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Diversity, Inclusion, and Equity in the Engineering Curriculum: Evaluating the Efficacy of a New Teaching Module

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ABSTRACT

Current diversity and sexual harassment trainings often take an informative approach that results in a gap between theoretical knowledge and practical resolutions of ethical dilemmas. Available research suggests that diversity training programs often elicit the greatest amount of change among people with a minority identity and can result in hostility from majority group members. To better prepare all engineering students for modern-day organizations, it's imperative that universities develop effective approaches at the student level to mitigate these discrepancies. We propose that our novel ethics-based training will elicit positive diversity-related outcomes overall. We inductively explore the differential impact of diversity training across majority and minority identities. Longitudinal quantitative data were collected to examine changes in participant attitudes and behaviors in response to the diversity module. Undergraduate engineering students enrolled in an introductory engineering ethics course at a large Southwestern university were presented with a week-long teaching module on diversity. Survey results were evaluated to measure differences in effectiveness among majority and minority students. The diversity training successfully decreased levels of sexism, acceptance of sexual harassment myths, and increased intentions to confront discrimination. Differences in outcome variables between majority and minority members were found with regard to political orientation, race, and physical and mental disability status. Overall, this study presents a promising new avenue for diversity training scholarship. Specifically, we find that an ethics-based approach to diversity training may be particularly effective for majority group students.

Key words: diversity, discrimination, harassment



INTRODUCTION

For decades, leaders in engineering have stressed the importance of diversity and inclusion in the engineering workforce. In 2001, the National Academy of Engineering (NAE) hosted a workshop to identify and describe corporate programs that have successfully recruited, retained, and advanced women and underrepresented minorities and to discuss metrics for evaluating diversity programs. In introducing the publication based on the workshop proceedings, William A. Wulf (2002), the then-president of the NAE, emphasized that “the *quality* of engineering is affected by diversity (or the lack of it) [because] engineering is a profoundly creative profession”.

To improve the diversity of the engineering profession and other STEM fields the National Science Foundation (NSF) has joined the NAE in spearheading and supporting diversity initiatives to broaden participation in the engineering enterprise. For example, the NSF has sought to support the recruitment and retention of a diverse STEM workforce through grants awarded under the ADVANCE and Broadening Participation in Engineering Programs. Despite these commendable efforts, engineering still lags behind other fields in its representation of traditionally underrepresented groups. Nationally, women make up only 20% of engineering graduates, and lesbian, gay, and bisexual students are less likely than heterosexual students to major in STEM fields (Greathouse et al. 2018, Hughes 2018). While the proportion of racial and ethnic minorities studying engineering has increased since 2016, Black and Latine students remain underrepresented in the United States (Fry, Kennedy, and Funk 2021). These numbers become grimmer when considering minorities with intersectional identities. Latina women are 6.5% of undergraduate engineering students and Black women make up less than 5% of engineering undergraduate students (Fry, Kennedy, and Funk 2021).

Despite pipeline programs and other efforts to recruit women, racial minorities, and others from underrepresented groups, the pipeline “leaks” when there is attrition related to environments that are inhospitable or even hostile. Indeed, women are much more likely than men to leave engineering fields, primarily due to heightened experiences of incivility, sexism, and harassment (Fouad et al. 2020; Frehill 2020). They are also less likely to feel supported by these engineering organizations, further exacerbating these differences (Singh et al. 2018). This high attrition among qualified employees creates unnecessary gaps in the workplace and high costs for employees and employers in fields that require a high degree of specialization.

Twenty years after President Wulf’s observations, engineering still faces significant gaps in knowledge about what engineering organizations and educational institutions can do to promote Diversity, Inclusion, and Equity (DI&E) in the profession. To create an equitable and welcoming environment for all engineers, it is imperative to promote DI&E concepts early in engineering students’ education. In this paper, we focus on a unique learning module designed to engage and educate



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students about DI&E concerns while students complete an engineering ethics course. Most notably, the training approaches DI&E from an ethics point of view. Although there are numerous models, initiatives, and pockets of innovation by scholars and programs that have coupled DI&E and ethical considerations, the connections between ethics and DI&E are often “hidden” in engineering discourses (Hess et al. 2021). The training described in this paper attempts to make those connections more explicit, impacting students’ experiences while they are in school and preparing them for practice in a multicultural world.

The present study examines the extent to which a week-long learning module can impact attitudes toward diversity, inclusion, and equity among engineering students. Unlike many other modules, this training offered in an engineering ethics course approaches DI&E as an organizational ethics concern. Specifically, an ethical organization can only be built on the foundation of safety and respect for those who come through its doors. Within the organization, ethical conduct, including the treatment of employees, goes beyond formal policies and procedures but includes climate and culture. Understanding this, the developers of the module used the analytical framework of “ethical infrastructure” to approach the topic of ethical conduct and DI&E. As described by Professor Ann Tenbruensel and her co-authors in their seminal work, ethical infrastructure consists of formal systems and informal influences, as well as the organizational climate in which they are embedded (Tenbrunsel, Smith-Crowe, and Umphress 2003). Drawing on this schema, the module provides students opportunities to examine how formal systems, as well as informal influences and climate, impact diversity, inclusion, and equity within organizations.

The module also provided students an opportunity to learn the value of DI&E as part of their undergraduate training while they were shaping their professional identities. As such, a goal of the module was to give the students the conceptual and ethical resources that they need to succeed as responsible professionals in a globalized, diverse, and multicultural society.

To gauge the effectiveness of the module, we conducted an empirical study to obtain data on the impact of the DI&E module. To the best of our knowledge, the impact of incorporating DI&E training in ethics engineering courses has not been empirically tested and reported in the existing literature. Additionally, the study examines how identity interacts with the effectiveness of diversity training. Research suggests that minority group members are more likely than majority group members to benefit from diversity training programs given that they are more interested in and motivated in completing the training (Kulik et al. 2007). At the same time, a training program that focuses on changing biases and ethical perspectives may have a stronger impact on majority members, who have less experience with DI&E issues. Thus, the current study examines how this unique training program may differentially impact majority students as compared to minority students.

**Diversity, Inclusion, and Equity as an Integral Part of Engineering Ethics**

Harassment and discrimination are inherently unethical behaviors, to a large extent because they involve harming and disrespecting others. However, harassment and discrimination are shockingly prevalent in STEM fields, with roughly 40–70% of women reporting sexual harassment during school or their careers (Russell 2017). This results in a variety of negative organizational and personal outcomes including disengagement, decreased commitment, lower productivity, and even organizational retaliation (Buchanan et al. 2014; Fortney and Morris 2021).

