, but she says she needs to remember they were once in her shoes as well! Felix is empowered by his gender/sex and he says he can 1) recognize when others face difficulty due to their gender and 2) make sure to treat them as equals. Serenity says that even though she is marginalized due to being African, she says she feels empowered to be a part of this identity because *“we have gone through so much and still prevail and will not allow anyone to define us.”* Speaking of this empowerment and letting it show is the best way to help others feel empowered, she says.

### 6.3.3.2 Faculty

In Cohort 1 gender and role are empowering. Faculty share that being in a position of power allows them to get student voices heard. For disempowerment, age or role are also what faculty write, although each with a little nuance. Fanny shares she does not have any peers, but that everyone is respectful which does not make her feel disempowered. Fay shares that Sarah sees her (Fay's) age as a good thing and

therefore Fay is considering intersectionality again. Finally, Fatima feels disempowered by these identities as well, but says that if there were older, tenured faculty present, the sessions would feel more valid, but she might feel more disempowered and uncomfortable with speaking up.

In Cohort 2, both participants are empowered by their role as faculty. Felix says he can “empower students by creating a more inviting space for them” and Felicity says she can use her power to amplify the voices of students and staff. Both feel disempowered by race. Felicity does not expand but Felix says he oddly felt disempowered because he is white-presenting and it made him feel awkward discussing topics around race.

Overall, it is hard to understand how faculty are defining disempowerment because they do not expand much on their comments.

### 6.3.3.3 Inclusive Practices Developed from Sessions

The final topics for change for Cohort 1 are:

- Unequal Access
- Respect
- Identity
- Forming Groups
- Power Dynamics in Groups

Due to time constraints, participants in Cohort 1 did not have the opportunity to develop these ideas into specific practices or policies. They do have specific examples of how each of these might look.

The final topics for change in Cohort 2 are:

- **Accountability and Action**
- Create an Independent **Accountability** Office to deal with DEI Issues
  - That Takes the Impetus off of the Affected Party
- How to **Care**; Include Others
- DEI Resources/Centralized Information
- Interweave Diversity **into the Classroom**
- Stronger **Disciplinary Actions** for acts of Exclusion, Racism, etc.

- Give People \$\$\$ for doing a good job with Inclusion

Participants in Cohort 2 had more time to write more specific practices, but less time to expand on what each meant.

## 6.3.4 Connections to Domains of Power

### 6.3.4.1 Interpersonal Domain

Having explicit conversations about identities seems to give the participants an opportunity to see how power affects those with different identities or a different set of intersecting identities in different ways than how they experience power. In session 1, students and faculty are sharing similar experiences of interpersonal interactions as they did in their interviews, such as having the quality of their ideas judged. But as the sessions progress, they start naming how their experiences compare to those of others. This brings up feelings of comfort or discomfort. Because participants can think about their identities after the first session, in shared discussions, they begin to share experiences of sexism and racism. In seeing how their identities play out, participants start sharing their feelings of awkwardness or of wanting to distance themselves from their privileged identities. Or others grapple being a minority when they tend to be privileged and in the majority in engineering spaces. Participants are forced to deal with these realities, mostly in the safe space of reflections. It is interesting that Felicity points out students in Cohort 2 using the space to ask for advice. Both faculty in this space notice the deep feelings students are dealing with as they share experiences of discrimination. Faculty in Cohort 1 point out that students ask them where their ideas of exclusion are coming from.

### 6.3.4.2 Disciplinary Domain

Although not mentioned explicitly, feelings of awkwardness and disempowerment might come from the fact that conversations of identity are not normalized in engineering spaces. Emotions themselves are culturally looked down upon in a culture that values objectivity. We also see other types of emotions coming from Imposter Syndrome and admissions of being vulnerable. Another theme that is not explicitly mentioned is that ignoring racism or conversations of exclusion do not have a consequence in engineer-

ing spaces, in fact, there are probably more consequences if you do have these conversations. Participants in Cohort 2 are more likely to explicitly name things as “racist” than participants in Cohort 1. In fact, participants in Cohort 1 at one point call microaggression “blind spots.” Finally, participants begin to share ideas of reporting or consequences for those discriminatory behaviors. Rightfully so, faculty realize the importance of not leaving the responsibility on the students to report, given the power dynamics. Finally, we also see some participants begin to talk about how other spaces that would have people with more privileged identities would make these conversations harder, again due to the power dynamics.

### 6.3.4.3 Structural Domain

For the structural Domain, students and faculty start the first session with naming more structural problems. This includes not being able to sign up for class or quiz sections, financial barriers to accessing resources, and access to extracurricular activities or even internships. Building up a substantial resume is a critical aspect of engineering in order to get a job post-graduation. Even though internships and extracurriculars are not really optional in engineering spaces, students are expected to find these opportunities on their own but there is unequal access to participating in such. This creates structural barriers. Socioeconomic status is brought up as ideas of exclusion in Cohort 1, but participants in Cohort 2’s personal experiences implicitly allude to SES. This brings up an interesting question about how finances are known barriers but that the lived experience really varies.

## Section 6.4 Looking towards Change

Section 6.4 discusses the post-interviews, focusing on participant takeaways. The questions included:

1. What are 3 takeaways from this workshop [engagement]?
2. What was the most surprising thing you observed about power dynamics?
3. After this experience, what do you see as the role of [the conversation around] power dynamics in engineering spaces?

Overall, students and faculty had similar takeaways. The examples used by each participant give us a nuanced understanding of what they took away from this engagement. This section will be organized by pre-

senting the takeaways first in Section 6.4.1, and then overall participant observations about power dynamics in Section 6.4.2, organized by students first and then faculty. Section 6.4.3 will include connections from these findings to the Domains of Power.

## 6.4.1 Participant Takeaways

There were six takeaway themes from all the participants. Takeaways 1-3 come from both students and faculty while takeaway four and five come from only students and takeaway six comes from faculty only.

### 6.4.1.1 The Opportunity to Hear Each Other's Perspectives

The most common takeaway from participants was, from the student's perspective, that "it was nice" or from the faculty's perspective, that "it was interesting" to have this opportunity to talk to each other. Nine of the 12 participants had a takeaway related to this opportunity. Interestingly enough, just one of the 4 students from Cohort 1 had this takeaway, while all students from Cohort 2 and all faculty members had this takeaway.

Comments from students included:

*"It was an environment where I could talk about these things, it was a really nice environment. Because I would never go [talk about] these issues, with my professors or like anybody else."*  
(Serenity)

*"It's really kind of unique to like, talk or interact and listen to what they [faculty] have to say, especially when it's like outside of the classroom. It's kind of a different environment."* (Sawyer)

Selena also thinks the interactions were "nice" and adds comments about also being able to hear that faculty have a different perspective about student interactions saying,

*"I think also the fact that the faculty members were, I think it was crazy that some of them didn't know. Well, I feel like they do know, but they don't realize to what extent [students face discrimination] and I think that was like an eye opener, because, you know, we don't talk about this sh\*t."*

Sebastian adds that it was an "error" on his part to assume and that "it's not just the students" that experience discrimination.

Faculty's appreciation of this interaction mainly comes from seeing how, although both students and faculty are aware of similar issues of exclusion, each group's perspectives and priorities are different. Fanny "liked the collaborations between undergraduates and the faculty." Similarly, Fay thought it was "great getting the student perspective." In addition to enjoying hearing the student perspective, Fatima thought it was a "very valuable part of the experience [workshop]." Felix thought "it was a really interesting opportunity to get to talk with undergrads about how they think about inclusion in the classroom space."

Finally, Felicity shares an interesting perspective,

*"One takeaway for me was not surprising how different a lot of the student responses have been to some of the questions compared to what faculty observed either directly or indirectly. Also, another takeaway was that there were some similarities, especially, for example, the conversation around what students had experienced from older, more senior faculty. Like some of that echoes across the power dynamic."*

The experience as a whole was valuable to both students and faculty. For students, it was a different type of interaction, and mostly a positive one. Faculty appreciated hearing perspectives from students because it's not often that they have this opportunity. Fay mentions she sometimes hears from her TA's or from course evaluations, Fatima mentions hearing some of these perspectives from student reflections, but it is more about whether or not they liked the course. And Felix mentions that he has been a Residential Assistant before, but that students never really shared about instances of discrimination.

### 6.4.1.2 The Work is Hard and Slow

Half of the participants (four students and two faculty) mentioned that the work of creating change in terms of inclusion in engineering space is hard and takes time. Serenity says, *“it’s really hard work...there’s a lot of work that still needs to be done.”* Sebastian remembers Felix’ analogy of a ship turning; *“it hard to know if progress is being made... it might just take a while.”* One of Sarah’s takeaways is that she cannot believe that the proportion of women in specific engineering departments has not changed in decades. Sam’s perspective is that there is “a lot of work that still needs to be done” and that,

*“There are tangible things that can be done within classrooms and in the community that just have so many legalistic or so many institutional blocks that prevent that from happening; something as simple as adding things to a syllabus or restructuring how classes are done, I guess logistically as well.”*

Serenity shares a similar sentiment when recalling the last session when the group was trying to come up with policies. She thought it would be doable but once she started thinking about it, it just became *“that much harder.”* She says,

*“Trying to find solutions is really hard. There’s so many things to consider that can’t think about once you start trying to come up with solutions, there’s so many things to consider. And the work that people do, and it’s just like, you can’t please everybody at the same time.”*

Two faculty express similar feelings. Felicity says,

*“I think, for me, especially the last session, it was kind of hard for us to narrow down where exactly changes to be made, or how to implement suggested changes to help balance the power dynamic and moving equities that we brought up during the meeting.”*

Fanny shares a similar sentiment as Serenity, saying *“It’s really difficult to strike a middle ground where you’re going to make it, I guess, inclusive and a good experience for all parties.”* Both students and faculty

here realize the difficulties of this work, whether that is because the change is slow, including the bureaucratic processes or because it really is difficult to create spaces that make everyone happy. Inclusion is not about pleasing everyone, and that is why it is difficult, it's a negotiation process.

