

## **Lessons Learned from Development of an Elective Undergraduate Course on DEI in STEM**

### **Dr. Leigh S McCue, George Mason University**

Leigh McCue is Chair of George Mason University's Department of Mechanical Engineering.

### **Dr. Christopher Alexander Carr, George Mason University**

Christopher Carr is a leadership and policy wonk in the areas of diversity, higher education, and STEM (science, technology, engineering, and mathematics). His unwavering support in the work of intersectional justice has allowed him to trek a path in the difficult areas of retention in institutions of higher learning, teamwork and organizational development in the collegiate and professional sphere, and diverse representation in STEM fields. With a background in public policy, he takes his ethical stances into conversations around tough issues to make sure all voices are included.

In his professional life, Carr has convened numerous diversity leadership forums in STEM education – bringing together over 100 deans and diversity administrators to talk about underrepresented students persistence, diverse faculty recruitment, and creating inclusive campus climates. Carr has also been a champion for access to opportunities for those from historically oppressed groups. He worked to see outreach efforts exponentially expand to Historically Black Colleges and Universities, Hispanic Serving Institutions, and Tribal Colleges and Universities. His efforts transformed the way the National Science Foundation both solicited the premier Graduate Research Fellowship Program, which led to comprehensive changes in other federal STEM fellowships.

In his role at Mason, Carr supports the faculty with search committee parameters to help ensure that the George Mason faculty better represents the diverse Mason student body, he supports the Office of the Dean and the associate deans in their efforts to develop and enhance an equitable and just campus climate within the College of Engineering and Computing, and he supports the larger campus community goals by helping to challenge the status quo and assist in the university in its strategic goals.

Christopher has is Bachelor of Arts in International Relations & History from William Jewell College, a Master of Public Policy from Pepperdine University, and a Doctorate of Education in Interdisciplinary Leadership from Creighton University.

### **Mr. Kevin William Kuck, George Mason University**

Kevin W. Kuck is a dedicated and accomplished individual whose journey is marked by a passion for engineering, a flair for photography, and an unyielding commitment to academic excellence. Born and raised in Virginia, Kevin has always been driven to excel in both the technical and creative realms of his life.

In 2019, Kevin graduated from Lake Braddock Secondary School, earning his High School Diploma with distinction. During high school, he distinguished himself as a Certified AP Scholar and regularly appeared on the Academic Honor Roll, foreshadowing the academic successes to come.

Kevin's thirst for knowledge led him to George Mason University, where he embarked on his pursuit of a BS in Mechanical Engineering. As of the expected graduation date in May 2024, Kevin has maintained an impressive cumulative GPA of 3.73. His dedication to his field is further demonstrated by his Major GPA of 3.63, showcasing his mastery of Mechanical Engineering concepts. Additionally, Kevin has a minor in Photography and boasts an exceptional Minor GPA of 3.90, emphasizing his commitment to diverse interests and talents.

Throughout his academic journey, Kevin has been recognized for his outstanding achievements. He has consistently been named to the Dean's List at GMU, an impressive feat accomplished in 7 out of 9 semesters. His commitment to excellence in engineering has also been affirmed through his certifications as an Autodesk Certified User in both AutoCAD and Inventor.

One notable highlight of Kevin's academic career was his presentation of his first independent research paper on bias in generative artificial intelligence titled "Generative Artificial Intelligence: A Double-Edged Sword," which was given at the World Engineering Education Forum & Global Engineering Dean's Council in October 2023. His work demonstrates his keen interest in cutting-edge technology, engineering solutions, and a passion for DEI topics.

In addition to his academic pursuits, Kevin has gained valuable experience through various internships and work roles. He served as a Mechanical Engineering Intern at Jacobs, where he contributed to HVAC and MEP design projects, created energy models using HAP, and performed essential calculations for mechanical equipment selection. His involvement in report writing summarizing ultrasonic pipe testing showcased his skills for technical reading and writing and being able to bridge the gap between client and engineer.

In his role as an Intern Engineering Inspector at CES Consulting LLC, Kevin demonstrated a strong commitment to quality assurance and control, ensuring that construction aligned with design plans and bringing errors to the attention of senior inspectors for correction.