In higher education, formal measures to address the individual and institutional costs associated with harassment and discrimination include adopting formal codes of conduct and conducting training such as online tutorials for faculty and students. These modules commonly cover background information and then require test-takers to work through a series of questions where they are directed to choose an appropriate response (Sekreta 2006). Although such online delivery of content is efficient, relying only on such modules may leave gaps in the ethical infrastructure because knowing the rules and applying them in an online session is not the same as learning how to recognize, work through, openly discuss, and resolve an ethical dilemma when there may not be one right solution to an issue (Sekreta 2006). Moreover, such online trainings do not challenge participants to examine their beliefs, biases, or personal ethics. By contrast, taking a proactive and ethics-centered approach to DI&E training in a course allows students to examine and discuss DI&E as an aspect of ethical decision-making. In addition, DI&E training conducted in courses helps equip faculty and students to shape their learning and work cultures, not just on campus, but also in students' future workplaces. This promises to improve overall well-being and satisfaction on campus and the retention of members of underrepresented groups. By reaching future professionals and inculcating values of inclusion and respect, the DI&E module also contributes to the development of a diverse engineering workforce and ethical treatment of those who deal with engineering graduates.

Diversity, inclusion, and equity issues may be covered in the engineering curriculum in a number of ways. One option is to use pervasive teaching by adding DI&E topics in various courses throughout the curriculum. Although such an approach may increase the exposure to a variety of perspectives, the risk is that topics without a clear place in the curriculum may be forgotten or ignored. A different approach is to devote class sessions to the study of DI&E. This was the approach taken in developing the "Ethics of Diversity" module for coverage in a professional ethics course for future engineers. The basic tenet in designing the module was to communicate that DI&E is integrally intertwined with the ethical treatment of others in organizations. By doing so, we aspired to place DI&E concepts at the forefront of the curriculum and strengthen ethical infrastructure at the university by informing students how ethical standards are communicated, monitored, and how violations are sanctioned.



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Often students view compulsory DI&E programs negatively and these programs have been, in some cases, attributed to increasing hostility towards minority groups (Dobbin and Kalev 2018). This is problematic as, following the theoretical basis put forth by Kulik et al. (2007), those most resistant to diversity training are those most in need of it. To combat these negative perceptions, the current training program highlights the benefits of diverse organizations and inclusive environments that are free of sexual harassment and other discriminatory conduct. While there has been contradictory evidence about the efficacy of diversity training outcomes (Bezrukova, Jehn, and Spell 2012; Chang et al. 2019), our module differs from traditional training in addressing DI&E as an ethics concern involving formal systems, informal influences, and climate. Therefore, we expect that generally, our training will increase diversity-related attitudes and decrease negative, discriminatory outcomes.

H1: The ethics-based diversity-training module will result in a) increased diversity self-efficacy, b) increased diversity-related attitudes, c) more positive attitudes towards working with dissimilar others, d) increased intentions to confront bias, e) decreased levels of individual racial prejudice, f) decreased levels of individual gender-based prejudice, and g) reduced acceptance of sexual harassment.

Importantly, our diversity training program may have different effects on students who are members of majority groups versus students who are members of minority groups. On the one hand, it is possible that students who are members of minority groups will be more likely to exhibit improved diversity-related outcomes associated with our training. Previous research has shown that diversity training is most effective for trainees who can sympathize and see themselves as allies to stigmatized groups (Gardner and Alanis 2020). Students of minority backgrounds are often sympathetic to and understanding of other minority-related issues. Indeed, many allies identify with different stigmatized groups (Fingerhut 2011). During sexual harassment and race-based diversity training programs, students who are members of majority groups such as White men sometimes feel excluded, defensive, and/or disinterested in the content, thus reducing the program's effectiveness. Sometimes this can even result in a backlash effect, exacerbating negative diversity-related attitudes and behaviors among these groups (Dobbin and Kalev 2018). Thus, it is possible that the positive outcomes of the module will be more pronounced for students who are members of minority groups versus students who are members of majority groups, given these differences in receptiveness to and interest in these programs.

Conversely, it is also possible that students who are members of majority groups will be more positively impacted by the training module than students who are members of minority groups. Kowal, Franklin, and Paradies (2013) theorized in their development of diversity training centered



on race that employing a more self-reflective approach can avoid the backlash of negative emotions and manage potential bias/negative emotional responses. The ethical and theoretical framing used in our training utilizes this approach to more effectively reach students who are members of majority groups. Indeed, if our training program is able to effectively produce positive changes in students' diversity-related outcomes, it will likely produce greater effects among students with majority identities, who have the most room to learn and grow in these areas. As such, an effective training program could have a stronger positive effect on students with majority identities, potentially increasing their diversity-related knowledge, attitudes, and behaviors to the levels exhibited by students with minority identities. Given the lack of research in this area and the conflicting theories related to the impact of identity on diversity training outcomes, we examine the following research question:

RQ1: How will the ethics-based diversity-training module differentially impact students who are members of minority groups versus students who are members of majority groups?

A New Learning Module on DI&E

Starting in Spring 2020, a new learning module on DI&E was added to the syllabus of *ENGR 482: Ethics and Engineering*. An interdisciplinary team of scholars from the departments of mechanical engineering, philosophy, psychology, and law developed the module. Professors presented the module in two parts: 75-minute lectures (for groups of about 100 students) followed by smaller workshops (for about 25 students) that lasted for about 110 minutes. The group discussions were facilitated by teaching assistants (graduate students) from the department of philosophy and the college of engineering. All teaching assistants attended the same lecture as their students, plus a special training session in which they were taught procedures for facilitating these DEI-related discussions. These teaching assistants were given a case study on sexual harassment within a major tech company with specific facilitation instructions, learning objectives, and additional assigned readings to complete beforehand (see Table 1). A team of eight instructors, four from philosophy and four from engineering, taught the module by working in pairs of interdisciplinary teams. Because of the COVID-19 pandemic during the 2020/2021 academic year, students participated either in person or remotely via Zoom. Of the 2347 students who took the module in 2020/2021, fewer than 50 students elected to complete the module in person.

The DI&E module at Texas A&M University has five elements (See Figure 1). The first focuses on concepts and terminology, e.g. prejudice, stereotypes, discrimination, implicit bias, etc. The second introduces students to the notion of implicit bias and its origins. Two types of factors triggering implicit bias are highlighted: namely, cognitive and affective ones. Confirmation bias is an example of a cognitive factor that triggers implicit bias: we all have a tendency to interpret new information



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Table 1. Diversity Training Module Training Components.