### 6.4.1.3 Connecting Power and Identity

This next theme relates to takeaways participants had specifically from having conversations about power and identity. Six of the 12 participants mention this takeaway (three students and three faculty). From the students, only ones from Cohort 1 had this as one of their takeaways.

Sam and Sawyer both mention the Identity Wheel and how it facilitated the conversation. Sam says,

*“When we did that identity wheel activity, I think that's when the conversation truly opened up to a new level where um the participants could be a lot more open with each other, more communicative, more understanding, I think, establishing that initially, it's really crucial to have these kinds of difficult conversations about inclusion and equity.”*

Sawyer says, “We could talk about the identity wheel, and really seeing how some of those identities and the identity wheel are connected to power dynamics or ways people are excluded or included in the [engineering] classroom.” He then continues to share his surprise when both male and female participants shared gender as contributing to their feelings of empowerment. He was able to see how who was in the room affected the feelings of empowerment on different identities. Sarah mentions that she can use “the word power dynamics or the words power dynamics to describe some of the things that I see not really necessarily at school, but just kind of in life.” Power is a term that transfers to different environments.

Faculty with this takeaway each have very different perspectives, but all relate to identities. Fanny says it is “rare” to be in a space where you talk about identities, like we did in the sessions with the Identity Wheel. She continues, “**I guess something that you subconsciously think about, but not something that you actually explicitly say or speak out loud.**” Like Sawyer, she is also surprised how people picked the same identity (age) for feeling disempowered, but everyone's age differed so much. She also

says she was “*surprised by how much people were willing to share,*” especially since conversations about identity usually happen with *friends* or in *therapy*. Felicity was surprised how the combination of identities and roles of participants played out. For example, she was surprised that there was not as much distinction in power between male identifying and female identifying participants as she would have expected. Fatima expresses feeling empowered during the sessions because of the demographics of the group.

Both faculty and students share that the identity wheel and the usage of power as framework was helpful to understanding what they were seeing. Students and faculty were also able to see how different identities impacted people differently.

#### 6.4.1.4 The Opportunity to Hear Other Students’ Perspectives

Five of the seven students shared having this as their takeaway. All student participants from Cohort 2 shared this takeaway. Students from Cohort 2 had the added feeling of being validated by hearing that other students had had similar experiences of exclusion. Serenity says,

*“Sometimes, for me, it’s easy to feel like, I’m the only one who has these thoughts, or I’m the only one who’s seeing these issues. So, it was very **comforting** to see other people that have the same thoughts as me [and] that have been talking about these issues as well.”*

Selena shares very similar thoughts,

*“Obviously, there are other students that have similar experiences, or have similar feelings... dealing with these issues and obstacles. So that was really nice. I think it just **validates my own experience...It doesn’t make me feel like I’m isolated.**”*

Both students feel a sense of relief that they are not the only ones having these experiences or thoughts about these experiences. Sebastian’s perspective varies a little. He says he grew up in an environment similar to the environment of the university. In his high school, the only other Hispanic students were his cousins in a predominantly white school. He is surprised that the other students in the engagement could

recall very specific instances of exclusion while he either had exclusion “*happened often enough*” was “*oblivious*” to it, or “*grew up adapting to it.*”

Student takeaways under this theme from Cohort 1 were slightly different in nature. Sawyer appreciates “creating ideas with other students” and Sandy was happy that the other students were “willing to listen to what she had to say.”

#### 6.4.1.5 Taking Action

Although other students mention being inspired to take action in their post-interviews, only the female identifying students from Cohort 1 list it as one of their three takeaways from the engagement. Sarah mentions that “*every time you ask someone their opinion, or what they think or what they got, **you are taking action** to include them.*” Sarah has also shared this insight in previous reflections. Sandy’s takeaway is to be “*more out there*” and to “*get more people involved.*” Sandy talks about “*being more out there*” often, when she is talking about being a leader, being bold, or even just being willing to share her ideas. Both students seem to be inspired into action by the engagement.

#### 6.4.1.6 Session Feedback

Finally, three faculty mention the overall engagement as one of their takeaways. Fanny says, “there should be more of them, this is something that should be done more frequently.” In her takeaway, Fatima shares what she liked about the engagement: “*I like the weekly progression starting with the discussions of ways that power and empowerment or disempowerment might play out in the classroom and building up towards developing some practices in the classroom that we can use.*” And Felix mentions that even though some of the pacing of the exercises were a bit “awkward”, the end discussions they were having were “*really interesting.*” Overall, faculty seemed to enjoy the content and process of the engagement.

### 6.4.2 Observations on Power Dynamics

This next section focuses on the remaining data of the post interview. In this section, I talk about themes that arose from what students said and proceed with themes that arose from what faculty said.

## 6.4.2.1 Students

Three themes arose as students shared their final thoughts on power: “Seeing Power in the Sessions and Beyond”, “Empowered to Change”, and “Who is going to talk about it?”.

### 6.4.2.1.1 Seeing Power in the Sessions and Beyond

Sam mentions being surprised that,

*“once I started keeping it in the back of my head and started thinking about the power dynamics, especially in every interactions I've had like within the week, or even like in the sessions themselves, we all contribute to those power dynamics, you know whether it's from a student perspective or a faculty perspective, or even the interactions I have with friends...we all contribute to these power dynamics, and **that we're not just disenfranchised by them, we are actively participating in them.**”*

Sawyer adds a similar perspective when thinking about how in the future, he thinks he will be able to notice more ways people are being excluded. He says,

*“The identity wheel really helped me understand about the different experiences, the different perspectives that people can have like, for example, for, like gender or race, or like language barriers or socioeconomic status, it help me understand the different perspectives that people identify with, and it made me want to really think about how these different identities affect their opinion, or affects the way they are treated in the classroom, or like power dynamics, or the way they're excluded.”*

He mentions how in the past, *“I don't think I really picked up on a lot of the ways different people could be left out before and I think, from doing this [workshop], I'm definitely, I hope I'm more aware.”* Sarah mentions that she can think of examples of how power could be beneficial as a tool. Sarah already mentioned that one of her top three takeaways was being able to use power as a concept. She brings up her example from the pre-interview, where the professor she does research for can use his power to connect her in industry. She says, *“by talking about it, we kind of open the door to me, knowing that I can use his*

power.” She then says the term can be used also when someone exercises their power in a negative way.

*“Even just where I went with discrimination and power dynamics, thinking about things in that way of, ‘Why is that discrimination happening? It’s coming out of a power dynamic’ can help you back-track [and think about] why something happened, or why something could happen and sort of stop it before it does. Sort of correct. I think it hopefully would open up the space to more people feeling like they belong.”*

She is describing a scenario where someone can pause, think about the power relations involved based on identities, and name what is happening. Sebastian recounts two visits “to kill time” to random non-STEM classes, where he observes that the “diversity was way larger there. There was like a pretty even split on guys and girls and just different ethnicities too.” It was not until he was outside the STEM context that he realized that as a whole, the University was more diverse than he thought, but he had to go outside of his normal context. He also shares an experience his co-worker, a graduate student, shares with him. She is receiving resistance from a professor regarding a class, and she shares that she filled out an anonymous report form “not because she expected something to come of it, maybe at most an apologetic email, but in case for whatever reason, the professor were to like do something that held back her graduation, she could pull up...the receipts.” He mentions it was interesting that she was using this DEI tool “not necessarily get something done but in kind of self-defense.” He brings up this example because he does not think DEI trainings are effective, whereas in this scenario he says, “by sharing it, you kind of just become more aware of what it could look like.... know how other people react to it or try to resolve it.” Through this story, he is pointing to the fact that two structural efforts to support inclusion are lacking—marginalized individuals do not trust the reporting form to create change as intended and DEI trainings are also lacking. He also finds that hearing a personal story first-hand has more impact than generalized stories of exclusion.