His involvement extends beyond his work and academic pursuits; His membership in the National ASME and AIAA organizations reflects his commitment to his field and his versatile interests. Additionally, he has taken on leadership responsibilities as the GMU ASME President, where he has organized informational sessions and collaborated with various companies and individuals to foster a dynamic engineering community. Kevin is also an active member of the Student Platform for Engineering Education Development (SPEED), where he serves as Webmaster and Photographer. SPEED is a worldwide non-profit student organization that serves to work towards a common goal: generate a positive effect of engineering on society and the environment, and involve students in the participation of the decision-making process.

Outside of academics and work, Kevin's skills are diverse and impressive. He is proficient in various software and tools, including Revit, HAP, HVAC and MEP design, Adobe products, AutoCAD, Inventor, 3ds Max, Python, MATLAB, welding, and automobile servicing. He has experience with finite element analysis (FEA). Additionally, Kevin is proficient in Spanish, further showcasing his versatility and global perspective.

**Dhiambi Otete**  
**Violet Veronika Reges**

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**Abstract:** This paper summarizes the pathway to development of a discussion-based course that provides a historical look at contributions by engineers marginalized by race, gender, sexual orientation, or socioeconomic status. Case studies are included that particularly shine a light on engineering teams in which a lack of diversity contributed to adverse consequences. The course was designed for engineering students, co-taught by faculty with complimentary backgrounds in engineering and education. In this paper, we discuss the evolution of this course offering from what was originally a single credit hour course taught from solely an engineering perspective and designed to primarily emphasize women in engineering, through multiple offerings to its present format, as a three-credit technical elective focused on all historically marginalized engineers, leveraging collaborative faculty expertise in engineering, diversity, equity, inclusion, and pedagogy. Included in our findings are first person insights on the impact of this form of class on learning and professional development, course evaluation data, and lessons learned in hopes of informing other practitioners in the design of similar course offerings.

## 1.0 Background

There is a rich literature base for those seeking to develop inclusive STEM curricula, with a comprehensive survey of STEM programming designed to enhance inclusion provided in a recent review paper by Palid *et al* [1]. For educators, there are numerous resources to help improve instructional design, ranging from best practices developed by the National Science and Technology Council [2] to courses and workshops hosted by organizations like the National Science Teaching Association [3] and the Inclusive STEM Teaching Project [4] to initiatives within ASEE that help set the bar for inclusive excellence in engineering [5]. Similarly, we note increasing emphasis in the literature on providing students the platform and opportunity to share their experiences with peers and instructors, to help improve a program's culture of inclusivity. Two particularly intriguing recent contributions that emphasize the student's voice include Seattle University's DEI Student Ambassadors program [6] and Northeastern's "New Engineering Toolbox" [7].

In this paper we discuss the development of a course designed to engage undergraduates in the STEM DEI conversation. We couple tools, strategies, and resources often taught to educators to foster diversity, equity, and inclusion in the classroom with the empowerment of spotlighting the student's experience inside of and outside of the classroom, to develop a new course that fosters student interest in DEI advocacy and helps prepare students for their entry into the workforce.

## **2.0 Course Design**

The following subsections describe the history and design of the course in a manner intended to provide a framework for others who may wish to replicate a similar model at their institutions, and expanding upon that which was presented previously in an IFEES/GEDC webinar [8].

### **2.1 Course Evolution**

The current course offering evolved from what was originally a 1-credit course at Virginia Tech focused on the history of women in aerospace and ocean engineering. McCue taught that course in 2008 and 2010. She emulated that design with a 1-credit course offering in Spring of 2020 at Mason, the semester which included a mid-term pivot to online instruction due to the COVID-19 pandemic. Using lessons learned from those instructional experiences, McCue and Carr launched a 3-credit hour course in Spring of 2022, offered a second time in Spring of 2023, at Mason focused broadly on diversity, equity, and inclusion in STEM.

In its present design the course outcomes are that:

- Students will demonstrate the knowledge needed to be advocates for diversity, equity, and inclusion in the engineering workforce
- Students will demonstrate the skills needed to be change agents in the engineering workforce

To accomplish these course outcomes, the course blends case studies with historical, cultural, and pedagogical discussions, in a heavily discussion-based learning environment (e.g. there are no slides). The course culminates in a final project selected by the student. To ensure each student participates in the course fully and demonstrate our commitment to the discussion-based environment, 1/3 of the final grade is devoted to class participation. The remaining 2/3 are split between written and oral project presentation, with a short written and oral status update presented at the midterm period, to permit formal instructor feedback, and a substantive final written report and oral presentation in the closing weeks of the semester.