Module Learning Objectives:

1. Understand the relationship between bias, prejudice, and discrimination, and be able to explain the processes by which implicit bias commonly arises.
2. Understand the distinction between diversity and inclusion and some practical ways to ensure that your behavior is not unintentionally exclusionary and how you can support those who find themselves in an “outgroup” in their organizations. Evaluate diversity in organizations and communities that you have experienced using the “culinary model” of diversity.
3. Be able to describe the UBER case and propose possible interventions by various parties that could have changed the outcome.
4. Summarize Rosalind Hursthouse’s assessment of the challenges and obligations of those whose formative years included racist influences.
5. Explain and identify the additional impediments to responsibility encountered by engineers in organizations that are introduced in the online session (blind spots; microscopic vision; authority and professional autonomy; fear of retribution; and ignorance).

Readings for Discussion Facilitators:

1. Mor Barak, Michàlle E. “Inclusion is the key to diversity management, but what is inclusion?.” *Human Service Organizations: Management, Leadership & Governance* 39, no. 2 (2015): 83-88.
2. Hursthouse, Rosalind, ‘Virtue and the Emotions’, *On Virtue Ethics* (Oxford, 2001). <https://doi.org/10.1093/0199247994.003.0006>
3. Fowler, Susan. “Reflecting On One Very, Very Strange Year At Uber”. <https://www.susanfowler.com/blog/2017/2/19/reflecting-on-one-very-strange-year-at-uber>
4. Gerdeman, Diana. “How Gender Stereotypes Kill a Woman’s Self-Confidence”. <https://hbswk.hbs.edu/item/how-gender-stereotypes-less-than-br-greater-than-kill-a-woman-s-less-than-br-greater-than-self-confidence>

as evidence for our existing beliefs and opinions. As an example of an affective factor, the module distinguished in-group favoritism and out-group denigration that may lead to implicit bias.

The third element aims to present objective facts about the prevalence of implicit bias. The factual information is based primarily on findings reported in high-quality peer-reviewed journals. For instance, job applications with names of applicants that are commonly assumed to be White are more likely to be selected for interviews than applications with names that are commonly assumed to be non-White, and this is so even if the applications are identical except for the names (Bertrand and Mullainathan

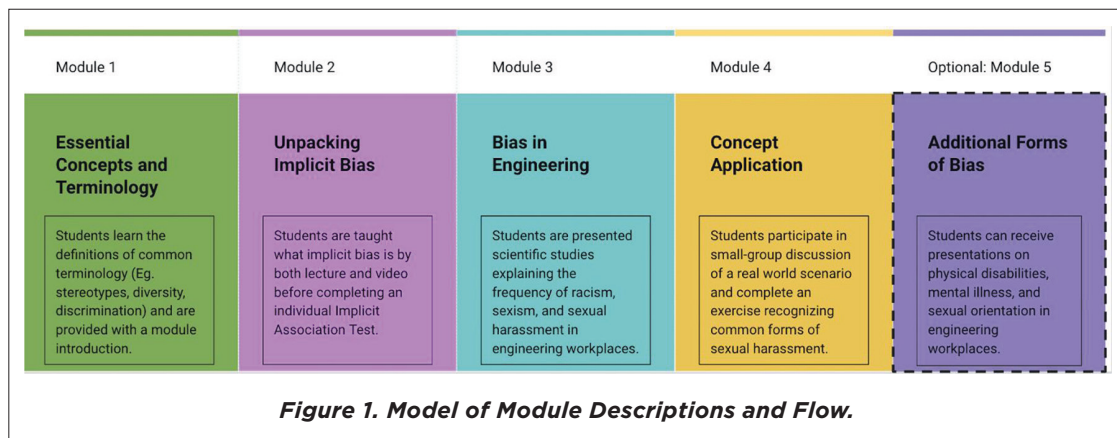


Figure 1. Model of Module Descriptions and Flow.



2004). Moreover, 68% of engineers of color (men as well as women) indicated that they believe that they have to prove themselves repeatedly as compared to 35% of White men. Engineers of color also report that they are less likely than White men to have the same access to desirable assignments (Funk and Parker 2018). In the training, students also learned that in 2016, women in engineering earned between 86–95% of what men did, and that 57%–66% of female engineers working in offices and plants report that they have been sexually harassed (Funk and Parker 2018).

The next part of the module is a case study that exemplifies many of the issues brought up in the initial parts of the module. Specifically, the case study was based on a class-action suit against Uber brought by hundreds of female engineers who alleged that they had been sexually harassed by Uber managers. The suit was settled after Uber paid ten million dollars in damages and fired twenty employees, including its Chief Executive Officer. The case study tasked students with discussing in small groups the following: “What were the underlying causes [of the problems at UBER] and what strategies could we use for preventing similar problems in the future?” Before attending the discussion, students were asked to read a piece from 2019 entitled “How Gender Stereotypes Kill a Woman’s Self-Confidence” by Dina Gerdeman. The facts of the case were summarized by the instructor, who also asked students to bring in perspectives from another assigned reading entitled “Inclusions is the key to diversity management, but what is inclusion?” (Mor Barak 2015).

The fifth and final part of the module focused on other forms of bias in engineering, e.g. bias related to physical disabilities, mental illness, and LGBTQ+ issues. These were included as additional modules that were presented based on the amount of time that was available within these lectures and in accordance with instructor discretion. The section on physical disabilities focused on reasons for underrepresentation and underemployment in the workplace while the section on mental illness focused on the stigma against mental illness in engineering, as well as how these stigmas manifest in engineering contexts. Finally, the section on LGBTQ+ issues covered heteronormativity and LGBTQ+ bias pervasive within STEM organizations.

RESEARCH METHODS

All 2,347 students were emailed a link to the pre-test survey one week before the administration of the DE&I module. To avoid coercion and to comply with Institutional Review Board regulations, these emails were not sent by the instructors and instead were sent by outside researchers associated with the study. Additionally, participants were given the option of writing a short essay on DEI-related topics rather than participate in this study in order to receive the same amount of extra credit. To incentivize students to complete survey instruments, students could earn extra credit



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points in exchange for completing both two surveys. Then, a week after the module, they were sent a second link to the post-test survey. A total of 389 students completed both surveys. These surveys assessed students' diversity self-efficacy, attitudes towards diversity, attitudes towards working with diverse others, diversity-related behavioral intentions, modern racism, modern sexism, and attitudes towards sexual harassment. Participants identified primarily as White (51.41%), male (72.24%), heterosexual (93.83%), Christian (57.58%), conservative (35.22%), and did not identify as having any physical (96.14%) or mental (93.57%) disabilities.

