Incorporating Readings on Diversity and Inclusion into a Traditional Software Engineering Course

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Abstract—**Computer Science courses must increase students' awareness of diverse identities and perspectives in the tech industry, foster a greater understanding of how lack of diversity and belonging in tech affect the world into which tech products are shipped, and inspire students to create more inclusive and welcoming spaces in the field of computing, whether it is the classroom, industry, or academia. This is becoming an increasingly critical objective given recent high-profile cases of discrimination and harassment in the tech industry, as well as the global reckoning of social injustice and systemic racism in the United States and around the world. Despite the importance of this topic, it is rarely included in Computer Science (CS) curricula, particularly in "traditional" CS classes that are otherwise technically focused.**

This paper presents our experience of addressing diversity and inclusion in computing in a traditional undergraduate Software Engineering course by incorporating reading assignments into the technical curriculum. Over the course of three semesters, nearly 600 students were required to read, reflect on, and exchange ideas regarding articles about why diversity is important, what tech companies are doing about it, and what issues are faced in the field of computing by women, People of Color, members of the LGBT community, and people with disabilities. This paper describes the background and motivation for this work, the logistics of implementing these assignments, and student feedback and observations. Our hope is that other CS instructors will be inspired to incorporate similar types of assignments into their courses as well.

Index Terms—**education**

I. INTRODUCTION

Computer Science courses must increase students' awareness of diverse identities and perspectives in the tech industry, foster a greater understanding of how lack of diversity and belonging in tech affect the world into which tech products are shipped, and inspire students to create more inclusive and welcoming spaces in the field of computing, whether it is the classroom, industry, or academia. In light of the recent high-profile cases of discrimination and harassment in the tech industry, as well as the global reckoning of social injustice and systemic racism in the United States and around the world, it is important that the current generation of CS students act as leaders in creating inclusive, supportive environments; be mindful of the impact that computing has on the world; and

actively strive for increased equity so that more people can enter and thrive in the tech industry.

Though some courses are designed to specifically focus on issues of diversity, equity, and inclusion in CS, e.g. Duke University's "Race, Gender, Class, & Computing" course [1], and many CS curricula include components on ethics and social impact, it is rare for technically-focused CS courses to also seek to directly address topics related to diversity and inclusion and the issues faced by various underrepresented and marginalized groups in the tech industry.

This paper presents our experience incorporating reading assignments on diversity and inclusion in the field of computing into a traditional undergraduate Software Engineering course at a large, private R1 university in the Northeast United States. The goals of this intervention were for students to be able to:

- Understand why cultivating inclusion in the tech industry is crucial
- Recognize the political, socioeconomic, and educational factors that need to change to achieve greater equity in the field of computing
- Develop an action plan on how to carry knowledge and skills related to diversity and inclusion to spaces that were not created with them in mind

This paper is intended for CS educators who seek to prepare their students to address the challenges of diversity and inclusion faced by the tech industry, and describes the background and motivation for this work, the logistics of implementing these reading assignments, and student feedback and observations.

II. BACKGROUND

A Computer Science Department town hall on diversity and inclusion held in Spring 2018 at the institution discussed in this paper made it clear that diversity-related topics were not covered anywhere in the curriculum (except briefly in the Engineering Ethics course), and that many students in the majority "in-group" were unaware of the experiences and challenges faced by their classmates in the marginalized minority "out-group," including impostor syndrome, stereotype threat, microaggressions, and harassment.

Therefore, an opportunity became apparent to introduce interventions into the CS curriculum that would increase

Response	Male	Female	TOTAL
Strongly agree	17.9%	37.1%	25.8%
Somewhat agree	35.8%	41.6%	38.3%
Neutral	36.6%	15.7%	27.6%
Somewhat disagree	9.8%	5.6%	8.4%
Strongly disagree	0%	0%	0%

students' awareness of the perspectives of members of other identity groups, facilitate the exchange of ideas regarding issues around diversity and inclusion, and inspire students to take action to create a more inclusive and welcoming environment.