### **2.2 Instructor Knowledge, Skills, and Abilities**

A unique enabling feature in growing the class from 1 credit to 3 credits and broadening the aperture of topics covered was the complimentary backgrounds of the co-instructors. One co-instructor is a straight, female, white, tenured engineering faculty member, whose academic credentials are all in engineering. One co-instructor is a queer, cisgender, African American/Black, male senior administrator and affiliate faculty with a background in leadership studies and approximately fifteen years in engineering and computing education – with a focus on diversity, equity, and inclusion. The co-instructors' differing life experiences and educational/professional backgrounds provides them the opportunity to engage with the material in different ways providing a more holistic experience for the students. As such, the course is deliberately structured such that engineering case study discussions are led by the engineering faculty member and historical, cultural, and pedagogical discussions are led by the Chief Diversity Officer.

### **2.3 Key Topics**

In its current iteration, a typical semester syllabus for this course is structured for twice weekly meetings. In one meeting per week, emphasis is placed on discussion of 1-2 chapters of the required course textbook, *Changing the Face of Engineering: The African American Experience*

edited by John Brooks Slaughter, Yu Tao, Willie Pearson Jr. [9] or other prescribed supplemental readings such as National Academies reports [10] and first-person testimonies [11-12]. The second weekly meeting typically involves a discussion of a case study, with past topics including pulse oximetry, crash test dummies, self-driving cars, and clinical trials, or a guest lecturer. Guests including visiting seminar speakers from other institutions, to the University President, have addressed the course. Additionally, in the most recent course offering, an optional field trip to the National Museum of African American History and Culture was offered for students in the course. The initial inspiration for the field trip was to consider how a museum like NMAAHC showcases contributions by historically marginalized individuals, and what lessons we learn from that mindfulness in design, outside the context of a museum designed specifically with this intent. That said, in practice, the field trip proved to be a valuable community-building activity for the class, giving yet another opportunity to better understand each other's perspectives and values. With new exhibits focused on infrastructure and redlining – to topics around climate change, the impact of engineers from minoritized backgrounds was brought to the forefront for students and instructors to experience, highlighting the value and importance of DEI in engineering.

Students also participated in an assessment of intercultural development as designed by the Intercultural Development Institute. Working to build the students intercultural understanding is key to accomplishing the first course outcome focused upon demonstration of the knowledge needed to be advocates for diversity, equity, and inclusion in the engineering workforce. Intercultural understanding broadly defined is the “ability to communicate effectively and appropriately in intercultural situations, to shift frames of reference appropriately and adapt behavior to cultural context” [13]. Research has shown that students enter college with a lack of cultural awareness and understanding of what it takes to effectively engage diversity [14].

The class culminates with final student reports and presentations, with multiple days allocated to student presentations in order to give sufficient time for meaningful discussion of each topic a student chose to research. Student work has resulted in conference presentation and publication [15].

### **3.0 Course Evaluations**

This section focuses upon course evaluation data from the current, co-taught, 3-credit hour design of the course. A nuance to course evaluations at our institution is that for co-taught courses, students are provided evaluations for both instructors. We generally requested students complete at least one evaluation, typically for the lead instructor. As such, differing response rates between the two instructors should not be viewed as an adverse finding, though they are reported here separately due to no effective mechanism to aggregate responses without potential duplication. A summary of questions and responses is provided in Table 1. Number of respondents is provided in each column description. In 2022, 20 students were enrolled in the course; in 2023, 6 students were enrolled in the course. Each quantitative question was evaluated on a 5-point scale, with responses corresponding to 1-“Strongly Disagree,” 2-“Disagree,” 3-“Neither Agree nor Disagree,” 4-“Agree,” 5-“Strongly Agree.”

