



Diversity-focused Course Design for Computer Science Students

Incorporating Diversity Conference Attendance into Course Design and Delivery

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ABSTRACT

Computer Science (CS) has the potential to be one of the most diverse fields when it comes to education and employment opportunities, yet there still exists an equity gap in the field when it comes to accessibility and empowerment. To mitigate that, conferences that celebrate diversity in CS were founded and are becoming major yearly technology events. For years, our department offered scholarships for students to attend a number of these major diversity conferences. A few years ago, we started working on pre-conference preparation, during-conference activities, and post-conference reflections, in order to provide a deeper and a more comprehensive experience for the attendees. In 2021, we started offering a diversity-focused course for students attending the Tapia and Grace Hopper Conferences, with the goal of incorporating their conference experiences into a CS course that discusses diversity and inclusion topics. This paper presents how we planned and implemented this course, and students' reception and feedback. We also provide lessons learned that can work – with the course description – as guidelines to help structure and plan diversity-focused courses for CS departments whose students attend diversity conferences.

CCS CONCEPTS

• Social and professional topics → Professional topics → Computing education → Model curricula

KEYWORDS

Computer Science Education, Diversity and Inclusion, Course Design.

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1 INTRODUCTION

Universities, with their natural provisioning of learning opportunities based on merit and qualifications, and active learning dynamics, are the cornerstone to promoting future equitable societal interactions. However, as diverse as today's university campuses are, there are still reports of bias, discrimination, and microaggression [1] [2], which can negatively impact academic performance and excellence. Therefore, inclusion is a crucial policy that needs to be adopted across universities in order to foster a safe and equal-opportunity society in which everyone can prosper.

One of the most growing and thriving majors in today's higher education is Computer Science (CS). Given its nature, it may be assumed that this major should set a positive example for higher education inclusion across gender, race, social status, age, identity, and all other dimensions of diversity. However, statistics show [3] that in 2020, self-identified males constituted 77% of CS graduates, and self-identified white ethnicity was still the majority with 36% CS degrees awarded. This gap in enrollment in a CS degree may in part be attributed to a gap in K-12 participation in CS courses and training. A recent Gallup study [4] reported that only 40% of high school students thought CS is important to learn, and only 31% of female students perceived CS as important. Compared to gender, the racial and ethnic dimensions of diversity show no gap when it comes to CS learning preferences within high school students, but access to advanced CS courses is not equitably distributed for those groups [5]. This gap also exists in universities despite adopting several diversity initiatives, including offering specific diversity modules.

This paper provides an overview of the current gap in how CS education addresses diversity and inclusion topics. We then present our pilot course entitled "Diversity Issues in Computer Science", which incorporates diversity conference attendance into an introductory diversity module for CS students.

2 COMPUTER SCIENCE IN HIGH SCHOOL

The huge gap in embracing CS education by high school students, and in diversifying those students, has several reasons that were explored in research. One reason was the misalignment of teachers' priorities of CS learning and their assumption that CS is not an important subject to learn [4]. Stereotypical representation of

computer scientists as male nerds with poor social skills, combined with biased gender capacity assessment enforced by parents and teachers, were cited as factors in the decline of female enrollment in Science, Technology, Engineering, and Math (STEM) [6] and CS education [7]. Even with the presence of strong female pioneer role models who shaped the computing and software engineering field, it is rarely the case that those role models are incorporated in high school curriculum. The gender, race, and social gap remains despite ongoing initiatives to bridge this gap and provide more effective and equitable access to CS for high school students [8] [9].

Even as students enroll in universities and especially in a CS major, there is still underrepresentation of many groups across gender, race, social status, and ethnicity. To address this gap and to support Diversity, Equity, and Inclusion (DEI), many universities started to adopt initiatives for DEI in their programs [10].

3 INTEGRATING DIVERSITY IN COMPUTER SCIENCE HIGHER EDUCATION

Many research studies explored the methods in which universities integrated DEI initiatives in their programs, including STEM programs. When researchers explore integration of DEI into CS higher education, three areas are addressed: curriculum and course content, learning environment and recruitment, and departments' pedagogical strategies and policies [11] [12]. Each of these areas was associated with expected outcomes, practices, and tools for applicability. The main tools proposed were training for instructors [13], workshops and coaching for instructors and students [14], entry-level curriculum design [11] [15], and assignments and projects for students [16] [14]. Active learning, mentorship, pairing, reflective reporting, and gamification are all techniques that are used across the proposed research experiments, to allow educators to express their perspectives on diversity's current status and what is needed to improve it in the future, and to encourage students from different backgrounds to join diversity courses or programs.