A. Course Description

The target for some of the initial interventions was the undergraduate Software Engineering course, which is an upper-level elective that mostly focuses on traditional software engineering topics such as the software development lifecycle, process management, design patterns, testing, and maintenance.

This course was a good candidate for these interventions for three main reasons: the course was one of the more popular undergraduate electives and thus the intervention would reach a large number of students; the course's intended audience of juniors and seniors generally already had a perspective on diversity in the tech industry through their prior summer internships; and the course has a stated goal of preparing students for successful careers as professional software developers, so this seemed to be a natural fit.

The intervention described in this paper was first piloted in Spring 2019 (198 students), and then continued in Fall 2019 (77 students) and Spring 2020 (320 students).

B. Student Perspectives

To get a baseline understanding of students' attitudes toward diversity in the field of computing, at the start of the most recent offering of the course (Spring 2020), students were invited to complete a survey in which they were asked to what extent they agreed with the statement "Diversity in computing matters to me."

A total of 214 students (66.9% response rate) participated in the survey. Students were also asked to identify their gender, and the results of the survey separated by gender are shown in Table I; no students identified as non-binary, genderfluid, or preferred to self-describe, so those categories are omitted from the table.

The results indicate that 64.1% of the students claimed that they somewhat agreed or strongly agreed that diversity in computing matters to them, with 53.7% of the male students and 78.7% of the female students agreeing. And though 35.9% were neutral or somewhat disagreed with the statement, no students in the class strongly disagreed with the statement.

Although not shown in Table I, we also asked students to identify their race: 60.3% of White students and 62.4% of Asian students somewhat or strongly agreed that diversity matters to them, but 100% of Black/African American students agreed, as did 80% of Hispanic/Latinx students.

Students were given class participation credit for submitting the survey, and thus the responses were not anonymous, which may affect the validity of these findings. Therefore, we do not claim these results as a contribution of this paper or seek to generalize them across institutions or other student populations, but rather use them as anecdotal evidence that, at least in our case, the majority of students stated that diversity in computing matters to them, but that there may be variation among the perspectives of different demographic groups.

III. LOGISTICS

In order to increase students' awareness of the issues around equity in the field of computing, and to prepare them to make positive contributions in this area once they enter the tech industry, we introduced mandatory reading assignments on diversity and inclusion in the tech industry into the Software Engineering course starting in Spring 2019, and continuing in the two following semesters. There were typically six such assignments over the course of the semester, and for each assignment, the students were expected to read 2-3 articles selected by the instruction staff, write a brief response to the articles in the class discussion forum, and then reply to another student's response.

A. Topic Selection and Assignment Creation

To facilitate the organization of these assignments, we created a "Teaching Assistant for Diversity & Inclusion," or "Diversity TA," position. The Diversity TAs were responsible for working with the instructor to identify topics and articles for the reading assignments, produce assignment descriptions, grade submissions, and organize optional in-person discussion sessions. [1] In some cases, TAs and students in the course were asked to preview the assignment descriptions prior to their release, to ensure that the readings were consistent with the course's goals, used appropriate wording, etc., and were also invited to recommend alternative readings.

B. Assignment Instructions and Grading

These assignments consisted of three steps, to be completed over a two-week cycle. The first step was for students to read the assigned articles. Typically we assigned 2-3 articles, though on some occasions we assigned videos or podcasts.

Next, students were instructed to post a response in which they described any thoughts, observations, or insights they had while reading the articles. Students were allowed to write as much or as little as they were compelled to, though we suggested 200-300 words, and welcomed students to disagree with the authors or provide other perspectives, as long as their response made it clear that they had read all the articles

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[1]The first author of this paper was the instructor of the course during all three semesters; the second author was a Diversity TA during that time; the third author was a student in the course in the first semester and an undergraduate TA in the other two.

and that they had insights into the topic beyond simply summarizing them.

Last, to complete the assignment, students needed to review another student's response to the readings and post a reply. Students' replies were expected to be thoughtful and meaningful, i.e. they should not simply be "+1" but rather should demonstrate that they read the response, considered their classmate's perspective, and have insights of their own that they could share. Students were free to reply to multiple classmates' responses or to engage in further discourse on the discussion board.