<b>Question</b>	<b>2022 Instructor 1 (n=8)</b>	<b>2022 Instructor 2 (n=6)</b>	<b>2023 Instructor 1 (n=6)</b>	<b>2023 Instructor 2 (n=5)</b>
I completed all assigned tasks before each class.	4.25	4.17	4.67	4.60
I consistently contributed to class activities/discussions.	4.38	4.33	4.83	4.80
I gained an understanding of the main concepts in this course.	4.5	4.33	5.00	5.00
I learned through the variety of learning opportunities (e.g. assignments, projects, papers, discussions, group work, peer review, exams) provided.	4.5	4.20	5.00	5.00
I found the instructor's feedback helpful for learning.	4.38	4.33	5.00	5.00
I learned due to the instructor's teaching methods/style.	4.38	4.17	5.00	5.00
The instructor created an environment that facilitated my engagement with course content.	4.50	4.50	5.00	5.00
The instructor encouraged expression of diverse perspectives.	4.50	4.50	5.00	5.00
The instructor offered opportunities for students to provide feedback on the course.	4.50	4.17	5.00	5.00
The instructor offered opportunities to meet outside of class time, such as virtual or in-person office hours.	4.38	4.40	4.67	4.60
The instructor used technologies and/or resources/tools that increased my engagement with course content.	4.13	4.33	5.00	5.00
The course organization supported my learning.	4.50	4.33	5.00	5.00
The instructor clearly communicated course requirements to students.	4.13	4.00	4.50	4.40
The instructor clearly presented the course content.	4.50	4.17	5.00	5.00

One can observe that while course evaluations were favorable both years, they were higher in the second offering. This may be in part due to the smaller course enrollment; e.g. after the prior year's offering, students had a better sense of what to expect based upon feedback from peers, and therefore the students who elected to take the course were those most passionate about the subject matter. This has both pros and cons. For example, the 2023 offering's small size resulted in fewer dissenting opinions; that is to say, in the first year's course offering there was often spirited debate whereas in the second offering the class dynamic largely led to digging deeply into a more focused

viewpoint. The instructors strive to have this be a class where all opinions can be voiced such that we can learn from each other building awareness and empathy to a variety of worldviews. Probing this more deeply, we added a supplemental question to the course evaluation asking “How did this class make you feel?” Selected responses include:

- “It made me feel excited to try to think about how to implement a lot of what we talked about in class. Especially, considering how to be a role model for both the younger generation and my co-workers.” - 2022 student
- “This class made me feel supported and like I had a voice that mattered in a department. This class also helped me feel less alone and grow community with my peers. I loved the laid back structure of the course and the opportunities to talk about what mattered to us.” - 2022 student
- “This class made me feel heard and seen. I enjoyed speaking with my peers about certain topics and being able to understand different mindsets. Not once did I feel like anyone was being disrespected and I felt as though [sic] this class did very well with making sure everyone felt as though they had a voice.” - 2022 student
- “Like I should have picked a different elective.” - 2022 student
- “Sometimes the class made me feel uncomfortable but that’s what these discussions are supposed to do. The whole point of the class was to have uncomfortable conversations, but I loved having these discussions. I loved the class!” - 2023 student
- “This class was difficult at times but so necessary as a starting engineer. It was very eye opening, and a good mix of hopeful and dissapointed [sic]. Of all of my engineering classes taken at GMU, I think this one will have the biggest impact on my career.” - 2023 student

It was our goal to develop a course where students could have meaningful conversations about challenging topics. Course evaluations and informal feedback did point to the need for careful balance between addressing conflict while avoiding falling into an echo chamber.

#### **4.0 Course Alumni Insights**

Alumni of the course were invited to contribute to this paper as co-authors to share their insights on the class and how it fit into the traditional engineering curriculum. Their perspectives are included in the subsections that follow.

##### **4.1 Kevin Kuck**

My name is Kevin Kuck (pronounced 'cook'). At the time of writing this, I am a 5th-year senior at George Mason University pursuing an undergraduate degree in mechanical engineering. Before I explain this class's profound impact on me, I need to provide context as to why. Until Spring 2022, I had no real intention or desire to be more involved at Mason. I knew very few people within the department and even fewer people in my graduating class (the class of '24) because I was taking a 5-year graduation route, the majority of people I started my academic journey with (the class of '23) gradually began disappearing from the classes I was taking as they were graduating a year before me. I studied alone, did homework alone, and felt like an outsider to the class of '23 and the class of '24, and I typically avoided socializing because of that. I felt I had missed my chance to make friends and enjoy college because of the COVID-19 pandemic, so I kept to myself and focused all my time and energy on school.