Sam makes several observations of power after sharing that he was seeing it everywhere. Again, in his first interview, Sam is the one who said students are aware when they are not being treated well. He begins by saying that *“being a student”* and showing *“respect to upperclassman TA’s, teaching staff, professors ... .is so normalized.”* He continues that this respect has been ingrained through all the interactions he has had with *“I can’t even count the number of teachers...I’ve interacted with throughout my entire life.”* Serenity has a similar example. She says in a room with different people,

*“No matter what, power dynamic is going to be established, using anything, you know, it could be your age, your sex, anything like that. And people, you do it unconsciously.... You hear out the older person a bit more, you listen to their stories more intently..., I certainly was...I gave the faculty a lot more attention.... And it was like a mix of like, oh, they’re older, they’re wiser, they’re faculty members, and I’ve never heard that side before.”*

Sam then continues with how everyone conforms because *“those who choose not to [conform] have many consequences.”* He spends time talking about grades as consequences and then access to opportunities. He says,

*“...in engineering, job opportunities, research opportunities, program opportunities, letter recommendation opportunities that can completely change the course of a student's life, and I think a lot of students might choose to contribute [and] allow these power dynamics to happen for those opportunities. They do that cost-benefit analysis in their heads and say, ‘hey, is it worth it to be treated in this way to receive this benefit?’ And I think a lot of students say yes, it’s worth it.”*

Another conclusion he makes is that some factors that should be addressed in engineering education is that,

*“There are so many factors that play into that power dynamic, and it can’t just be erased even with the series of initiatives or actions. But I do think that awareness...of the power dynamic, right? And what’s okay and what’s not okay, giving resources to students that are facing issues because of these power dynamics and ensuring that faculty are well educated, and also aware of how they may play a role in these power dynamics in not so good ways.”*

I will end this section by sharing Selena's story trying to reconcile her relationship with her white peers. She has two white, female identifying friends in her department, whom she likes. But she says, *"their white woman experience isn't the same as mine...I think it's because of a whiteness of privilege that's there."* And she says this reality is hard for her.

*"If I'm playing reggaeton the people are gonna be like, 'What the f\*ck is [this]...they'll dance to it maybe, but they'll be like, what are you doing? Like, that's loud. Anyway... I've always dealt with that."*

She continues to share how this makes her feel:

*"it's just... not cringe...my body is like trying to close in on itself. I'm trying to make myself look smaller, feel smaller. My brain just wants to disappear from the situation...I automatically go into like white mode. I like the way I talk fast. I use my hand motions, I'm unapologetic right now, but when I'm in a classroom, white people, right maybe like one Asian one black person.... I tone it down because they're gonna say, 'Oh, you're being too loud.' Okay, gotta tone it down."*

Again, we see here the embodied feelings of experiencing power.

#### 6.4.2.1.2 Empowered to Create Change

Again, we see this theme of change re-occur outside of the students top-three takeaways. This time, in addition to the two female-identifying participants from Cohort 1, the female-identifying participants from Cohort 2 also consider change. This is not to say the male identifying participants did not mention creating change. Their suggestions of change were more structural in nature rather than interpersonal. When asked who she has talked to experiences of marginalization with before the engagement, Selena says,

*"outside of this workshop experience, I feel like it's more like ranting and more like letting it off your chest and more like us talking to our friends or like it doesn't really lead to anywhere, you know, but compared to like, in the workshop here, we actually talked about like this had happened about how do we think we would go about it?...we're like, would there be any solutions? Like, are there any plans?"*

In the next section, I share why she thinks this type of engagement might not work in the future, but for now, one of the benefits of the participating is that instead of just talking about her experiences of marginalization, she was able to imagine solutions with the rest of the participants. Serenity also finds benefits in the sessions regarding sharing her experiences of marginalization. She says,

“...I'm just used to not talking about these issues at all, or only with my friends or people of color that get it, I think it's in me, it's very easy to be... pessimistic about stuff or like, not willing to take actions, but I guess it all starts with me, you know, **if I want change, I guess I should start bringing up the things that affect me.**”

She is weary of having to carry all these experiences of marginalization with her. But she continues,

“But then again, that's really uncomfortable. I hate the fact that it has to get personal...it has me thinking about how I've been moving through life with these thoughts in my head, only in my head or to certain people. I should probably change that, **at least do something with this trauma instead of just sitting in it.**”

Even though being in spaces not designed for one creates embodied feelings of marginalization and requires emotional labor, these women of color are still thinking about change and making things better. They are aware it is no easy feat, but they also want to see a different reality.

#### 6.4.2.1.3 Who is going to talk about it?

The last, but not least theme is that students know the work of this engagement will not solve inclusion efforts. We start with a quote from Sam on his takeaway from interacting with faculty:

*“...there are actually people in leadership roles, and those that have power... that are, you know, really willing and passionate in making change.”*

He points out that the faculty present in the session are *“those that have been marginalized and those that have had their voices smothered.”* He was also *“disappointed to see...those that might abuse those power dynamics weren't really present.”* He brings up the legalistic processes that create barriers for

change and says *“that was really saddening to hear, not even disappointing”* and he ends with saying, *“it was also really inspiring and really just touching to hear how they’ve [faculty in the workshop] personally made changes in their own classrooms.”* From Sam’s quotes, we see this tension between remaining realistic, when it can be too easy to become pessimistic. With regards to power, Sarah says,

*“Well, someone has to decide to talk about it and so usually it’s either going to be the person in power talking about it, in which case they **have to be aware** that it’s a thing, they **have to care** that it’s a thing, and then they **have to want to do something** with that information,”*

echoing a little bit what Sam said about just the many steps required for one person to even decide to want to make change. Sarah also mentions the realities of *“prioritizing your time”* to talk about power and also *“feeling like the risks are too great.”* Sawyer also expresses very similar sentiments. He says,

*“The biggest thing I learned about it is, you really have to have someone who is willing to talk about it in order to see change because if you’re having professors or students who don’t want to talk about... you’re not going to see results. You have to have someone who is at least willing and open to see change.”*

He continues and adds why he thinks some professors might not even see inclusion as an issue. He says,

*“They’re so used to it... in their eyes they’ve never really seen it as a problem from the perspective of a student, and they’re only viewing it from the perspective of a professor, but I guess in that way it could benefit them the most. They probably say ‘Well, it hasn’t been a problem in the past twenty years or thirty years. Everything has been fine; I’ve been teaching just fine’.”*

Serenity expresses a similar sentiment as well. She says,

*“I feel like the only way people are ever going to talk about this is to force them. Not gonna lie... I will gladly willingly talk about this, because it affects me all the time .... conversations like this might make certain people feel uncomfortable, but then, but I think it’s important to feel uncomfortable. That’s how you grow.”*

This comment is consistent with her other comment about talking about her experiences even though she is uncomfortable with it so that change can happen. She is not asking any more of others' than she is willing to do herself. Her next comment is interesting considering the recent Supreme Court Decision making race-based admissions unconstitutional. She says,

*“So I feel like you have to force it just like everything in this country, like affirmative action... it's very sad, but I feel like that's the only way...throughout history [you have to] force change, or else it's not gonna come to a consensus.”*

Selena also has thought about why she thinks these workshops might not work on a larger scale.

*“It would be nice to have these conversations, I just don't see it being possible right now. And I think that goes in hand with our little POC students we have in certain engineering departments, how would we organize these conversations? ...some faculty, I don't think they'd be willing to talk about these kinds of issues because it makes them uncomfortable .... And it's just like a lot [of things to consider].”*

The engagement was intended to be a step toward change. Although students still have reservations, students still saw opportunities for change after participating in the sessions, given their post-session interview responses.

## 6.4.2.2 Faculty

In their concluding thoughts, faculty share what they are used to hearing about from students, how they saw power in the session, and how to move forward with conversations of power in engineering education spaces.

### 6.4.2.2.1 What We Hear from Students

Felix has had many opportunities to work with and mentor students as a residential advisor. In that position, students often shared feeling stressed about the amount of work they had or even other mental well-being concerns. He did not really hear about students feeling like they did not fit in. Felicity also talks

about the few interactions she has with undergraduate students, especially as a new faculty member working on building her research program. She teaches one course to undergraduate students and maybe has students working in her lab. Beyond this, students seem to go to Academic Advisors for advice, and she says this makes sense because they have usually been at this institution longer than she has. Fay also talks about hearing from students through mid-quarter assessments and by talking to the undergraduate TA's she has. Fatima shares that she hears from "*students after classes are over like some kind of one-off reflections.*" Overall, students rarely talk to faculty about experiences of discrimination. Felix adds,

*"I don't think a lot of people also recognize exactly what people of color go through, or what women or minority groups go through in engineering, especially, like seeing these perspectives from students, again, it doesn't come up, like, there's no mechanism to be like, these students are not having a good time, there's not a lot of black people in the department, because they don't see a space for themselves..."*

This quote highlights one of the reasons spaces for conversations like the ones had in the sessions are important.

#### 6.4.2.2.2 Power in the Sessions

Faculty also shared ways they saw power within the sessions. Before the start of the interview, Fay shares,

*"I do feel like I tend to, like talk a lot, and I worried sometimes that I dominate...It's a role for me... and I try and rein myself in sometimes, but it's like, a natural place for me to go .... whether that's part of because I'm faculty...okay, well, gotta get this done."*

This is an instance of her seeing her exercise her power by "talking a lot." She continues to share that oftentimes, she is not consciously thinking about whether or not she is in a position of power. She says,

*“Most of the time, in our conversations in this, I’m not even thinking about power or not coming from that place, which may be because I’m coming from this place of power. Because I’m coming from the faculty versus the student.”*

She attributes this observation to the fact that she often felt comfortable in the conversation and made the realization that it was because her role of faculty held privilege compared to the role of students. Fatima shares that she was surprised to see the power dynamics between students. *“Even among the students I kind of got a sense that there was a power dynamic between the younger and more senior students.”* She says she had assumed the students would come in feeling like a cohort. Fanny says, “[I] guess that was kind of like almost anti-power dynamics in the session.” She says that what she thinks *“toned down”* any power dynamics that could have been there was the fact that *“more or less like everyone’s kind of willingness to share vulnerable things.”* She continues to share that she once participated in a very similar activity with her department on Zoom. They discussed how to create more inclusive teaching practices, and the leader was determined by who had the closest birthday coming up. She remembers *“being in a breakout room like me, and three faculty, and absolutely feeling like the power dynamics there, like the faculty had all the power in that situation, I was like careful about what I said.”* The facilitators did attempt to address power but were not aware of who was present in the room, nor did they talk about why acknowledging power was important. Felix notes that students’ hesitancy to speak probably pointed to the presence of a power dynamic. He says, *“even if it’s something you hold as a deep-seated belief, or that you feel strongly about that doesn’t always mean you’re gonna voice it to somebody who may react negatively toward it, especially if that person is in a position of power...in the group in which you exist.”* Faculty were able to see and acknowledge how power dynamics affected the conversations they were having.