C. Student Anonymity and Conduct

Students' responses to the reading assignments and replies to their classmates' responses were posted in a public forum: we used Canvas for the Spring 2019 offering and Piazza for Fall 2019 and Spring 2020. An important consideration in designing these assignments was the extent to which we would allow students to remain anonymous in their responses and replies, and ensuring that discussions were carried out in a respectful and thoughtful manner. In particular, we wanted students to feel free to express ideas that may run counter to the prevailing sentiment on these topics and/or not be fearful of revealing a relative lack of experience or background knowledge, but know that they would still be held accountable for what they wrote.

To address this, we gave the students the option to post their responses and replies anonymously to their classmates, but not be anonymous to the instruction staff. In the most recent offering of the class, 73% of initial responses to the reading assignments were anonymous, as were 78% of replies to other students' responses.

Students were also reminded that they were expected to abide by the University's and class' codes of conduct, specifically to exercise consideration and respect in their writing, to listen to opposing perspectives and authentically and respectfully raise concerns before engaging in conflict, and to refrain from demeaning, discriminatory, or harassing behavior and speech. To our knowledge, there were no incidents in which the instruction staff observed or a student reported a violation of these policies.

IV. ASSIGNMENT TOPICS

This section describes the topics covered by each of the reading assignments. Slight changes were made from semester to semester, and the interruption caused by the COVID-19 outbreak in Spring 2020 meant that some assignments were omitted during that offering (as described in the last paragraph of this section), but the ones listed here are indicative of what had been assigned in prior semesters and that we would expect to use going forward.

A. Why Diversity Matters

The first assignment addresses the fundamental question of "why is diversity important in the tech industry?". Although a majority of students agreed with the statement "diversity

in computing matters to me" in our initial survey, there was still a sizable number who were neutral on that statement or disagreed, and it seemed that the right place to start was by getting the students to consider the importance of diversity in computing, either from a business perspective or from a social justice perspective, particularly as there was a chance that a student may complete only this assignment and choose not to do the the others.

As part of this assignment, students were asked to read articles about the lack of representation of women and minority groups in tech [2], why diversity matters in tech [3], and why diversity efforts need to be prioritized [4]. Then, as described above, they posted a response based on their own insights, observations, or experiences, and then replied to another student's response.

B. Employee Resource Groups and Success Stories

The next assignment explored how tech companies seek to achieve the benefits of diversity by fostering inclusive environments, specifically via Employee Resource Groups (ERGs). Students were asked to reflect on readings that explored the impact that ERGs could have [5], and to investigate specific success stories such as Slack [6] so they could see the benefits of these initiatives.

C. Assignments Focusing on Underrepresented Groups

Each of the remaining assignments explored the issues faced by various underrepresented and marginalized groups in the field of computing, and what individuals and organizations could do to address those issues. For these assignments, students were permitted to write open-ended responses based on their observations, but were also encouraged to consider the following prompts:

- How does the perspective of members of this group enrich the tech industry and help companies flourish?
- What are the major issues faced by members of this group in the tech industry, and how do they relate to the issues faced by groups that were investigated in other assignments?
- What can you do to make members of this group feel more welcome and included in the field of computing?

Readings that focused on women in computing typically described their status in the tech industry [7], as well as success stories and female role models [8] and ways to be an ally for women in tech [9]. Issues faced by Black, African American, Hispanic, Latinx, and Indigenous people in tech were combined into a single assignment on People of Color that explored the so-called "pipeline problem" [10] and presented first-hand perspectives of why diversity and inclusion in the tech industry is important to members of these communities [11] [12]. Similarly, readings related to the Lesbian, Gay, Bisexual, and Transgender (LGBT) community explored what it's like to be LGBT in an industry struggling with diversity [13], what is driving LGBT people out of tech [14], and why inclusivity of LGBT people is good for tech companies [15]. The final topic focused on people with

disabilities in computing [16], including those living with mental illness [17].