During the 2022 Fall semester, I spent 10 to 18 hours a day on campus, taking notes to stay on top of my classes and completing assignments. I was not going out. I only talked to classmates when necessary. My mental health was in a less-than-ideal place. By the end of the semester, I was severely burnt out. I was alone and wanted to be done with college and wanted to leave Mason behind me. When it came time to register for classes for the 2023 Spring semester, I spoke with my advisor, Dr. McCue, and asked if any ME courses did not have exams. She recommended that I take *A Seat at the Table*. There were no exams, but there was a final presentation, and the course was discussion-based. She then explained what the class was about. While it sounded like an interesting topic, I would not have exactly described myself as passionate about the topics of DEI (Diversity, Equity, and Inclusion) at the time. However, it seemed like a class that would not significantly add to my course load, as I was anticipating another dreadful semester like the last one. So, I registered for it.

This class changed my life. It was me and five other students, all of whom were in the graduating class of '24. I had been acquainted with them at various points but did not consider them close friends. Something changed throughout the course and the semester, and unbeknownst to me at the time. In each class we spent discussing DEI issues in education and industry, we also spent time sharing our individual experiences at Mason or finding ways that these issues were tied into the curriculum. It also allowed us to learn about Dr. McCue and Dr. Carr's experiences with DEI, what they were passionate about, and their passion for students, the university, the engineering department, and all the communities they are a part of and associate with. One person who inspired me the most, and still inspires me, is Dhiambi Otete, when she shared her experiences growing up, her experience in the education system, and her takeaways from reading the assigned chapters of *Changing the Face of Engineering: The African American Experience*. You could sense how much she cared about these topics and her concern for how they impacted others.

For the final project, we were tasked with drafting a paper and creating a presentation based on our paper's content. We selected a research topic or issue relating to DEI and engineering. I initially chose to collect a small sample of data from a popular generative AI (Artificial Intelligence) filter on TikTok and then discuss how it exhibited bias. When I began researching bias in AI, I recognized it was a significant problem in AI. More needs to be done to change AI's behavior, which led me to write a ten-page paper titled *Generative Artificial Intelligence: A Double-Edged Sword*, which was accepted for full presentation for the 2023 World Engineering Education Forum (WEEF) and Global Engineering Dean's Council (GEDC) [15]. The paper heavily discusses and shows how generative artificial intelligence exhibits bias towards race, gender, occupation, nationality, etc., and the implications of that on the future of generative AI. It also introduces a framework that offers a structured approach to examining these biases with the idea and hopes that this new framework can act as an incredibly valuable tool for the community, whether it be users, creators, researchers, developers, or policy-makers, by offering a lens through which to address the issues of bias in AI.

One of the wonderful aspects of taking this course was that it allowed us to hold open, honest discussions with our peers free of judgment and in an environment where we felt safe to do so. This allowed us to feel a level of comfort in the classroom that most of us had never felt before. It allowed us to be emotional, vulnerable, and empathetic for everyone's unique struggles, experiences, and values. It opened our minds to perspectives we might not have considered and



showed us the importance of DEI in engineering. It gave us a deeper understanding of ourselves and each other, bringing us closer as a group. I often wished that our class periods were longer because our discussions got so involved that we got out of class late every class. We were engaged, thinking critically, listening, and bouncing ideas around. All while learning about DEI issues in engineering education and the industry it was a gratifying experience. I learned so much without needing to take notes, watch mind-numbing PowerPoint presentations, or listen to a lecture to try and decipher what was important and what was not.

All these factors ignited my interest and passion for George Mason, the Engineering Department, and DEI topics. I wanted to be more involved at Mason, not just as a student but even after graduation. Throughout the 2023 Spring semester, as my friendship with my classmates in A Seat at the Table grew, so did my friendships with my classmates in my graduating class. I was socializing more. I got significantly more involved with the American Society of Mechanical Engineers (ASME) student section, so much so that the 2022-2023 executive board offered me a junior board position because I was helping them and contributing so much. This eventually led to me running for and being elected President of ASME for the 2023-2024 academic year. I realized how impactful getting more involved with George Mason and the Mechanical Engineering department can be and how it can benefit all students, improve their experience, and give them opportunities to get involved. I want to be a proponent of change. Dr. McCue, Dr. Carr, Dhiambi, and Violet's engagement within A Seat at the Table inspired me and, in the process, allowed me to discover a new side of myself. I will forever be grateful to them because they guided me out of a darker spot in my education career.