A more concrete view of how these areas can be formalized into a framework was proposed for public administration education [17], in which a DEI model was proposed as a framework to examine how to include and improve gender diversity in course and syllabi design. The foundational base of the model is the representation of the gender in the classroom, which is focused on the identification of women's contributions – as well as other genders' contributions – to the subject matter that is being tackled. Once good representation is founded, pedagogical practices can then be put into action to implement the model and allow students to contribute to the course content and create knowledge from their own experiences. Examples include student discussions, reflection papers, research projects, or social media outlets and online platforms. The paper still raised several concerns, especially with respect to introducing gendered topics in a standard curriculum, as well as the power dynamics that may be enforced if peer learning environments and discussions are graded.

Although the focus of the previous studies was on gender and ethnicity inclusion strategies and practices, other studies focused on intersectional diversity groups and how they can be included in initiatives for CS education [18] [19] [20], and they produced similar conclusions. Department and institutional adoption of initiatives

and engagement of faculty in those initiatives and restructuring of the curriculum to integrate diversity-focused courses, or integrate themes of diversity in existing courses, were crucial to a successful DEI strategy.

The attitude of instructors and faculty members towards diversity courses and their vision on the integration of diversity into the curriculum is crucial but not sufficiently investigated [21] [22]. Although statistical evidence showed that diversity courses were offered more by faculty with diverse backgrounds, there are determinant factors that made faculty incorporate DEI content into their courses. These factors were the department and institutional commitment to promoting diversity initiatives on campus, and formal participation in organized diversity activities. However, integration of diversity into an existing department curriculum proved to be challenging from the perspective of educators, because of the broad nature of the subject and its multiple facets on one hand, and the crowded major-specific curriculum on the other hand [21].

3.1 Long-term Diversity Training/Courses

Long-term diversity training programs that have a time span longer than a day were proposed both for faculty and undergraduate students, with reported positive impact on faculty's diversity awareness and inclusion practices [13]. Long-term diversity training provided the participants with the opportunity to practice how to define diversity learning objectives and how to align them with course learning objectives in the course design process. Compared to shorter diversity workshops, long-term training and exposure programs allow the participants to reflect on their thoughts and convictions, and apply inclusion practices through the framing theory, which allows different perspectives to be inspected in depth.

The positive impact of long-term diversity training was especially observed if participation was voluntary. This means that aspects of this training can be offered to undergraduate students in the form of elective diversity courses; long-term in their very nature, albeit extending longer beyond a training workshop duration. However, in many universities, the general policy is to have one diversity course with no sufficient focus on an in-depth diversity awareness framework. Enrollment statistics in elective diversity courses revealed that the target groups do not necessarily feel motivated to enroll until they declare their major [23]. It was recommended that diversity content be incorporated in university degree programs to communicate the importance of diversity as an essential value of the university, and to challenge students to engage in diversity content specific to their field of study.

3.2 Attending Diversity Conferences

In addition to diversity courses and DEI training, diversity conferences emerged because of the need to bring DEI awareness to university campuses around the US [24]. Integration of multicultural and diversity conference attendance into university departments in various fields grew in the past few years as a result, but this experience has its own challenges for students. In general, attending scientific conferences is a valuable experience for undergraduate students, and especially for CS students. Being present in these conferences allows students to network with

experts from their field of study to develop professional and social skills and explore career opportunities. However, students need mentorship when attending these conferences to maximize the benefits from the experience. Flaherty et al. designed such course for a conference that formally framed the conference attendance experience as a set of assignments to be performed by the students before, during, and after a conference [25]. The assignments were associated with intended outcomes and assessment points. Students reported maximized benefits from the course, and that the course and the conference attendance allowed them to interact with their peers as well as the experts in the field.