Measures

Demographics. During Time 1 students were asked to identify their race, gender, sexual orientation, religious orientation, political orientation, physical disability status, and mental disability status. For a full breakdown of student demographics see Table 2.

Diversity self-efficacy. Diversity Self-Efficacy was measured using a three-item scale adapted from Holladay (2004). The survey instrument asked participants to rate their confidence in their ability to work with diverse others (e.g., "I feel confident in my ability to effectively perform a task with a group of people who are different from me.") on a scale from 1 (Strongly Disagree) to 5 (Strongly Agree). This scale demonstrated acceptable reliability ($\alpha = .71$).

Diversity-related attitudes. Pluralism and Diversity Attitudes were measured using 4 items from the Pluralism and Diversity Attitudes Assessment (Stanley 1996). On a scale of 1 (Strongly Disagree) to 6 Diversity (Strongly Agree), questions were pulled from the Value of Pluralism (e.g., "Each minority culture has something positive to contribute to American society."), Implementation of Pluralism (e.g., "Minority individuals should adopt the values and lifestyles of the dominant culture."), and Uncomfortable with Cultural Diversity (e.g., "Minority individuals are hard to work with in career and technical education.") subscales. This scale demonstrated acceptable reliability ($\alpha = .72$).

Attitudes toward diverse workgroups. Nakui, Paulus, and Van der Zee's (2011) Attitudes Toward Diverse Workgroups Scale (ADWS) was adapted to measure attitudes towards diversity. Participants were asked to answer the extent to which they agreed with five questions about their feelings towards working in groups that vary in the degree of diversity on a scale of 1 (Strongly Disagree) to 5 (Strongly Agree). For example, one statement said, "Working in diverse groups can increase one's understanding of those who are different from me.". This scale had acceptable reliability ($\alpha = .82$).

Behavioral intentions. An adapted version of Linnehan, Chrobot-Mason, and Konrad's (2006) Behavioral Intentions Scale assessed participants' likelihood to confront others engaging in biased behaviors (e.g., "Confront those who tell jokes that are offensive to members of other demographic groups"), seeking to better understand members of other cultures (e.g., "Ask members of diverse demographic groups for their views and ideas"), and including members of other demographic

**Table 2. Sociodemographic Characteristics of Participants.**

	n	%
Gender		
Female	104	26.7
Male	281	72.2
Non-binary	2	0.5
Not listed	1	0.3
Race		
African American/Black	5	1.3
Asian American/Pacific Islander	80	20.6
Latina/Latino/Hispanic	59	15.2
Native American/American Indian	1	0.3
White/Caucasian/European American	200	51.4
Bi-/Multiracial	36	9.3
Not listed	8	2.1
Sexual Orientation		
Heterosexual	365	93.8
Lesbian	2	0.5
Gay	3	0.8
Bisexual	11	2.8
Pansexual	2	0.5
Asexual	2	0.5
Not listed	2	0.5
Religion		
Christian	224	57.6
Jewish	2	0.5
Muslim	21	5.4
Hindu	12	3.1
Buddhist	8	2.1
Agnostic	51	13.1
Atheist	52	13.4
Not listed	15	3.9
Physical Disability		
Yes	13	3.3
No	374	96.1
Mental Disability		
Yes	17	4.4
No	364	93.6
Political Orientation		
Extremely Liberal	12	3.1
Liberal	67	17.2
Slightly Liberal	56	14.4
Moderate	115	29.6
Slightly Conservative	66	17
Conservative	62	15.9
Extremely Conservative	9	2.3

Note. N = 388

groups (e.g., “Look for instances where members of other demographic groups are overlooked and take action to get them involved”). This scale demonstrated acceptable internal consistency reliability ($\alpha = .88$).



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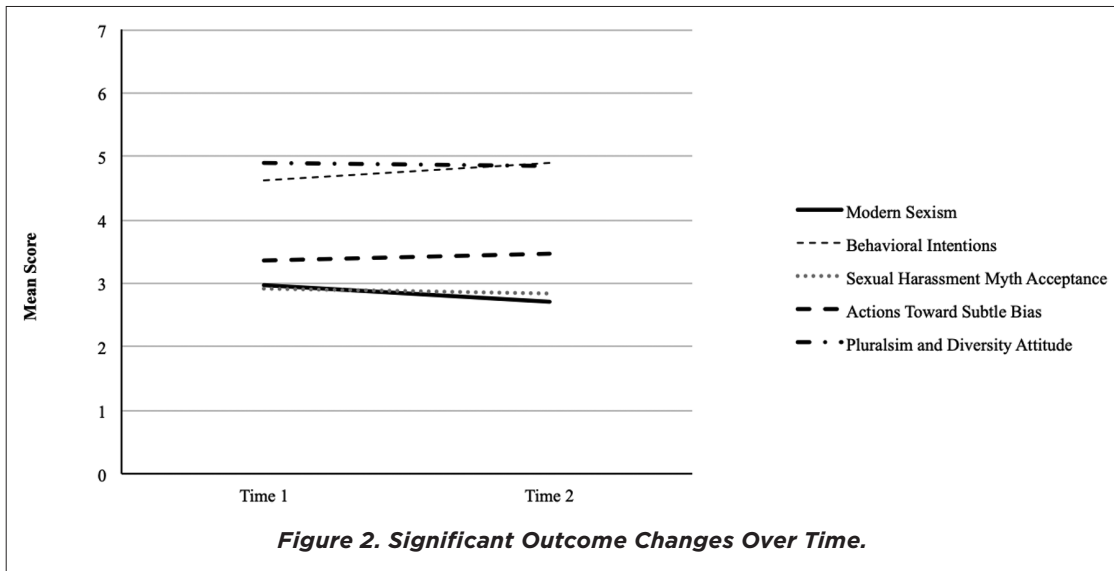
Racism. Racism was assessed using McConahay, Hardee, and Batts (1980) Modern Racism Scale. The instrument asked participants to note the extent to which they agreed with five statements about the experiences of African Americans (e.g., “Discrimination against blacks is no longer a problem in the United States”) on a scale of 1 (Disagree Strongly) to 7 (Agree Strongly). This scale demonstrated acceptable reliability ($\alpha = .88$).