#### **4.2 Dhiambi Otete**

My name is Dhiambi Anne Otete, and I am a Black woman. At the time of this writing, I work as a Ship Design and Integration Engineer at the Naval Surface Warfare Center, Carderock Division. George Mason University served as a phenomenal institution where I could pursue my interests. I competed in D1 Track and Field as a triple jumper, I received a full-tuition University Scholarship, I researched path dependencies in systems engineering as a research assistant, and I graduated with Magna Cum Laude honors. Although all of my individual pursuits shaped my belief systems, I can say with confidence that A Seat at the Table shifted the trajectory of my career in engineering. The required classes within the mechanical engineering department provided the proper resources and tools to sharpen my foundational engineering principles and succeed on a technical level. However, this elective was the first to emphasize how important it is for students of diverse backgrounds to learn and work in STEM.

From my experience, A Seat at the Table was profound in its (1) pedagogy and (2) its real world application. The course employed a Socratic seminar method in its pedagogy. One feature that was integral to the success of the course was a lack of screens. No PowerPoints were utilized throughout the semester, with the exception of student project presentations at the end of the course. Additionally, students and professors sat in a circle configuration, and this contributed to creating meaningful discussion about various topics. Most of the content for our discussions were fueled by *Changing the Face of Engineering*, in addition to a few case studies and a guest speaker. This textbook in particular was paramount in changing my perception of engineering. I learned

how many everyday objects are Black inventions: the bicycle, refrigerator, and '.com' internet. Additionally, *Changing the Face of Engineering* featured suggestions for improvement on retaining Black individuals in STEM and highlighted notable programs like the NSBE organization and HBCUs that accelerated growth in this area. Case studies like driving test dummies and automatic soap dispensers really showcased how a lack of including women or individuals with darker skin colors can create the perfect storm for deep failures when engineering products are released to the public. Even more foundational was listening to my peers' takeaways from these chapters. Our cohort consisted of women and men, varying sexual orientations, economic backgrounds, and educational backgrounds. Our distinct behaviors and compounding intersectional roles shaped and influenced our lives, and listening to my peers opened my perspective in a way that was unmatched to my technical classes.

Another aspect I enjoyed deeply was the semester research project. Students selected a project related to DEI and Engineering based on their individual interests, and it was fascinating to hear the topics my fellow peers explored throughout the semester. My individual research project, *The Deep-Rooted Toxicity of Black Excellence*, allowed me to consolidate how a simple term drove key accomplishments in STEM while simultaneously perpetuating a toxic intergenerational obligation and burnout among Black individuals in the struggle for exceptionalism. Prior to my research project, I would not have thought that my fascination with academic success could be related to a systematic feeling that multiple minorities in predominantly white fields experience.

Another great takeaway is how this class shaped my career beyond the classroom in the 'real world.' After learning about how integral diversity, equity, and inclusion are in promoting more innovative solutions in engineering, I realized that this class had cultivated a passion within me for this topic, and I wanted to help others throughout my career. I have met individuals who have years of experience in DEI in industry, formed meaningful mentorships and connections, and discovered a purpose in how I would like to help future engineers after me. It was through my newfound lessons in *A Seat at the Table* that drove me to join the Scholarship Outreach Committee for the American Society of Naval Engineers (ASNE), where I help promote outreach to universities and underrepresented students seeking naval careers. It is with the most profound sincerity when I say that this course changed my life forever.

### **4.3 Violet Reges**

My name is Violet Reges, and I am a bisexual white woman with ADHD. At the time of writing this I am a first-year graduate student at George Washington University studying for a Master's in Mechanical Engineering with a focus on design of mechanical engineering systems. I began my education at Northern Virginia Community College where I graduated with my Associate Degree of Science in Engineering and then transferred into George Mason University in the fall semester of 2021 where I earned my Bachelor's degree of Science in Mechanical Engineering. My experience with multiple different learning institutes has shaped my understanding of the world and my interest in how different academic institutes teach. I was a member of the 2023 class of *A Seat at the Table* and this class turned out to be an integral part of my education as an engineer.

The class structure of outside readings and in class discussions was very different from any other engineering course I had taken. The most recent discussion-based class that I had taken was an English class in my freshman year, and even that class included much of the standard lecture style of teaching. In fact, the style of teaching in A Seat at the Table reminded me strongly of how old British movies portrayed Oxford University where the professor wasn't lecturing at the students but speaking with them. As a child I imagined college to be much more like A Seat at the Table, though admittedly with a much more opulent backdrop.