Anecdotally, students who identified as members of these communities sometimes commented that they did not like being reminded of the challenges they are facing in computing, but appreciated that we were raising awareness and getting other students to consider their perspectives. Partly because of this, and also because of the interruption caused by the COVID-19 pandemic, in the Spring 2020 semester the assignments that focused on individual communities were combined into a single assignment in which the students were asked to find and read an article describing the issues in the field of computing or tech industry faced by members of a community with which they do *not* identify, so that they would consider the issues faced by other communities and reflect on their own personal insights into differences and similarities.

V. Evaluation & Student Feedback

An initial concern we had about these assignments was whether students would actually do them in the first place. The assignments did count for around 10% of the course grade, and in our pre-semester surveys, students did claim that diversity was important to them, but to what extend would they engage in such assignments? Fortunately, the numbers were quite encouraging: of the 595 students who completed the course during the three semesters in which we used these assignments, 582 (97.8%) did at least one assignment, and 489 (82.2%) did all of them. This is lower than the percentages of students who completed the more traditional programming assignments, but still higher than the percentage who agreed that diversity in computing is important to them in the survey described above, indicating that students who were neutral or even disagreed at least engaged with the assignments.

To further understand students' perspectives on these reading assignments, we conducted a post-semester survey at the end of the Fall 2019 course offering; we did not do a similar survey at the end of the Spring 2020 offering, since we were unable to cover all the assignments and assumed that the results would likely be skewed by the COVID-19 pandemic.

In the survey, students were asked to assess whether the assignments were suitable for the class, and what (if anything) they would change. A total of 48 of the 77 students in the class (62.3% response rate) provided feedback, which we categorized as follows:

- 62.4% felt that the assignments were suitable and recommended some changes, e.g. offering a broader range of topics or incorporating more synchronous, in-person opportunities for engaging with the material
- 14.6% felt that the assignments were suitable and did not recommend any changes
- 8.3% said they thought the assignments were *not* suitable for the course
- the remaining 14.7% did not provide feedback on the suitability of the assignments

We also analyzed the University-administered end-of-semester evaluations for all three offerings of the course, which include an open-ended question about assessing the quality of the course overall. Only a very small number of students mentioned the reading assignments in their responses: a total of 16 across all three offerings, out of 104 who responded to the prompt.

Perhaps not surprisingly, since these assignments differed from the types of assignments that Computer Science students were used to, and may have been seen as pushing some sort of particular agenda, some students expressed negative feedback in their evaluations:

- "Even though I agree that the topics of the reading assignments are important, I wish a bit less time were spent on discussing them and a bit more time were spent on learning new technologies like jQuery, Ajax, etc."
- "It would have been better if multiple sides of the argument had been presented in the assigned readings."
- "Some wordings made me feel that there is an expected answer and I sometimes felt that I was put in a position where I have to write those expected responses."
- "Although it's great that reading assignments were added to the course, I think that these issues might be too complex to be addressed by reading articles about them."

However, a number of comments were quite positive, and demonstrated that students enjoyed the assignments and understood their importance:

- "I think the homework assignments on diversity and inclusion readings are a wonderful idea."
- "I really liked the readings because they highlighted a part of the tech industry that no other class talks about."
- "I especially liked the diversity readings and discussions we had in this course. It is incredibly important for diversity to be discussed and taught in computer science, and the inclusion of this is a step in the right direction."
- "[The instructor] makes it an objective of the class to learn about the social environment in tech and the many barriers that members of underrepresented minorities often face that the majority of us will never experience. I think this education is important in instilling a social awareness in future engineers."

Given that the majority of students had agreed that diversity in computing matters to them (Table I), we feel that this positive feedback is indicative of the initial success of this intervention.

VI. Conclusion

The assignments described in this paper represent an important step in increasing students' awareness of diverse identities and perspectives in the tech industry and inspiring them to create more inclusive and welcoming spaces. Future work could assess changes in students' perspectives on diversity in the field of computing as a result of these assignments, particularly whether they affect members of different groups differently, and could also include longitudinal efforts to evaluate the impact of these interventions on students once they enter the tech industry.

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