#### 6.4.2.2.4 How to Move Forward with Conversations of Power

Finally, all faculty shared their thoughts on how it would be possible to continue having these conversations in engineering spaces. Most agreed these conversations are necessary but that there should be more done beyond just the activities they walked through in the sessions. Participants shared what ways the workshop experience was successful. Felicity shares that *“the real-time”* discussions are more impactful because *“whatever scenarios playing out rather than like, oh, like months ago, I heard so and so say this, then, like, you know, that was problematic, because and then it's been months later.”* She also mentions that for the barriers to be lowered to have such vulnerable conversations, it *“takes a lot of community building.”* Both Fay and Fanny suggest that increasing representation among the faculty would help overall with helping students feel comfortable and welcomed, especially when *“they're just looking at a room of people that don't look like them, or don't have the same experiences as them.”*

Faculty agree for the most part that power is not going away. Felix says, *“It's not enough to be not racist, you have to be anti-racist,”* expanding on the need to have an active role in addressing these issues *“if we're not doing anything to create that sense of belonging, then we're failing, we're allowing the system to go unchanged. Because it doesn't just change organically.”* Both Fatima and Fanny also point to including people with more privileged identities. Fatima says *“we need to get more people across the dynamic spectrum to be present in these conversations,”* and Fanny says, *“It goes beyond just students and faculty like solving this I think that you need people from higher up kind of helping with the diversity, because a lot of these problems, I think, would be not fixed,”* both pointing to the need of support from leadership and the support of those with most privilege to create change against entrenched norms. Finally, Felix adds some of the things he has been doing for himself to address power and privilege. He mentions he will pay closer attention to peer-to-peer interactions, use his privilege to start some of these uncomfortable conversations, and continue to *“educate myself in trying to see where a lot of my knowledge gaps are, listening to lots of history podcasts, listening, trying to read books on race relations in the U.S.”* Faculty agree that there is still more to be done, but that these conversations are helpful.

### 6.4.3 Connection to Domains of Power

In these final thoughts, students and faculty point out many of the issues that contribute to inclusion remaining such a big problem in engineering. First off, there is the inherent interpersonal power dynamic between students and faculty. These power interactions are very different based on the identities on either side. Culturally, there are still many older faculty who do not want to change or do not see any problems with how things are. And many of these older faculty are respected for their contributions and therefore, as a community, there is a culture of admiration towards these older faculty who are the ones reproducing racist, sexist, practices and receive little to no consequence for doing so but do receive praise for their technical contributions. Engineering programs are also usually located in institutions with long histories and set ways of doing things. Making changes becomes harder, the longer the institutions have been doing things one way, and even worse, when institutions have tens of thousands of students. Whether the changes are related to grading policies or the norms of how students and faculty can interact with one another, change is slow.

## Section 6.5 Conclusion

In summary, we heard about how students and faculty are already thinking about power dynamics in engineering education environments. From participating in the sessions, students and faculty have similar and different takeaways, and there are even more differences depending on how many marginalized identities students have. For faculty, hearing from individual students about issues faculty are for the most part, already aware of, personalizes the problem for them. And at the same time, it confirms that what they think are problems, really are. Students are able to see faculty in new ways. They hear that faculty are also working for change and that they actually care. They also see how faculty are also affected by experiences of exclusion. Participants with more privileged identities benefit from being able to hear how different identities, specifically marginalized identities experience these spaces differently. Their concept of intersectionality makes more sense when they are able to see how people with some shared identities but not others, are affected differently. For students with more marginalized identities, hearing from other students that they are also experiencing exclusion in these spaces is comforting. But it is even more impactful that they have the opportunity to think about action and solutions with peers and faculty, bringing

back some hope. In the next chapter, I discuss the implications of these results for the engineering education community as we seek to create structural changes.

## Chapter VII: Discussion

The results section has shown that engineering students and faculty can articulate instances of power dynamics in their engineering environments. Students clearly see how the faculty's ability to impact their grades and opportunities creates an environment where they are less likely to speak up. Students are also very aware of how interactions with their peers are dependent on socially constructed "hierarchies," one big factor which is their perceived intelligence of each other. Faculty are also aware of the power dynamics they are working within. The biggest of this is the tenure system, which disproportionately affects non-tenured or non-tenure track faculty. Beyond this, faculty talk about strategies they use to mitigate the misuse of their power in their classrooms. Yet not all faculty members are fully aware of the full impact many of their decisions have on the future opportunities of their students. Through this intervention, a Sustained Engagement with a series of co-design sessions for students and faculty, we see that not only are we able to give students and faculty frameworks to better understand and articulate the power dynamics they are a part of, but the engagements are also able to raise consciousness and/or build awareness into their own abilities to exercise their power to impact change. The discussion concludes with what I call a realistic perspective towards change, one in which participants are aware of how difficult and slow the process can be, yet one in which they know it is important for them to personally have a role in making a difference. The following chapter starts by discussing the limitations of this work. It then discusses the contributions of this work and the implications as it relates to moving towards creating systemic change in engineering education. Included in this approach is the constant work required to see and understand structures of power. This chapter also connects the results to current literature related to creating inclusive spaces and systemic change in engineering education.

As a reminder, the research questions for the final study were as follows:

- **What affordances does co-design provide to support engineering students and faculty working together to create situated DEI practices at their universities?**
- **How do engineering students and faculty understand and make sense of power dynamics in their environment?**
- **How might we leverage the naming of invisible power dynamics to enact change?**

## 7.1 Limitations

Although limitations are usually found at the end of a chapter, I want to foreground the discussion of the findings in the real limitations of the work. When reading the discussion, readers should remember that these co-design sessions were done at a large public institution that is predominantly white (PWI). The participant pool was a group of self-selected individuals who had a baseline interest in DEI efforts, given the recruitment information mentioned the study was about co-designing inclusive practices within engineering education. Several important identities were missing from the participant pool. There were no tenured faculty and no white, cisgendered, male identifying participants. Although I think part of the success can be attributed to there not being such privileged identities in these spaces, it would be interesting to see how these identities would participate in the conversations. There were also several other racial identities not represented. Finally, there were several terms used within the study to help participants have a common language and to help in eliciting specific aspects of their experience. I cannot know how much this affected the way students were talking about such issues. Were they using the words with the same meanings? Would they have used these words to describe their experiences otherwise? We do not know for sure, but with triangulation, we can see that at the very least, their general ideas were consistent. The terms introduced to participants as part of the study included power, power dynamics, empowered, disempowered, privileged, marginalized, inclusion, exclusion, and identity. Now that I covered some of the important limitations, we can proceed to discuss the findings.

## 7.2 Promises and Potential Faults of Co-design for Conversations on Inclusion

As a result of this study, there were many benefits that both students and faculty experienced. But participants also noted potential issues that could arise with a larger scale implementation of this method. To start, I will summarize what we heard from students and faculty as the benefit of participating in these sessions. And I will follow with how we should carefully move forward. The most important takeaway from students and faculty was the opportunity to have conversations with each other. Students, particularly students of color are used to their relationships with faculty being strictly professional. But this opportunity

allowed students to see the reality that faculty themselves also experience exclusion, and even more important was for students to hear that some faculty are doing the work of trying to improve the classroom environment. Students mention being inspired by this fact and were happy to hear that “*someone cares.*” On the other hand, faculty appreciated being able to hear directly from students. Oftentimes, faculty only get to hear from students through evaluations, reflections if faculty use them in class, or they work with undergraduate students as either teaching assistants or research assistants. Beyond this, faculty and students do not have many opportunities to interact beyond lectures or office hours, yet the literature shows how big of an impact faculty have on student learning [103]. For faculty, being able to talk directly with students helped them get a more nuanced understanding of the problems students at their specific university are facing. Faculty also noted that even though students and faculty often have similar concerns about exclusion in the classroom, students bring a different perspective and understanding of the problem and how they would like to see it addressed. Getting this perspective did not necessarily give faculty a better idea of how to address the problem, but it did give them a different side to consider.

Another benefit to having these conversations together was that both students and faculty were reminded of the complexities of the problem of inclusion, and the reality of the slow nature of change as my earlier studies showed, [89], [104]. This realization resulted in a combination of feeling like it was too big of a problem but also realizing that they were all able to contribute in one way or another. For students, this restored hope a bit in realizing that there were more efforts to promote change than they were aware of. One note of caution for faculty and others in power, is to not use the slowness of change as an excuse to not advocate for change. Change is slow, but everyone should be aware of how they can push for change and at the same time, not create barriers to change. Even if slow, change should be making a difference. Although I will discuss this more in future sections, one of the biggest benefits for participants was being able to see power and identity play out while having conversations about it. This was particularly true for understanding intersectionality for those with more privileged identities.