Classes like A Seat at the Table and similar discussion led classes should be required for engineering students, especially in the latter part of their engineering degree. The traditional engineering curriculum teaches us the mathematics and science behind being an engineer and often these classes stress how working in teams allows for different perspectives to be shared, which will ultimately improve final designs. Unfortunately, due to the curriculum of each individual course, any team project assigned to the students has a very limited scope and the differing perspectives of the other students don't inform the final design. Without a course like A Seat at the Table, engineering students are left with only the idea that multiple perspectives are important and no real experience in why. The engineering case studies were invaluable in that aspect. Pairing the case studies with the readings from our textbook allowed for us to be able to see not only the current issues created by lack of diversity in the engineering world (crash test dummies, oximeters, motion sensors), but also the current demographics in engineering colleges and the steps being taken in the educational world to help solve this problem.

One thing sorely lacking in the traditional engineering curriculum is teaching students how to discuss, argue, persuade, and receive feedback from peers. Focusing only on the benefits gained from the discussion aspect of the course, the skills learned from having constant practice in these areas are instrumental to our educational experience. Students entering the engineering workforce need to have the skills to put their own ego to the side when discussing engineering problems and designs with future team members. These future discussions can only positively impact future work, but this can only occur if students have practice taking part in these discussions.

One of the immediate benefits I recognized that this class gave me was the ability to take criticism from my peers and superiors without feeling personally attacked. In the summer immediately after taking A Seat at the Table, I attended an internship where we worked on a team project that was taken to a panel of our superiors six times throughout the summer. On these panels at least two (often four or five) of our superiors would look at our work and provide feedback on areas we should improve. I have never been good at taking constructive criticism of my work, as I always ended up internalizing it in regard to my own self-worth. Taking A Seat at the Table, where I often had to navigate conversations related to DEI, allowed for me to learn how to take criticism with an open mind. It surprised me how much I ended up enjoying the feedback panels this past summer. This change is solely due to my experience with this class due to the discussion-based nature of the class but especially due to the DEI aspect.

A Seat at the Table also helped teach us how to have necessary conversations about DEI, our society, and the role that discrimination has in the engineering world. The 2023 class of A Seat at the Table provided a small class size and a safe environment where opinions, experiences, and feedback were respected. We learned from each other's perspectives and also challenged each other

on our preconceived notions. This class provided a valuable step towards unlearning our societally ingrained ideas and broadened our minds. Having conversations where your opinion and world view may be challenged by your peers is instrumental and directly transferable into skills used when working as a team in an engineering setting.

A DEI related; discussion-based class should be part of every level of education from elementary school to university. Due especially to the large level of diversity in the United States of America, people can only benefit from being involved in these conversations. Learning how to have these conversations is an integral part of becoming a well-adjusted open-minded adult.

## **5.0 Lessons Learned**

There is a well-established, and growing, volume of literature highlighting the importance of belongingness for undergraduates [16], within STEM [17], and amongst students from historically marginalized communities [18-19]. We note the alumni insights in Section 4.0 speak strongly to the role of this course in developing that sense of belonging within the students' cohort and professional community. Specific to course implementation, from a practical standpoint, we found nuances based on class size. Smaller class sizes were prone to uniting on a single perspective, or a single voiced perspective in which those with less popular viewpoints may have been reluctant to share. A larger class size enabled a broader range of voices to be heard. In designing this class, the instructors aim for a class size in the 15-20 range to provide ample opportunity for everyone to be heard, yet a sufficiently large dynamic so as to avoid becoming an echo chamber. Perhaps the most critical lesson learned in the delivery of this course is to be flexible and allow space for discussion of current events. This finding may be intuitive to those in the liberal arts, but is less natural in an engineering classroom. While instructionally, we came to class each day with a plan for the discussion, including driving questions and resources to share, we regularly found the conversation would be driven by the students' lived experience both inside and outside the classroom. Giving the space for students to share that experience, and adapt the conversation plan accordingly proved critical to the success of the class and provided valuable feedback on our programs at large. Being able to reflect on the war in Ukraine, protests on campus related to social justice and human rights, learning and respecting each others' perspectives gave us the space to process course content and what it means to be an engineer in modern society.

## **Acknowledgments**

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