Sexism. Participants’ degree of covert sexism was assessed using Swim et al.’s (1995) Modern Sexism Scale. Individuals who score high on the modern sexism scale may not notice that they are participating in sexism and can score low on traditional measures of overt sexism. Participants were asked the extent to which they agreed with five statements about the experiences of women (e.g., “Over the past few years the government and news media have been showing more concern about the treatment of women than is warranted by women’s actual experiences”) on a scale of 1 (Disagree Strongly) to 7 (Agree Strongly). This scale demonstrated acceptable reliability ($\alpha = .85$).

Attitudes towards sexual harassment. Student attitudes towards male sexual harassment of women were assessed using an adapted version of the Illinois Sexual Harassment Myth Acceptance (ISHMA) Scale (Lonsway, Cortina, and Magley 2008). Participants were given eight questions across each of the subscales measuring beliefs about Fabrication/Exaggeration (e.g., “Women who claim that they have been sexually harassed are usually exaggerating.”), Ulterior Motives (e.g., “Women who are caught having an affair with their supervisor sometimes claim that it was sexual harassment.”), Natural Heterosexuality (e.g., “Most women are flattered when they get sexual attention from men with whom they work.”), and Woman’s Responsibility (e.g., “Women can usually stop unwanted sexual attention from a co-worker by telling their supervisor about it.”) for sexual harassment. Responses were measured on a scale of 1 (Strongly Disagree) to 7 (Strongly Agree). The overall scale demonstrated acceptable reliability ($\alpha = .84$).

FINDINGS AND ANALYSIS

We first analyzed differences in each of our outcomes before and after implementation of the module (See Figure 2). First, we analyzed the impact of the module on modern sexism and found that students experienced lower levels of modern sexism at Time 2 ($M = 2.71$, $SD = 1.28$) compared to Time 1 ($M = 2.97$, $SD = 1.30$), $t(375) = 6.16$, $p < .001$. Behavioral intentions also significantly increased from Time 1 ($M = 4.61$, $SD = 1.2$) to Time 2 ($M = 4.9$, $SD = 1.16$), $t(384) = -6.94$, $p < .001$. Students exhibited lower acceptance of sexual harassment myths at Time 2 ($M = 2.84$, $SD = 0.98$) compared to Time 1 ($M = 2.91$, $SD = 0.99$), $t(382) = 2.07$, $p = .039$. However, diversity attitudes decreased from Time 1 ($M = 4.91$, $SD = 0.76$) to Time 2 ($M = 4.85$, $SD = .81$), $t(383) = 2.02$, $p = .044$. However, changes in



modern racism $t(382) = -.316, p = .752$, attitudes towards diverse work group $t(384) = 1.855, p = .064$, and diversity self-efficacy $t(382) = .067, p = .946$ did not exhibit changes as a result of the module. Please see Table 3 for the full paired t-test analyses. Thus, there was mixed support for Hypothesis 1.

We then examined differences in outcomes across different identities (See Table 4 for all F-values for all interaction effects). For sexism, political orientation influenced the module's effects, such that the module reduced levels of sexism to a greater degree for conservatives than for liberals, $F(1, 267) = 6.471, p = .012$ (See Figure 3). Similarly, mental disability status interacted with the effects of the module, such that sexism was reduced only among students without reported mental disabilities, $F(1, 373) = 36.82, p = .024$ (See Figure 4). There were no significant interactions between sexism and gender, race, sexual orientation, religion, or physical disability.

Table 3. Results of Paired T-tests on Main Outcome Variables.

Variable	Pre-Module		Post-Module		$t(389)$	p	Cohen's d
	M	SD	M	SD			
Diversity Self-Efficacy	4.141	0.694	4.138	0.701	0.067(383)	.946	0.757
Diversity-Related Attitudes	4.908	0.757	4.854	0.807	2.022(384)	.044*	0.522
Attitudes Toward Diverse Workgroups	4.113	0.804	4.057	0.796	1.855(385)	.064	0.591
Behavioral Intentions	4.607	1.203	4.903	1.162	-6.935(385)	.001**	0.839
Racism	2.577	1.36	2.588	2.329	-0.316(383)	.752	0.686
Sexism	2.972	1.303	2.711	1.284	6.159(376)	.001**	0.822
Actions Towards Subtle Bias	3.359	0.873	3.466	.872	-3.534(383)	.001**	0.593
Attitudes Towards Sexual Harassment	2.905	0.992	2.838	0.982	2.073(383)	.039*	0.642

* $p < .05$. ** $p < .001$.



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Table 4. F-values for Two-Way ANOVA Interaction Effects.

Study Measures		Demographic Variables						
		Gender	Mental Disability	Physical Disability	Political Orientation	Sexual Orientation	Race	Religion
Diversity Self-Efficacy	df	1, 378	1, 381	1, 381	1, 268	1, 381	1, 380	1, 381
	F	0.13	0.58	0.02	0.27	0.07	1.21	0.85
Diversity-Related Attitudes	df	1, 379	1, 382	1, 382	1, 269	1, 382	1, 381	1, 382
	F	1.90	0.01	3.87*	0.89	0.51	0.12	0.31
Attitudes Toward Diverse Workgroups	df	1, 380	1, 383	1, 383	1, 270	1, 383	1, 382	1, 383
	F	0.41	0.09	4.91*	0.03	0.22	4.82*	0.57
Behavioral Intentions	df	1, 380	1, 383	1, 383	1, 270	1, 383	1, 382	1, 383
	F	0.21	0.61	0.00	4.91*	0.02	0.30	0.46
Racism	df	1, 378	1, 381	1, 381	1, 268	1, 381	1, 380	1, 381
	F	1.66	0.02	0.54	0.13	0.75	0.06	3.75
Sexism	df	1, 371	1, 374	1, 374	1, 267	1, 374	1, 373	1, 374
	F	0.10	5.13*	1.54	6.47*	0.01	0.11	0.00
Actions Towards Subtle Bias	df	1, 378	1, 381	1, 381	1, 268	1, 381	1, 380	1, 381
	F	8.61*	1.96	0.65	4.33*	0.01	0.83	0.18
Attitudes Towards Sexual Harassment	df	1, 378	1, 381	1, 381	1, 268	1, 381	1, 380	1, 381
	F	1.12	0.81	0.38	1.21	0.42	0.06	1.11

Notes: * $p < .05$

With regard to attitudes towards diverse workgroups, race impacted this outcome such that attitudes towards working with dissimilar others became less favorable among students who are racial minorities and more favorable among students who are White, $F(1, 382) = 4.82$, $p = .029$ (See Figure 5). Physical disability also influenced the effects of the module, such that the module improved attitudes