Attending diversity conferences can introduce pedagogical changes by the academics themselves in order to effect change in classrooms at the different levels of academic education [26]. This exposure to DEI themes involving race, gender, class, and sexuality in conferences can provide both academics and students with opportunities for growth, discussions, and learning pathways. These learning pathways can later be formalized and introduced into the curriculum alongside the core competency courses. Two key changes were suggested as an outcome of diversity conference attendance that are relevant to CS education. The first is collaboration with community partners and K-12 educators, mainly through STEM maker spaces to engage underserved communities. The second is integration of innovative technology that supports accessibility and usability by design, especially Virtual Reality (VR) technologies, for more active learning activities that may otherwise not be available to all groups of students. VR technologies have been shown to promote inclusion [27].

Little work therefore was done to holistically integrate diversity conference attendance into a diversity-focused university course. There is a need to create a more interactive medium of communication whose place is the vibrant conference context, followed by a reflective medium of communication whose place is the more contemplative classroom.

3.3 Online Vs. In-person Diversity Courses and Conferences

At the peak of the COVID pandemic, studies emerged to investigate how online course delivery compared to the classical in-person delivery method, in terms of effectiveness and lasting learning outcomes. The effectiveness of online compared to in-person diversity courses was investigated in the context of social work education [28], with no significant differences between the two modes when it comes to learning outcomes. This may be indicative that technology itself can be an enabler of inclusion since it represented a medium as effective in course delivery as the classic in-person delivery method. However, effort fell on the course instructor to initiate and keep the communication among the classmates going, as the online medium of delivery tended to allow students to fall into a more relaxed attitude.

A similar comparison was made for diversity conferences. The impact of virtual conferences compared to in-person conferences in the promotion of diversity and inclusion among researcher attendees was investigated [29]. The data showed that virtual conferences provided more opportunities to young researchers and students with limited financial support to attend conferences. This

meant that academics from underprivileged groups that do not have immediate means to travel can now attend more conferences. However, the main point overlooked in the study is the effectiveness of interaction on virtual platforms compared to in-person discussions and scientific debates.

To summarize, for a strategic integration of DEI initiatives in higher education, the studies suggest that a flexible track/sub-track dedicated to DEI be included in the curriculum, and not only as an introductory course. Advanced courses that include more extended and in-depth discussions, as well as short-term focused training or hands-on experiences such as conferences and workshops, are needed. This allows practices to take time to be understood and embraced by students, and also allows proper evaluation of initiatives' integration strategy, efficiency, and subsequent evolution within the university curriculum.

4 DIVERSITY COURSES IN OUR UNIVERSITY

Our university currently has an asynchronous online diversity module that is required for all students. The module usually receives positive feedback, but since it tries to cover several topics as an introductory DEI module, it faces issues similar to those presented in [23] and [28].

1. It does not have sufficient depth for those who would want to know more about certain topics, which is understood given that it is an introductory module. The university, however, provides other specialized training opportunities for interested students, faculty, and staff.
2. It is not as engaging nor interactive as the in-person classes, which is common feedback about online modules in general, and the mandatory modules in particular. Given the nature of the topics and the need to cover all of the student population, an online module still seems to be the most feasible choice.
3. It is not integrated with specific curricular topics, and not linked to students' areas of study. Since the course is offered for all freshmen and transfer students, it is hard for an online DEI module to be customized and integrated with the large number of departments and programs in any given university.

In our CS department and based on a long history of commitment to DEI, we decided to focus on the third issue.

4.1 Our CS Department Support for Diversity Conferences

The Grace Hopper Celebration for Women in Computing (GHC) and the CMD-IT/Richard Tapia Celebration of Diversity in Computing Conference (Tapia) are two of the biggest gatherings for members of the computing fields who belong to underrepresented, underserved, and minority groups. They also offer opportunities for practitioners, academics, and industry partners to interact with students and young professionals, and to recruit large numbers of such groups through their career fairs.

Our department has been an academic sponsor for the two conferences (among others) for more than ten years, in demonstration of its commitment to supporting DEI among our student population, as well as the overall computing community. Additionally, the department offers fully-funded scholarships to students who show interest in attending any of the two conferences.

Every year, 10 to 15 students receive department scholarships that cover conference registration, transportation, and lodging. These scholarships allowed several students to attend and benefit from such a special experience, who would not be able to afford the costs of travelling and attendance otherwise.

