A Look Into the Lived Experiences of Incorporating Inclusive Teaching Practices in Engineering Education

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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) continues 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 [1]. 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 [2]. 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 [3]. 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 [4]. 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. [6]. 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 [1], [6]. Studies have also looked at the different dimensions of diversity in STEM beyond the gender and minority spectrum [7]. Other studies have looked at how specific underrepresented groups understand engineering through self-efficacy and funds of knowledge [8], [9], and how they experience engineering by looking at specific experiences in engineering research settings, design teams, and other personal campus experiences [10]–[14]. Researchers have also looked at inclusive values of peer educators, engineering identities, and first years' behaviors [15]–[17]. 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 [18]–[20]. 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 [3]. 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 [16], [21], [22]. 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 [23]–[25]. 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 [26]. 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 [27]. 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 [28], 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 Appendix A

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 21years, 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 [29]. 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 [4] when doing any preparation or working with students. Practices are found in Table 1 with the following codes:

- **CS**- Inside **C**lassroom- with **S**tudents
- **CE**- Inside **C**lassroom- by **E**ducators
- **OC**- **O**utside the **C**lassroom
- **IP**- **I**ntegrity of **P**ractice

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	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)
		CE6	Provide different forms of content (i.e audio, visual)
CS6	Have holistic evaluation methods		Ensure the room is set to be accessible for all
CS7	Allow time for reflection	CE7	Solicit feedback (i.e. mid-semester reviews, exit
CS8	Create student ownership	CE8	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)
	Practices Outside the Classroom		**Integrity of Practice [4]**
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		
OC3	Do Land acknowledgements	IP2	Be aware that it is important to be intentional
OC4	Do course preparation or revamping curriculum	IP3	Acknowledge the educator's role in normalizing inclusivity
OC5	Ensure building accessibility		
OC6	Talk with other faculty as a site of inclusion	IP4	Be flexible
OC7	In grading, include meaningful comments	IP5	Think about "How can I support you [the student]?"
OC8	Think of inclusivity in the Admissions process	IP6	Respect your students
OC9	Display artifacts such as safe space stickers posted on the walls	IP7	Trust your students
		IP8	Realize things do not need to be taught by the instructor (i.e can be by students or video)
OC10	Advocate for other faculty to adopt inclusive practices	IP9	Acknowledge diversity and inclusion is good for everyone not just marginalized groups
		IP10	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 surface 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 departamental 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 world wide 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.

<u>Learning from Experiences</u>

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 i*t."

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.

<u>The Work is Hard</u>

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 assasination" 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 non discrimination.*"

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 [23] 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 [30]. There is already work on small scale implementation of students contributing to designing curriculum [31]. 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 [30]. This method also acknowledges the power dynamics that can arise from different stakeholders working to design together [30]. 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 [32], and at times it has been conducted with educators and researchers, but not necessarily with the target students [33]. 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 [34]". 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 [35]." 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.

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Appendix A

Diverse and Inclusive Classrooms Interview Questions

1. Can you start by telling me a little bit about your teaching career. How long have you been teaching? What do you teach?
2. What are some of the things you value (or take into account) in teaching?
    a. How does diversity or inclusion fit with things you value as an educator?
3. What comes to mind when thinking about ways that you support diversity and inclusion in your teaching?
4. Tell me about one practice you wanted to incorporate that did not go as planned. What happened?
        i. Would you do this again? If so, what would you do differently?
5. How has diversity and inclusion played a role in your teaching over time?
6. Thinking broadly about your work with diversity and inclusion, what reactions (positive or negative) have you received?
7. What have you learned from trying to incorporate diverse and inclusive practices in your classroom?
8. Where might you go next [with Diversity and Inclusion]?