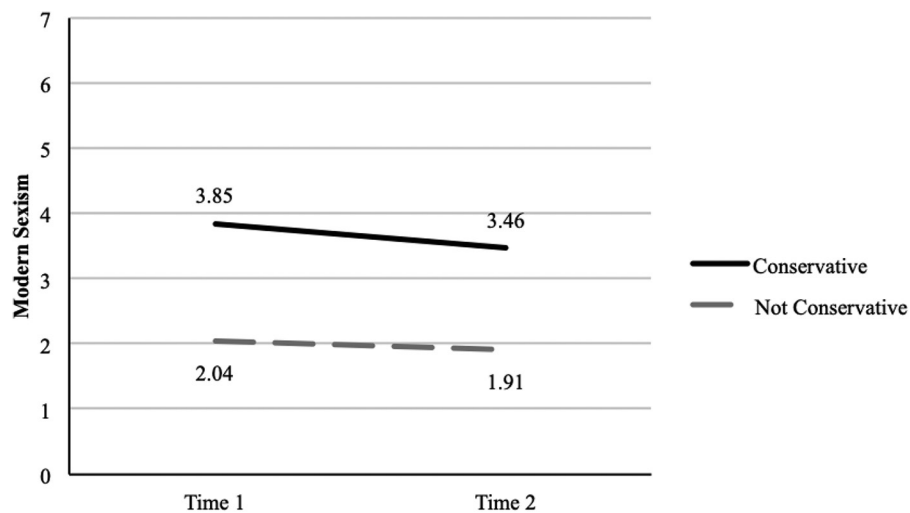


Figure 3. Changes in Modern Sexism by Political Orientation.

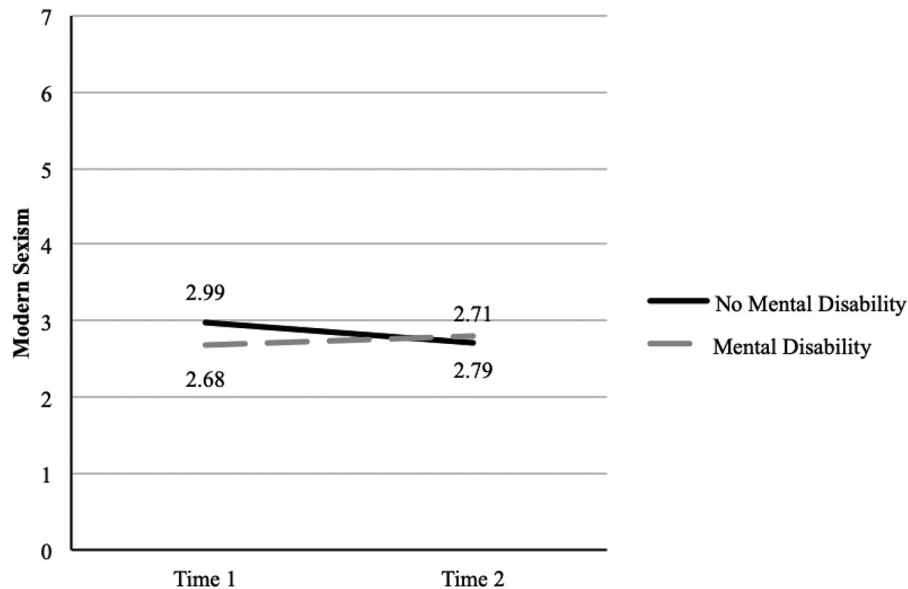


Figure 4. Changes in Modern Sexism by Mental Disability Status.

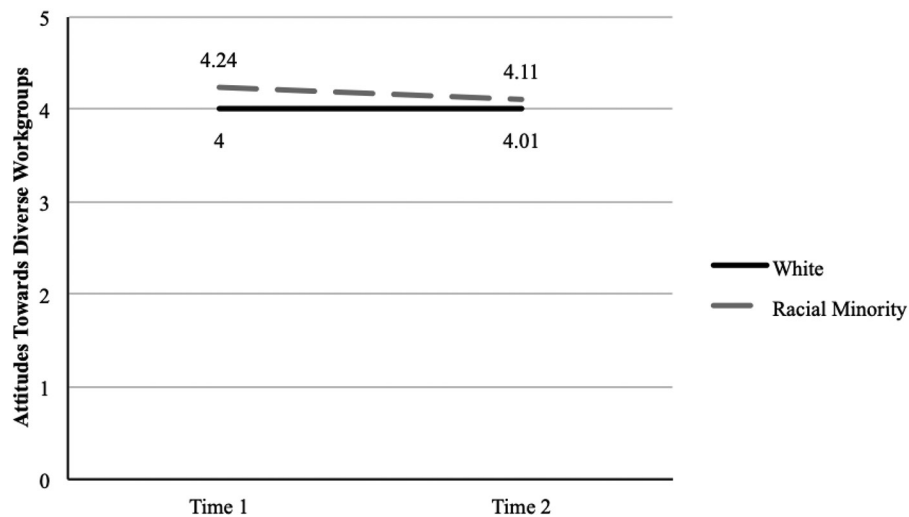


Figure 5. Changes in Attitudes Towards Diverse Workgroups by Race.

toward working in diverse groups among students without a reported physical disability and decreased attitudes towards working in diverse groups among students with a physical disability $F(1, 383) = 4.91$, $p = .027$ (See Figure 6). There were no significant interactions between attitudes towards working with diverse groups and gender, sexual orientation, religion, mental disability, or political orientation.