4.2 Students Engagement in Diversity Conferences

In 2017, we started encouraging CS faculty members to accompany the students during their trips to the two conferences. The idea was not to chaperon students, but to start incorporating some engagement and educational activities during the conferences. Such activities were divided into three categories:

1. Pre-conference

One pre-departure meeting that included ice-breaking activities, conference history, expectations, and best tips and practices on how to benefit the most from the conference experience.

2. During-conference

Students attend an orientation meeting in the first day and a closing reflection meeting in the last day. Students meet at the end of every day for quick check-ins. Students are also asked to participate in shifts of staffing our booth in the career fair, with the goal of giving them a chance to represent themselves and their department and university to the other conference attendees.

3. Post-conference

Students meet for a general meeting to catch up and reflect on the conference experience. They are also asked to submit a short report sharing their thoughts and reflections, and answering a few questions about their interactions during the conference. Students also participate in planning for future DEI events, and they help advertise and recruit for Tapia and GHC of the following year.

Although the activities may differ from one year to the other, the overall structure of the experience stayed pretty much the same, and students used to provide positive feedback in their final reports. However, in 2020, the conferences moved to the online modality due to the COVID pandemic. Although it can be argued that online conferences enabled a larger number of students to attend [29], we struggled with having the same level of engagement among our students. The feedback we received in 2020 made it clear to us that we needed to build a more comprehensive approach for students' engagement while attending DEI conferences. This aligned well with our plans to work on the third issue mentioned in section 4, and encouraged us to think about a CS-oriented DEI module for those who would want to dig deeper in DEI topics, which they can relate to as current CS students and future computing professionals.

5 INTEGRATING CONFERENCE ATTENDANCE INTO A DIVERSITY COURSE

In Fall 2021, we offered a 1-credit synchronous online course under the name "Diversity Issues in Computer Science". Our target audience were those who received the department scholarships to attend GHC and Tapia, but the course was not required for the attendees, and it was not a deciding factor when offering the scholarships. It was offered to both undergraduate and graduate students as a Pass/Fail course. Some students could not join the course due to class time conflict or maximum number of hours

exceeded. We ended up having 13 students signed up for the Fall 2021 course, with 6 undergrads and 7 grad students.

The broad vision of the course aligns with what we highlighted in section 3 as the culmination of the literature on the DEI integration efforts. The course has elements that address both theoretical concepts and hands-on experience. It has a long-term duration (one semester), while providing a focused experience in the form of conference participation. Additionally, the course structure and outcomes are evaluated for future evolution.

5.1 Course Goals

- Helping students who are attending GHC or Tapia to prepare for the experience of participating in such events.
- Building upon such participation to engage students in DEI-related conversations and discussions.
- Empowering students to explore themselves and express their own ideas.
- Preparing a cohort of DEI champions in the department.

5.2 Course Description

The course consists of five class meetings that last for two hours each. Since it was planned around GHC and Tapia which usually take place in September and October, the course was scheduled to provide spaces for students to prepare and reflect on their experience before and after conference attendance.

5.2.1 First Class: Early September, before the two conferences. The first class meeting was a general introduction about the course and the two conferences. For students' introductions, they were asked to form groups of twos in Zoom Breakout Rooms and answer certain questions about themselves. After returning to the main Zoom Room, everyone was asked to introduce their partner. Since students were coming from different grades and the class included a mix of grads and undergrads, it was important to encourage them to talk to each other, as well as to talk about each other in front of the whole class. Students were then asked to split into 3 groups and compile lists of their common interests and another list of unique interests and skills for each member. After returning to the main room, each group shared what they discussed using Google Jamboard. This exercise not only got student to know more about each other, but also showed them how different yet how similar a group of people can be, which worked as a hands-on demonstration of the value of the DEI activities and initiatives, including the conferences and our course.

After a short introduction about the course and logistics for online meetings, we talked about the two conferences starting with the namesakes, Richard Tapia and Grace Hopper, covering their work and contributions to promoting DEI in the computing fields. The introduction then touched on the special nature of the two conferences, and the similarities and differences in comparison to the regular computing conferences. Students learn about the conference activities like plenary talks, poster sessions, technical sessions, and the career fairs. We then used comments from students who had attended the conferences the year before to drive a discussion on expectations and misconceptions regarding the conferences. Those comments were also the source of

recommendations and tips regarding attending the conferences. Using past students' comments to provide recommendations made it more relevant and student-focused, and it was easy for the new students to relate to and connect with.