Students and faculty also had concerns about having future iterations of this workshop at a larger scale. And these concerns were very valid. Some of the biggest speculations were around what would happen if

those with the most privileged identities participated in these conversations. Some participants believed their participation was something that needed to happen, and yet expressed concerns over being as comfortable to share as freely as they did in this space. Other participants brought up the need for support from leadership, including funding at the college level. Students had real concerns about any repercussions they could face, particularly if faculty in future sessions did not agree with their ideas. Here, I will recommend several considerations for future iterations.

In order to continue to be aware of power when designing interventions that allow for students and faculty to have discussion on difficult topics such as exclusion and inclusion, researchers, educators, and anyone else involved in the development of such interventions should keep the following in mind:

Inherent to participatory research methods, including co-design are several tensions:

- Balancing the following: acknowledgement of power while mitigating drastic power differential and having participants reflect while taking action to exercise their power in a balanced manner.
- The goals of co-design are multifaceted. One aspect is to create design solutions to an agreed problem. But before beginning to solve the problem, there must be a community building portion to develop trust and making sure people are on the same page about the goal they are working towards.
- Because trust building in an environment where power dynamics are being actively acknowledged requires self-awareness and time to process any thoughts and feelings that might arise in such an environment, it is critical to leave space for different ways of processing. This includes individual reflections, conversations, and other ways participants would benefit from.
- Finally, there are different considerations for participants who have more privileged identities than those with marginalized identities, for that particular space. For those with more marginalized identities, it is important to know where they are starting from, in terms of awareness of their privilege. This will inform what kind of group they should participate in. It is important to know that different identities will have different takeaways. Those with more marginalized identities are likely aware of how power differentials affect people differently. For those with more privileged identities, these conversations will make those differences clearer.

Again, the takeaway for the students was being able to see that faculty also experience exclusion and that some faculty are also taking action to create change in their classrooms. For students, it is also im-

portant to know that there will be action. That the conversations will not just be an extraction of their experiences, but that those in positions of power will use the feedback to create changes. For faculty, hearing about the student experience from a variety of perspectives is helpful in helping see issues from different perspectives.

### 7.2.1 A Note on the Uniqueness of Students and Faculty of Color's Perspectives

As a dissertation focused on critical perspectives, one important aspect to note is the uniqueness of the perspectives of people of color. The deep awareness of students and faculty of color of the constant amount of marginalization that happens is impressive considering how resilient they are despite these barriers. This reality is consistent with the asset-based framework of Community Cultural Wealth [41], [105], which includes aspirational, linguistic, familial, social, navigational, and resistance capital, as sources of strength, particularly for these students. From our data, we particularly see both aspirational and resistance capital provides students the strength to persist in these spaces where they experience exclusion . By offering the framework of power and its connection, students can hopefully use the knowledge of naming power structures to take action to transform their environments. The peer interactions for students of color functioned as an affirming space, helping them with consciousness raising.

## 7.3 How do Students and Faculty Describe Power Dynamics?

Another important contribution of this work is the empirical collection of different ways students and faculty describe power dynamics in their engineering education environment. This question is critical as efforts to create systemic change to support diversity, equity, and inclusion in engineering education continues to be the strategy for our community. If we are having conversations about changing structures, students and faculty should be able to name the structures they are trying to change. From interviews, this work found that students consider those who are in positions of authority to have more knowledge and experience than them. They also believe that those in authority likely have more of a say and that their thoughts and opinions have more weight than those with less authority. This particular view on power emphasizes the responsibility that faculty have. Students automatically assume faculty know more and that, if anything goes wrong, it is the faculty member who will be given the benefit of the doubt. This attribution

of knowledge is exacerbated by the esteem given to faculty in STEM fields for doing work that society considers to be difficult and important along with the academic structures of tenure. But another interpersonal relationship often forgotten is the peer-to-peer interactions between students.

In engineering spaces smartness [106] is valued. But this smartness looks a particular way in engineering spaces. From the interviews, we saw that peers judged each other's smartness through grades and types of questions asked by the student. But a big question is how does identity play a role in someone's perceived intelligence? We heard students over and over again say how smart students were, in group settings, determining the direction of projects, delegating tasks, taking the role of leader. Students also mentioned that a lack of confidence in one's competence prevented them from sharing ideas and even their hesitancy to contribute to team projects. This constant evaluation of students' smartness impacted students of color the most. They often received comments of surprise that they had made it to an engineering program, based on the communities they came from, the color of their skin or their gender. Students of color themselves noted that they did not fit into the spaces based on their styles of talking, music, and even the type of questions they had either for courses or for finding resources to succeed.

Faculty were very much aware of the power of the tenure system to dictate the activities they should be participating in, prioritizing research over teaching, and prioritizing having good relationships with those colleagues who would be making decisions on their future careers. Those not on the tenure track had to prioritize keeping their job due to the lack of job security. Having to constantly switch between environments where they, non-tenure track faculty, had more control over the power dynamics, such as in the classroom, and spaces where they had significantly less control, such as faculty meetings, was simply difficult to keep track of. In a space where faculty have to worry about their own successes, which are not necessarily correlated to how inclusive their classroom spaces are, it is easy for faculty to forget the direct impact they are having on the success of their students, particularly their marginalized students for whom the "classroom-norms-as-usual" approach, negatively affect them the most.

Although student and faculty understanding of power did not fully align with my framework, there are opportunities for this specific understanding of power to impact their ability to enact change in their environments. I will explain how their current understanding of power aligns with my framework, and in section 7.2.3, I will expand on how creating the alignment will allow the conversations of inclusion to move forward in a more direct manner. Faculty and students:

- Know that power dynamics impact the feelings of control they have over an environment, situation, or even their future opportunities.
- Find it easy to name when others can exercise their power.
- Have different levels of awareness of their ability to exercise their power for good or for bad.
- Do not see that they can exercise their power for good or for bad.
- Find it difficult to acknowledge that they can exercise power, particularly because power has a negative connotation. Even if people have the ability to influence others for good, acknowledging your influence can feel like you are manipulating others.

Students and faculty must grapple with accepting their ability to exercise power and the reality that power can be used to impact people and environments in positive or negative ways.

## 7.4 What is so Invisible about Power?

One of the main reasons for choosing power as a framework was realizing how difficult it was to identify sources of power and how they created barriers to action. And yet, power was a word used ubiquitously to describe oppression. Where was oppression happening in everyday lives and how to identify it?

The ubiquitous nature of the word power is one of the reasons power is so difficult to identify. In order to constrain what power meant for this work, two aspects remained important. First, **power can be exercised**. Alternative ways of viewing power assume that we can “have” power. With this definition, if you do not have power, then that is the end of the story. If power is exercised and power is defined as the ability to **direct or influence the behavior of others or the course of events**, then the question becomes, what allows or prevents us from exercising our ability to create change? Second, power tends to have a negative connotation. To direct or to influence others sounds like manipulation or control. But from a positive perspective, a good leader can guide their teams to their goal successfully. So, when students and

faculty were asked what they thought of when they heard the words “power dynamics,” participants overwhelmingly responded with examples of power used in a negative manner. This confirmed the tendency for power to have a negative connotation within the engineering community as well. When asked specifically about positive uses of power, participants could describe such situations as well. **In summary, one thing that makes power difficult to identify is that people often forget or do not think about the ways power can be exercised to affect positive change.**

**The second aspect of power that makes it difficult to identify is the interconnectedness of various levels of society acting in one instance.** Using the Domains of Power to understand what participants were saying about power, we could categorize the Interpersonal Level of power (individual to individual, influenced by social identities), the Cultural Level (the influence of culture and hegemonic ideas on people), Structural Level (the systems and space with rules in which we are a part of), and the Disciplinary Level (the application of consequences for not following rules or conforming to the culture). The different levels make it difficult for individuals to understand the different effects of power on them, and how, if at all, they can exercise their power in a situation. Here is a seemingly simple vignette that quickly turns complex:

Jamie is a Latina student in a first-year engineering design class. She is working on a project in a team of four students, and she is the only student of color on the team. When sharing ideas for their design project, Jamie notices her ideas keep getting ignored in this **interpersonal** interaction. She begins to wonder if her ideas are truly valuable, or if she is not communicating them well. She does not want to cause a problem in case she is just imagining things. But these experiences make her wonder if engineering is even the right major for her. In engineering, where the **cultural** perspective is that a stereotypical student is white and male, students often have an unconscious bias that gives white, male students the benefit of the doubt, assuming they are smart and experienced. Socially, Black and brown women are stereotyped as angry or loud. Jamie’s awareness of this stereotype makes her think twice about speaking up. Additionally, **disciplinary** power also makes her reconsider speaking up—engineering courses are built on teamwork. If she were to speak up and was not supported by her peers because they did not notice anything

happening, and her professor mentioned that she should just learn to deal with team dynamics, she could develop a reputation as a problem student that would impact the rest of her academic experience. Teamwork is also often evaluated by peer reviews, therefore, there can be direct consequences to her grades. Grades impact future opportunities as there are often minimum GPA requirements for internships, jobs, and graduate studies. Grades also impact faculty perspectives of her for letters of recommendations. Finally, given that she is in her first year at a large public university, she has not been accepted into her major yet. This **structural** manifestation of power also impacts the choices she makes in the scenario. In order to get into her major of choice, she needs to maintain a competitive GPA and a good relationship with faculty.