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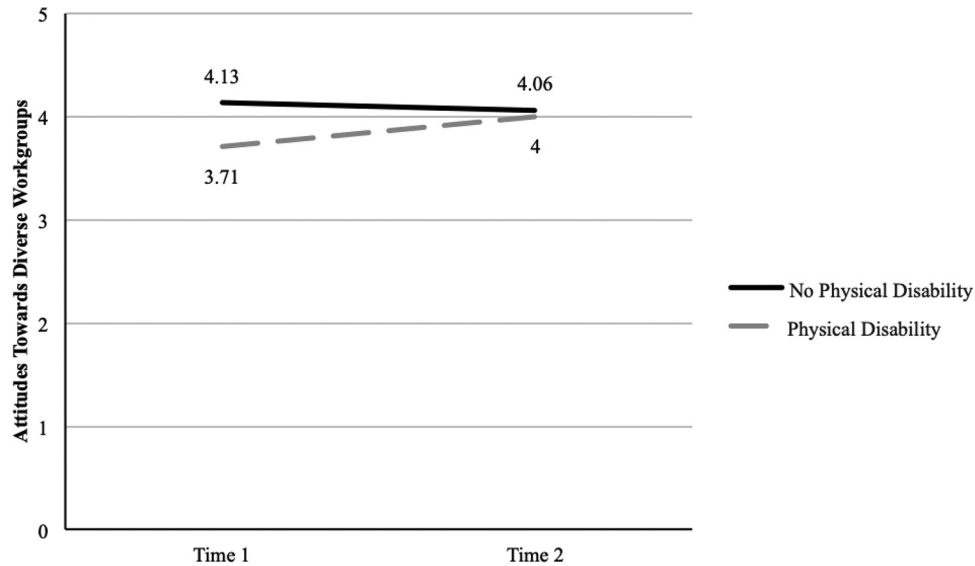


Figure 6. Changes in Attitudes Towards Diverse Workgroups by Physical Disability Status.

With regard to intentions to engage in diversity-related behaviors, political orientation also influenced the effects of the module, such that these intentions increased to a greater extent among conservatives than liberals, $F(1, 270) = 4.91, p = .028$ (See Figure 7). There were no significant interactions between behavioral intentions and gender, race, sexual orientation, religion, physical disability, or mental disability.

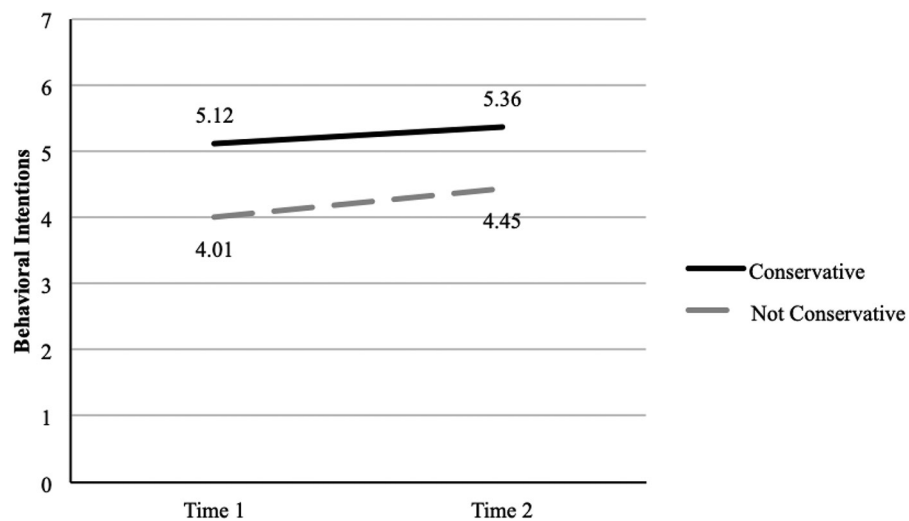
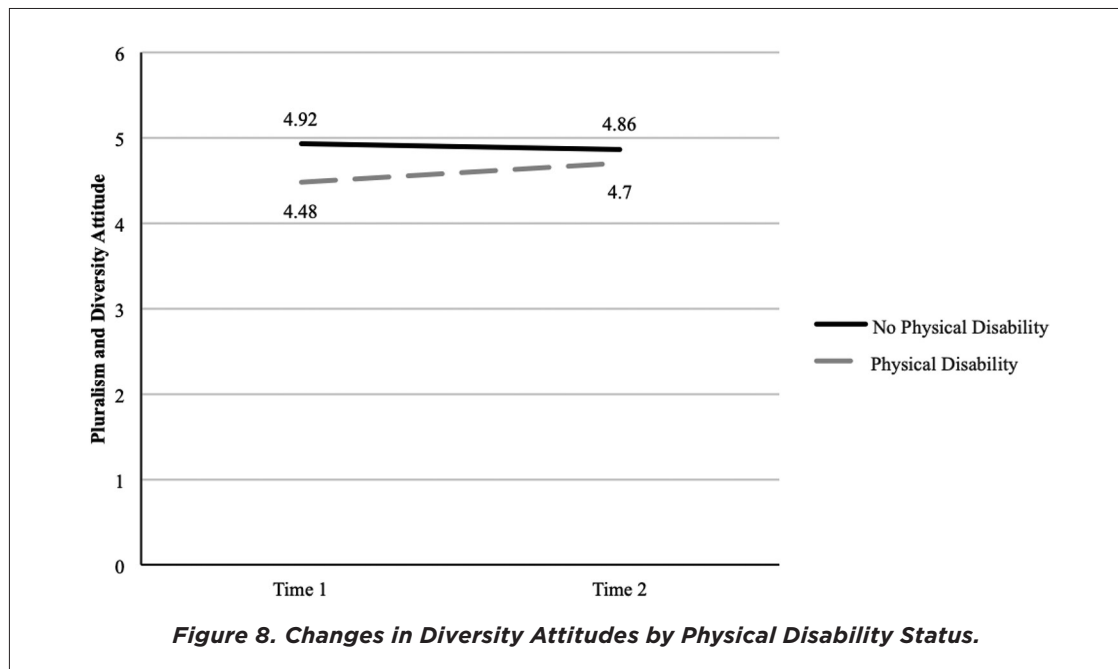


Figure 7. Changes in Behavioral Intentions Over Time by Political Orientation.



With regard to diversity attitudes, physical disability status influenced the module's effectiveness, such that the module elicited more positive diversity-related attitudes among students with a physical disability and more negative attitudes among students with no reported physical disabilities, $F(1, 382) = 3.867, p = .05$ (See Figure 8). There were no significant interactions between diversity attitudes and gender, race, sexual orientation, religion, mental disability, or political orientation.

There were no significant interactions between any of the measured demographic variables and diversity self-efficacy, perceptions of climate, and acceptance of sexual harassment myths. Thus, the findings for Research Question 1 were mixed, with some support for the notion that students with majority identities exhibited greater improvements in diversity-related outcomes as a result of the module compared to students with minority identities.

DISCUSSION

Our results indicate mixed support for study hypotheses. Overall, students who completed the module exhibited less acceptance of sexual harassment myths, lower levels of sexism, and increased intentions to confront prejudice. Racism, attitudes towards diverse workgroups, and diversity self-efficacy did not significantly differ before and after the training. This indicates a net positive overall effect of the training while signaling potential areas for improvement. In future editions of the



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module, we aim to enhance sections that may bolster its impact on attitudes towards race, working with diverse workgroups, and diversity self-efficacy.