Breaking down this situation to see all the ways different Domains of Power are working to against Jamie's success in a space not designed for her. For her, we also see how intertwined these domains gets. In that moment in time, Jamie probably does not have the time or emotional capacity to think about and process what is happening. In the following section, I will discuss three Domains of Power and interweave how the Cultural Domain interacts with each.

**Interpersonal Power:** Jamie is interacting with her peers, all of whom have a more privileged race/ethnic identity than she does. Although most are not consciously aware, their assumptions about what she knows, how good her ideas are, and even how much talking she should be doing is influenced by these. These assumptions not only come from cultural ideas from being in the United States, a Western culture, they are also coming from the fact that they are in a STEM environment, where the idea of what an engineer looks like is primarily white, male.

**Disciplinary Power:** As can be seen in the vignette, there are many consequences Jamie is considering as she decides what her next steps should be. She considers speaking up and pointing out that her ideas are being ignored.

With the positive exercise of power, one team member can decide to listen to Jamie, consider her concerns at face value, and implement a strategy where team members can share ideas more equally.

With the negative exercise of power, one team member can say, “we are not choosing ideas based on who is contributing them, we are objectively deciding which one is best. Additionally, we only have a week to get a prototype done, so part of this is also efficiency. It’s not about you.”

This team members feels good about himself, feeling as he did a good job keeping the team moving forward.

These are only two possible ways this can go. In the second option, we see how engineering’s cultural values of objectivity and efficiency make it so that Jamie’s concerns seem like an impediment to the team’s success, and maybe even self-centered. If we continue to follow this series of events, we can see how Jamie would question herself: was she really being self-centered? Given her identity, the students on the team can have confirmation bias, that yes, it’s true, Latinas are troublemakers. Jamie can experience stereotype threat and think, maybe she just does not know how teams should interact? This one decision to speak up can have a domino effect. Now she can get a bad peer evaluation that influences her grades. If the teammates are seriously concerned, they might share her “self-centered” attitude with a TA or the professor, impacting their perception of her as well. We can see here that the educators have a choice to make as well in terms of how they will exercise their power.

With the positive exercise of power, the professor can decide to listen to both sides of the story and keep an open mind about what is happening. Once the professor hears what is happening, she can offer the team advice around team dynamics.

With the negative exercise of power, the professor can decide that she’s heard this story before. There is always a problem student on the team. She can tell the team that they can spend the rest of the quarter dealing with these dynamics, or they can just focus on the project at hand, making sure they do their best work.

Culturally, engineers downplay the role of social dynamics and the feelings of individuals, believing that good work is influenced by technical decisions, not by how someone feels about the project. Faculty should be aware of how they are responding to student concerns, making sure they are not dismissing real problems due to engrained cultural beliefs.

**Structural Power:** Finally, structural issues of power continue to make **Jamie's one decision to speak up or not feel like it really is not a choice she has, given all the repercussions.** Structurally, Jamie is stuck on this team for the rest of the quarter, whether they see her concern or not. Although faculty often say grades do not matter, the reality is that the system of getting a career is built on academic achievement. Grades are considered for internships, early career jobs, graduate school, and even programs like the Peace Corp and Teach for America. So, for students whose other identities already have a disadvantage in having access to a job, yes, grades DO matter. Engineering programs also tend to use the cohort model, so once a student has developed a reputation for being a troublemaker, it is not that hard for the rest of the cohort to adopt that perception of a student, unless they are stopping to consider where this belief is coming from.

One decision can have lasting effects. The following section provides reasoning for why we should continually be Learning, Reflecting, and Taking Action in order to consider how our exercise of power is affecting the world around us.

## 7.5 Making Power Visible by Learning and Reflecting in Order to Exercise it for Change

In order to make power visible, we need to learn about how the Domains of Power interact in engineering spaces. We should also constantly reflect on our behaviors and their impact.

### 7.5.1 What should we learn about?

Seeing how complex power structures are when using the Domains of Power, we see it takes time to even just name everything going on, let alone having time to then process and decide how to proceed.

But with this framework, we can now think about what we need to be learning about with respect to

**power, when power is defined as something to be exercised not to possessed, and as something that can be exercised in both positive and negative manner, is a threshold concept,** or a “transformed way of understanding, or interpreting, or viewing something without which the learner cannot progress [107].”

One aspect to develop a better understanding about is how one’s different identities are socially constructed and how that affects us and others differently in any environment. Participants in the sessions had to decide whether their identities were privileged or marginalized in the sessions. And then they got to hear how these identities made others feel empowered or disempowered. In doing so, they understood a little more about themselves and about others. While self-assessing, people have to think deeply about those identities. Going one step further would be to understand what contributes to racism, sexism, ageism, etc.

A second aspect one should learn about is the culture of a community. Learning about a culture is difficult because when writing about a culture, society tends to describe all the good aspects, or how those aspects of a culture are good. Other fields, such as sociology, study and critically examine cultures in order to note where there are flaws. Everyone does not have to become a sociologist, but one can develop a critical eye towards our community. **There are so many great things about engineering, but what is the balance between blindly accepting something as good and consistently evaluating how so much of one thing, such as the emphasis on objectivity, can lead to unintended consequences?** Part of this learning includes learning the history of the discipline, looking at current events and what the media emphasizes about the discipline, and even looking at laws and policies related to the discipline. There are many other ways to do this. Each of these parts of society are also closely intertwined with the structures in place.

Thirdly, it is important to be aware of the structures in place and the rules intended to keep the structures in place. In engineering education, there are all sorts of rules. Of course, these are necessary for things

such as establishing a curriculum, defining what it means to have an engineering degree, and even to differentiate between a student and a faculty. What we need to be aware of is when these structures unfairly disadvantage some groups and not others. What defines a passing grade? How does that impact students, within the other policies around graduation or even major requirements?

Learning about these different aspects of ourselves, our society and the discipline, it is more difficult to misunderstand the structures of power that lead to disempowerment. Using the language of power can help you “trace” what happens.

### 7.5.2 What should we reflect on?

Knowing about one’s own identities or how policies affect others is just one step of the process. One must also reflect on how everything is working together or how one moment in time is being impacted by how power is being exercised. There are some instances where, what one is aware of suggests that there is an opportunity to choose how to exercise one’s power. These examples are taken from what we heard from participants.

**Justifying Behaviors:** When participants had experiences of marginalization, they often justified the behaviors of others. Jamie thinks it might just be that her ideas are bad. When justifying behaviors, it is important to consider what is causing one to pause. The same is true for personal actions. Think about why one would consider justifying behaviors. It might just be related to how power is being exercised.

**Saying “there is no power here”:** Power is everywhere. It is in any interaction. What we need to be aware of is when power is being exercised to harm others.

**Feeling awkward about having privilege:** In our western society, it is hard to accept that one can have unfair advantages without asking for them, simply based on identity, especially because people like to believe they are responsible for their successes. But the world works this way. How

can one appreciate the gift one was given and use it to amplify the voice of those without the same advantage?

**Feeling disempowered:** One thing to consider is whether one is feeling disempowered in the moment or if this is a larger problem. There will always be moments when our ability to exercise power is greater or smaller. Particularly for privileged identities, think about whether your identity is causing disempowerment in the moment or if there are structural systems at play. It is valid to feel disempowered at times. Sometimes our disempowerment is momentary, while other times it is systematic, and there is a big difference between the two. Appreciate how feeling disempowered makes you feel in the moment. For those with marginalized identities, think about what is causing the feelings of disempowerment and if there is an action you can take.

This list is not exhaustive. It is important to reflect on how power is being exercised because an insidious nature of power is that it is always changing. If we look at history, different groups of people have experienced more or less marginalization over time. Additionally, because power is changing, and the context matters, we should be evaluating how we are exercising our power in different spaces. Like we heard from non-tenured faculty, in their classroom, they usually have the ability to exercise their power the most. But this ability changes when they are in a faculty meeting with their tenured colleagues.

### 7.5.3 What should we do?

This one is the hardest one to consider. The easy answer is it is up to you. The complex answer is, only you can decide for yourself how you want to effect change in this world. The beautiful thing about power in this sense is that you can decide how to exercise it. People generally can name situations in which they felt like someone else negatively influenced their ability to act. It is also good to remember when someone positively influenced your ability to act. Alternatively, think about how you are influencing someone else's ability to act or the course of events in a positive or negative way. Moving beyond individuals, we can also ask how policies or stereotypes and cultural norms influence people's ability to act. As a last note, it is important to acknowledge the reality of questioning these structures. There is a reason why they work.

There are consequences for questioning these structures. These consequences keep things in order, for the good or for the bad. You have the ability to decide whether or not you are ok with risking the consequences that come from asking the questions. At the same time, the “cost-analysis” for some works out better than it does for others. But the question is, what is the right thing to do?

## 7.6 Future Work

Future work can look at how different engineering spaces can adopt the model of learning about, reflection, and taking action to change power structures in order to reduce barriers to representation. Even taking the first step of learning about structures and identities can start to reveal the complex nature of power.

One common tension I encountered throughout the data analysis process was the tension between how the Domains of Power discussed power dynamics and how participants described power dynamics with their own words. As a theoretical framework, the Domains of Power are intended to help have conversations about power, more realistically in academic spaces, but are not framed from the perspective of how one would describe an interaction. When participants talked about power, they did not talk about it in a way that was consistent with the Domains of Power. This tension points towards the need for more research to understand power dynamics within an engineering context and the need for a framework to help people in the community translate their understanding of power to a framework that allows for dialogue between individuals with differing perspectives. There is more work done for the engineering community to, as a whole, become comfortable with having conversations about identity in order to more easily see how cultural norms affect how those with different identities are impacted. This is particularly true for making connections between ideas of smartness and identity, the connection between the end goal of an engineering education with identity, and even the effects of tenure on identity. It is important to not only make these connections but also situate them in the engrained norms and how the norms become barriers to creating more inclusive spaces. There are many opportunities to expand on this work.

## Chapter VIII: Conclusion

As we come to the end of this dissertation, I provide a summary of what has been covered. This research project started with the driving question, **why has increasing recruitment and retention of underrepresented students, particularly racially and ethnically minoritized groups in engineering, been so slow despite such large efforts, including financial resources, to facilitate change?** The starting point for my awareness of this issue is my personal experience as a first-generation, low-SES, Latina student in engineering. Most of my friends at my undergraduate institutions were from racially and ethnically minoritized groups. All were brilliant, but some, like me, struggled with navigating the combination of everything that came with being an engineering student with so many marginalized identities.

Like many of us reading this, I was familiar with the student experience. Therefore, my first study was about talking to educators who were incorporating inclusive practices in their engineering classrooms. In writing this dissertation, I realized the importance of these interviews as my starting point. I started to learn about what I now know has been the culture of engineering education. I heard about the reality that many faculty were never taught how to teach. As I took classes in the college of education, I realized why learning how to teach was important. The literature shows teaching is a complex task. Educators have to plan for a lesson, carry out the plan, expect things to not go as planned and then find ways to know whether students learned or not. One can become an expert in any one of these steps of the process. But as an engineering faculty, the norm is to teach how one was taught, the way learning had worked for the faculty as an individual. The lack of teaching training was just the tip of the iceberg. Another issue was the tenure and promotion process. The goal of tenure-track faculty is to secure tenure. But in order to receive tenure, some activities are valued more than others. Research is the priority, therefore depending on one's area of expertise, one has to stay up to date with the most current advancements. Then comes teaching, evaluated very subjectively and finally comes service. In these interviews, I heard over and over again how educators trying to be inclusive kept encountering barriers related to the lack of knowledge on teaching and the priorities related to tenure. Being an inclusive educator takes time, effort, and emotional labor. Tenure-track faculty are incentivized to prioritize conducting research, which in technical fields, rarely relates to learning better pedagogical practices. And even if it does, with the advent of the teaching

professor, the community still does not know how to evaluate good research on pedagogy. This is one gap we can look to address. How do we **incentivize** good teaching? How do we **balance** that with the need for research?

When doing work that requires emotional labor, people also have to spend time processing their thoughts and feelings and understanding their changing sense of self. So many cultural values in engineering stand against the requirement to do inclusive work. How do we provide this support? In addition to all of these barriers, in order to be inclusive, one has to know what one does not know. We all have different experiences based on our identities, the contexts in which we live and grew up in, and even based on our own personal set of values. As the barriers to supporting faculty looking to be more inclusive continued to increase, I had the opportunity to spend one year having reflective conversations with an educator interested in incorporating inclusive practices into her classroom.

This opportunity was the perfect next step, given what I had just learned from my interviews. I had the opportunity to explore ways to support faculty incorporating inclusive practices. As the research team engaged in reflective conversations, the team served as each other's community, shared experiences with each other, and was there for each other when things got hard. And yet, the student perspective was missing. Beyond this, the interplay of the student perspective with the faculty perspective was missing. Once I saw the value in building community and learning from each other in supporting more inclusive practices, I looked towards participatory methods to get the main stakeholders involved in finding solutions to this problem: students and faculty.

There were several aspects of co-design that I knew would benefit these conversations in theory but I had to ensure they worked in practice. Through pilot studies, having students and faculty having conversations on inclusive practices proved to be fruitful. Acknowledging the power differentials and having the goal of working collaboratively to solve the problem of inclusion created a space for sharing stories or experiences. For the extended engagement with a series of co-design sessions, as a team, we ensured participants were getting either an incentive or full compensation for their time. For the in-person sessions,

students and faculty had space to have conversations while they ate lunch together before the start of the session. We did icebreakers to set a less formal tone. We acknowledged the reality of power. And we designed the sessions to have time to develop rapport before asking tough questions about identity and privilege. We also gave participants the opportunity to reflect on their experiences, in hopes that they could process anything they needed to. At the end, both faculty and students enjoyed having the opportunity to discuss these issues with each other, learning from each other.

In the previous chapter, I describe what I learned from this study. The first was that people have a definition of power, but predominant ideas of power have negative connotations. Fortunately, this at least means we all understand that power can lead to negative experiences. Students are aware of power dynamics in their engineering learning environment. Students with more marginalized identities note how their peers exercise their power based on identities. Students with more privileged identities are aware of how critical it is to “show” your smartness in group situations in order to be able to influence the direction of the project or even just to choose what aspect you want to work on. Faculty are very aware how their interactions with tenured colleagues can impact their future. Faculty also have different levels of awareness of how their role as a professor and their intersecting identities can impact the future success and opportunities of their students. Through these sessions, students of color experienced consciousness raising. Participants with more privileged identities were able to gain an understanding of the impact of intersectionality on life experiences from hearing other participants’ experiences in contrast to their own experiences. Finally, many participants got a better understanding of why doing this work is so hard. Why it is slow. Why it takes time. How seemingly big and small barriers are. Yet participants realized these conversations could not happen in just any space with just anyone.

Having communicated the research questions, approach to the study design and data collection process, methods of data analysis, and result, I now share two takeaways I want readers to go away with.

First off, take your time in becoming more inclusive, but make sure, as one of the participants said, “you are moving the needle.” Making change is a process. It takes time. There is so much you can learn about

the community you are a part of. But do not stop there. Make sure you are reflecting on your actions. How your identities impact those actions. How others might be experiencing the same situation differently based on their differing identities. And once you are aware of an issue that needs change, think about how you can exercise your power to move the needle forward. How can you advocate for yourself? How can you advocate for others? You do not have to be doing this constantly. But realize when you can make a difference by intentionally deciding on how to exercise your power. But again, this all takes time. And it is hard.

Additionally, have conversations. Have conversations with friends. Have conversations with people you disagree with, with an eye towards learning about their experiences, so you can learn something. Power is interwoven. We are all connected by it. We appreciate its complexity when we realize that we all experience things differently. Power structures are not static. We can change them by choosing how to exercise our power. But first, we must be aware of these structures.

# Appendix A: Session Activities

## SESSION 1

# Exploring Power Dynamics in Co-designing Classroom Practices

Co-designing Inclusive Practices with Students and Faculty

## Agenda

Introductions (10)

Peer Co-design (30)

Group Discussion (30)

Closing (10)

## Introductions

- Name
- Pronouns
- Role (student, instructor, faculty, researcher)
- If you could make any animal cat size, which animal would you choose?

## Context: Engineering Education

You are all students and faculty in engineering!

## Concepts

**Co-design:** The problem of exclusion in engineering education is a problem that needs to be solved together— with students and faculty.

**Exclusion:** Sharing personal experiences and observations of exclusion can help us identify and address these problems.

Google/Oxford dictionary: **exclude**- deny (someone) access to or bar (someone) from a place, group, or privilege.

**Power:** Often times has a negative connotation, but one can use their power to influence situations for the positive. Power dynamics are constantly occurring.

Google/Oxford dictionary: **power**- the capacity or ability to direct or influence the behavior of others or the course of events.

# Activity 1

## Brainstorming Guidelines

- When brainstorming, make sure to write one example per post it
- Make sure you are reading other people's examples as you go

## Experiences of Exclusion in the Classroom (10 min)

Instructions:

1. Choose a font color that will be yours.
2. Think of and write down acts of exclusion you have either experienced or witnessed in the engineering classroom
3. Aim for ~5 examples in 10 min

## **Categorizing ideas (8 min)**

Instructions:

1. Read through everyone's examples
2. Group your ideas into categories (3 min)
  - a. You can do this by physically re-arranging post-its
3. Discuss similarities and differences within and between the different categories (5 min)

## **Summarizing the Conversation (5 min)**

You will share your a summary of your conversation with the other group. Take some time to outline your points.

# **student workspace**

# **faculty workspace**

## **Activity 2**

### **Sharing discussions - 5 min/group**

Share the highlights of your conversation. What were common experiences? What were some differences?

# Closing

## Next Steps

1. Complete your reflection for Session 1
2. See you next Friday—on zoom, same time :)

## SESSION 2

# Exploring Power Dynamics in Co-designing Classroom Practices

Co-designing Inclusive Practices with Students and Faculty

## Agenda

Warm-Up

Addressing Exclusion

The Identity Wheel

Closing

## Reminder: This is a voluntary study

Please be respectful of everyone in the study. The study is confidential and anything said and discussed in this space should not be shared with anyone outside of this group.

The research team is taking extra steps to keep the data safe and anonymized.