Importantly, students' identities interacted with these main effects in several ways. Race interacted with the effects of the module on attitudes towards working with dissimilar others. Specifically, students who are racial minorities indicated less willingness to work with dissimilar others after observing the module, whereas students who are White indicated greater willingness. This makes sense given that during the course of the training, participants were given specific examples of discrimination occurring at the institution they attended. While this may have educated students who are White on the negative experiences faced by students who are racial minorities, it may have also highlighted the negative experiences that students who are racial minorities are likely to face when working with their peers who identify as White. Revising the module to emphasize positive intervention strategies that students who are members of minority and majority identities can use to work together cohesively may help to minimize this apprehension.

Physical disability interacted with the effects of the module on attitudes towards working with dissimilar others by decreasing willingness to work with others among students with physical disabilities and increasing willingness among students with no reported physical disabilities. Similar to the effect the module had on students who are racial minorities, this training may have educated students with no reported physical disabilities while reminding students with physical disabilities about the instances of discrimination they are likely to encounter. Surprisingly, the module interacted with physical disability such that students with no reported physical disabilities exhibited poorer attitudes towards diversity while students with physical disabilities exhibited more positive attitudes. While contradicting Hypothesis 1, this finding supports Research Question 1 and the rich get theory put forth by Kulik et al (2017). Mental disability interacted with the effects of the module on sexism. Students with mental disabilities reported increased sexism after completing the module whereas students with no reported mental disabilities reported reduced sexism as a result of the module. These counterintuitive findings may be explained by the heterogeneity within our sample. Indeed, students were dichotomized as either having a disability or not, yet there is a high degree of variability in experiences and outcomes among those with disabilities (Graham et al. 2019). Additionally, unlike the other demographics in the survey, students were also asked to self-identify with a physical or mental disability rather than choosing from preselected choices. Requiring self-identification may have led to students self-selecting out of the group identity if they were unsure of their status. Thus, the selection criteria may not have been explicit enough to accurately compare these groups.

Political orientation interacted with the effects of the module on intentions to engage in diversity-related behaviors, intentions to confront subtle bias, and levels of sexism. Specifically, the module was especially effective at increasing intentions to engage in diversity-related behaviors, addressing



subtle bias, and decreasing sexism for conservatives. These findings have strong theoretical implications as they contradict the ‘rich get richer’ theory put forth by Kulik et al. (2007). This theory argues that only those who are already invested in diversity and inclusion (ie., typically those with minority identities) benefit from diversity training programs. Counter to this model, our results showed that members of majority groups and conservatives benefited the most from our module. This supports the notion that these individuals exhibit greater improvements in diversity-related outcomes as they have more to learn and grow in these areas. Indeed, our module reduced the gaps in attitudes and behaviors that exist between students that belong to majority and minority groups, as well as between conservatives and liberals.

The findings from this study suggest that schools and organizations may benefit from pivoting existing training to focus more on the connection between ethical conduct and DE&I. Such training can consider the different mental models on the relationship between diversity and engineering ethics. For a discussion of these models, see Hess et al. (2021). Furthermore, the positive relationships between those with majority group identities and willingness to work with others suggest that this style of training is beneficial to improving attitudes among those with majority group identities. This training would be particularly helpful to organizations struggling with sexism and sexual harassment, as students displayed less sexism and less acceptance of sexual harassment myths, as well as increased intentions to change personal behaviors and confront biases.

Limitations and Future Work

As with all research, there were limitations associated with our study. Most prominently, the COVID-19 pandemic began in the Spring of 2020, prompting the module to be adapted for a synchronous online delivery. While studies have begun to explore the effects of online diversity trainings (Chang et al. 2019), there is minimal research examining the impact of online vs in-person training. It’s possible that the distance provided by the online format allowed students to engage with the material in a less threatening way, thereby reducing the defensive reactions that are often observed within those with majority group identities partaking in diversity-training interventions. Future research should examine if the delivery format moderates the extent to which diversity trainings can effectively reach those with majority group identities.

Although our design improves upon traditional approaches to integrating diversity into courses, our training was limited to one week. To allow for the positive effects of spaced practice, our training program should be dispersed across multiple weeks throughout the semester, allowing for increased learning and retention over time (Dunlosky et al. 2013). Subsequent research on this module should explore the effects of presenting this training program over a longer period of time rather than as a singular module. Future research should also examine the effectiveness of this novel diversity



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training program in conjunction with systematic institutional changes. As prior research has shown, training that is not partnered with visible and consistent change in its organizational structure will not have long-term effects (Dobbin and Kalev 2018). This line of work will help improve the culture and climate within engineering.

Additionally, political orientation is a relatively unexplored demographic in diversity training. Given that the liberal and conservative political groups can vary depending on a number of factors, including school culture and geography, it's important for future research to examine how and why this relationship occurs. Future research would benefit from examining if and how interacting identities could influence training outcomes. Intersectionality theory, developed by Crenshaw (2017), states that different combinations of marginalized identities have different experiences. To further advance the current study, greater attention should be given to potential compounding and intersectional effects associated with these and other identities. Additionally, future studies should further examine the unique benefits associated with these discussion and self-reflection programs. Past research has found that self-reflection and conversational learning provide participants with non-threatening opportunities to unpack and unlearn their individual biases (Bezrukova et al. 2012). Incorporating these techniques into diversity training courses may reduce the apprehension and defensiveness exhibited by majority members that sometimes lead to backlash effects (Dobbin and Kalev 2018). Indeed, our study demonstrated promising findings with regard to stereotype and attitude-change, which may be due in large part to these facilitated discussions. Future research should also focus on further developing the effectiveness of this novel approach to diversity and harassment training. In doing so, the line of work promises to help improve the culture and climate within the institutions where this module is taught.

CONCLUSION

While there was mixed support for the hypotheses, training modules that focus on DE&I and the ethical treatment of others represent a promising new avenue for approaching diversity and sexual harassment training. Importantly, our study reveals that this type of training has the potential to improve diversity-related attitudes and behaviors among those with majority group identities, who typically are most in need of and least receptive to these changes. By addressing DE&I concerns, such as harassment and discrimination, the training promotes environments where students and faculty may perform at their highest level. This also can contribute to reductions in attrition of women and members of underrepresented groups in engineering. Long-term, this will help advance the development of a more diverse STEM workforce and improve diversity, inclusion, and equity within STEM fields.



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