## Warm Up (15 min)

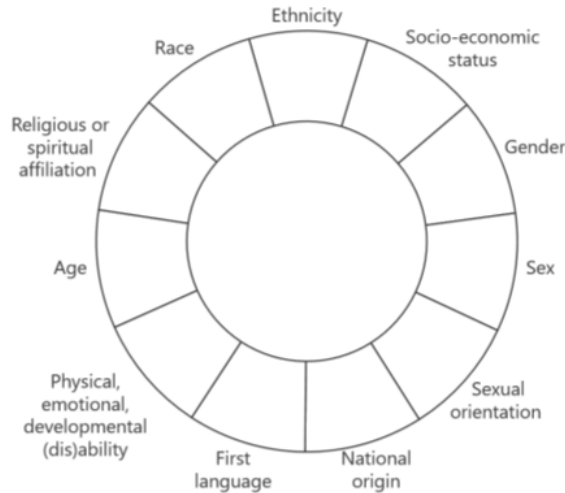
1. Name & Pronouns
2. Think of 2 instances (not classroom specific) (5 min)
  - 2.1. feeling included in engineering spaces
  - 2.2. feeling excluded in engineering spaces
3. Go ahead and read each others (3 min)
4. Sort with the rest of the categories (5 min)

## How might you address some of these issues?

**Note\*\*:** Next week we are going to ideate specific policies; today is mostly about having a discussion.

## Activity 2

## Identity Wheel (10 min)



Program on Intergroup Relations and the Spectrum Center, University of Michigan (n.d.)

In different contexts, aspects of our identities play out differently. Identity wheels are often used to reflect on which identities are dominant or privileged, and which ones are marginalized.

Look through the identity wheel and think about, in general, which identities are privileged (P) or marginalized (M) within engineering.

## Discussion (15 min)

What is one identity that is salient to you in engineering spaces— why?

### SESSION 3

# Exploring Power Dynamics in Co-designing Classroom Practices

Co-designing Inclusive Practices with Students and Faculty

## Reminder: This is a voluntary study

Please be respectful of everyone in the study. The study is confidential and anything said and discussed in this space should not be shared with anyone outside of this group.

The research team is taking extra steps to keep the data safe and anonymized.

## Agenda Designing Practices

Reflections- 10 min

Warm-Up: Identity Wheel & Power- 30 min

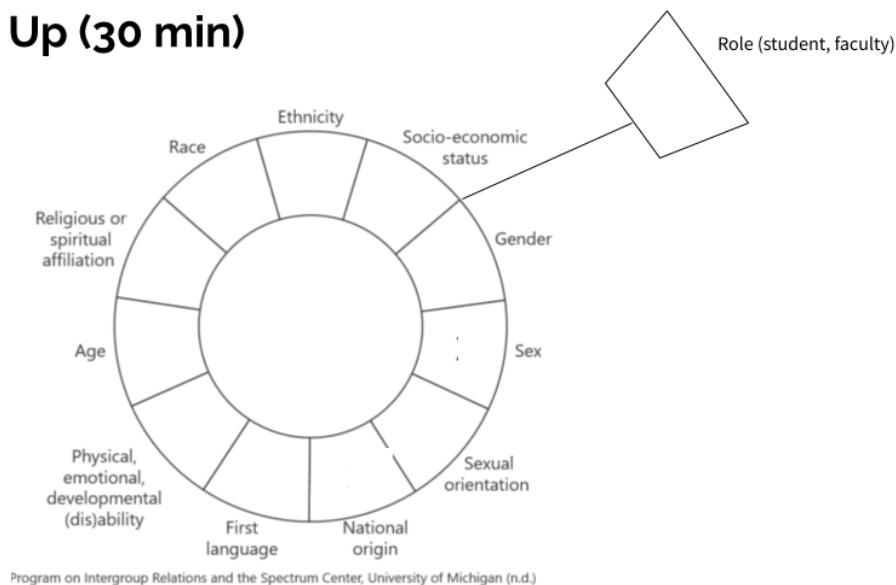
Co-designing Inclusive Practices- 40 min

Closing- 10 min

## Warm Up (30 min)

1. Name & Pronouns
  - a. What is your favorite sunny day activity?
2. Fill Out Identity Wheel

## Warm Up (30 min)



**Let's share with the group  
what we are comfortable  
sharing.**

## **Activity: Co-designing Inclusive Practices**

Given the exclusive practices, come up with 5-7 DEI Policies to add to a—college level

Suggested Steps:

1. 5 min brainstorm
2. Group common ideas
3. Discussion (pick 1 recorder)
4. Create your final list

This college values inclusion. Given this, here are some practices we like to follow to make the space feel welcoming to all....

## **Next Steps**

1. Fill out the calendly for the 30 min post-interview
2. Students— compensation will com 1-2 weeks after interview
3. I will share anything that will be published for your approval.

# Appendix B: Recruitment Material

Subj: Invitation for Engineering Faculty of Color to Participate in an In-Person Co-design Study with Students: Inclusive Practices in Engineering Classrooms

Hello Engineering Faculty,

Our research group is running a workshop-style study in order to have co-design sessions with students and faculty discussing inclusive practices in engineering classrooms. The study is the second iteration and is strictly **focused on the experiences of Black, Native American/Indigenous and Latinx students and faculty**. This study is part of my (Kenya Mejia's) dissertation work in the department of Human Centered Design & Engineering.

Because an important part of the study is the sustained engagement, **it is critical that participants attend all three co-design sessions**. There will be meals provided at each session. The workshops will happen on three consecutive **Fridays this quarter from 12:00-1:30PM**. Here is the time commitment requirements:

- **30-min:** pre-interview (scheduled with Kenya)
- **90 min:** Co-design Workshop 1 & Reflection
- **90 min:** Co-design Workshop 2 & Reflection
- **90 min:** Co-design Workshop 3
- **30-min:** post interview (scheduled with Kenya). This is a total of 5.5 hours over 5 weeks.

If you are interested in participating, please fill out this google form: <https://forms.gle/> with demographic data that will help us select a diverse (gender identity and ethnicity/race) set of participants. Because this is a research study (IRB exempt), each co-design session will be audio and video recorded. Only the research team will have access to these videos. Any research finding write-ups will be anonymized. Thank you so much for your time. Feel free to reach out with any further questions.

Best,  
Kenya, [kmejia@uw.edu](mailto:kmejia@uw.edu)

Subj: Seeking Current Juniors and Seniors in Engineering Participants for In-Person Co-design Study with Faculty: Inclusive Practices in Engineering Classrooms

Hello Engineering Students,

Our research group is running a workshop-style study in order to have co-design sessions with students and faculty discussing inclusive practices in engineering classrooms. Each session will have at least four faculty and six students.

### **Compensation for Students**

Due to the time commitments, students will be compensated a total of \$120, dispersed in two intervals. The first disbursement will be after the completion of co-design session two and the second will be dispersed after the post-interview. There will also be a meal provided for each co-design session.

**Students should be available for each session.** Time of day will be based on applicant availability. The workshop schedule is as follows:

- 30-min pre-interview
- October 18: Co-design Workshop 1 & Reflection
- October 25: Co-design Workshop 2 & Reflection
- November 1: Co-design Workshop 3
- 30-min post interview

If you are interested in participating, please fill out this google form: <https://forms.gle/>. with demographic data that will help us select a diverse (gender and ethnicity/race) set of participants. Because this is a research study, each co-design session will be audio and video recorded. Only the research team will have access to these videos. Any research finding write-ups will be anonymized. Thank you so much for your time. Feel free to reach out with any further questions.

Best,  
Kenya, [kmejia@uw.edu](mailto:kmejia@uw.edu)

**University of Washington Informed Consent to Participate in Research**  
Study title: Exploring Power Dynamics in Co-designing Classroom Practices

We're inviting you to participate in a co-design session with students and faculty to create inclusive classroom practices. Participation is completely voluntary. If you start the co-design session, you can always change your mind and stop at any time.

**What is the purpose of this study?** We are exploring the phenomenon of power dynamics in the co-design process between faculty and students in order to learn more about co-creating inclusive spaces in engineering education.

**What will I do?**

This will be a multiple session study. You will participate in a 30-min pre and post workshop interview. You will also participate in three 1.5 hour workshops where you will be co-designing inclusive practices with other engineering students and faculty. Finally, you will be asked to answer a reflection prompt after each workshop.

**Risks:** Some questions may be personal. You are free to share only what you are comfortable with. Any data collected from this study will be anonymized.

**Possible benefits:** The session is designed to create a cooperative space for faculty and students to learn from each other.

**How long will it take?** Over three weeks, you will engage in the following:

30-min pre-interview

Week 1: Co-design Workshop 1 & Reflection

Week 2: Co-design Workshop 2 & Reflection

Week 3: Co-design Workshop 3 & Reflection

30-min post interview

**What data is being collected?** We are collecting data through: (1) observation notes taken in the session (2) design artifacts created through the co-design process(3) video recorded workshop sessions (4) audio recorded interviews, (5) Reflection responses

**Future research:** Your data won't be used or shared for any future research studies.

**Who can see my data?** We (the researchers) will have access to de-identified (no names, birthdate, address, etc.) data. This is so we can analyze the data and conduct the study. We may share our findings in publications or presentations. If we do, the results will be aggregate (grouped) data, with no individual results. Video data will be stored separately for a higher level of security.

**Compensation (for students only):** Students will be compensated for their time with a \$120.00 gift card. The \$60.00 will be credited after the second co-design session and the other \$60 will be credited after the post-interview.

**Requirements:** You must be 18 years or older to participate.

Questions about the research, complaints, or problems, contact Kenya Z. Mejia at [kmejia@uw.edu](mailto:kmejia@uw.edu)

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**If you consent to participate in this research study, please sign and date below:**

I, \_\_\_\_\_ (printed name) consent to participate in the study described above.

Signature \_\_\_\_\_

Date \_\_\_\_\_

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