5.2.2 Second Class: Late September, after Tapia and before GHC. This class meeting took place in between the two conferences, so it allowed Tapia attendees to reflect on their own experiences, and to share some advice with those who were travelling to GHC. This class was split into three parts: The first part was dedicated to a general discussion of the concepts of DEI, with a group exercise around the concept of “belonging”. The second part provided information about the different online and on-campus resources that support DEI activities in the university in general and the department in particular. The last part of this class was for Tapia attendees to share their thoughts, with particular focus on talks they liked, aha moments, “Dos and Don’ts”, and what changes they might want to make in future versions of the conference.

5.2.3 Third class: Mid October, after GHC. After returning from GHC, the focus of this class was on women in computing. GHC attendees were asked to share their thoughts about their experiences, which was clearly different from what it used to be like for the in-person conference, especially when it comes to career fair and networking opportunities. The conversation then continued about DEI, with a particular focus on women in STEM. Students discussed the assigned readings and analyzed some of the provided numbers. They were also able to relate those numbers to what they think to be the current state in real life. A guest speaker participated for the second part of this session, who shared some reflections on her experience as a CS female professor in a developing country. Students discussed with her the differences and similarities between the US and other countries when it comes to the inclusion of women and other underrepresented groups in CS fields.

5.2.4 Fourth class: Late October. After one month of their conference attendance, students provided some ideas on how to make future iterations of the conferences better than the version they attended. The major change they wanted to see was for the conferences to get back to be in-person, with a “hybrid” option to allow those who cannot travel to benefit from the online conference experience. The discussion then focused on the intersectionality of being a member of multiple minority groups in CS. Race and gender issues have been revisited, followed by a discussion on the experiences of black women in industry and academia. The assigned readings offered relevant data about the topic, and a guest speaker talked about her research work as a CS professor in a different country, while sharing the challenges she had to go through as a woman in a male-dominated market.

5.2.5 Fifth class: Mid November. The final class meeting used a written assignment that students had submitted as the engine driving the discussion. Students were asked to propose action plans for the department and university to enhance the state of DEI in our community as well as the wider CS field. We showed a collective list of students' recommendations and suggestions and discussed it with the whole group. The class ended with students providing overall feedback about the course experience.

5.3 Assigned Readings

Before each class, a list of papers, articles, and – in some cases – videoclips are shared with students to help them gain some basic understanding of the topic to be discussed. The number of resources is usually between three and five so that students do not feel overwhelmed with the number of available resources. Students were encouraged to find other resources that could help them during their in-class conversations.

5.4 Written Assignments

In addition to the short writing pieces students had to submit after returning from the conferences, there were two major written submissions: the “moving forward” and the “final reflections” assignments. These assignments were requested in the final two class meetings, and aimed at connecting students' experiences and what they had learned to the future of DEI in our department, our university, and the CS community. The writings were assigned as a means for students to freely express their thoughts after becoming better equipped to engage in such conversations.

5.5 Students' Feedback

In addition to the recurring “thought sharing” exercises in every class meeting, students were asked to fill out an End-of-Semester survey, so that we could collect some anonymous feedback. The survey follows the same template for our university's generic evaluation form, but we added a few open-ended questions that are specific to this course. Out of the 13 course participants, 7 have responded to the survey, with a response rate of 54%. Figure (1) shows a selected sample of students' responses to questions about “having a deeper understanding of the subject matter” (3a), “feeling better prepared for conference attendance” (3c), “encouragement to continue learning about Diversity and Inclusion” (6b), and “recommending this class to other students” (6c). As the figure shows, all survey respondents provided positive feedback on their course experience.

The survey also included some open-ended questions, where students provided feedback about the instructor and course organization. The answers to those questions included sentences like “[the instructor] provided a safe space for us to speak up”, “... the guest speakers were inspiring”, and “[the instructor] organized the course really well”. However, it was more important to us to know how students perceived the course impact on their life as students and their future as CS professionals.

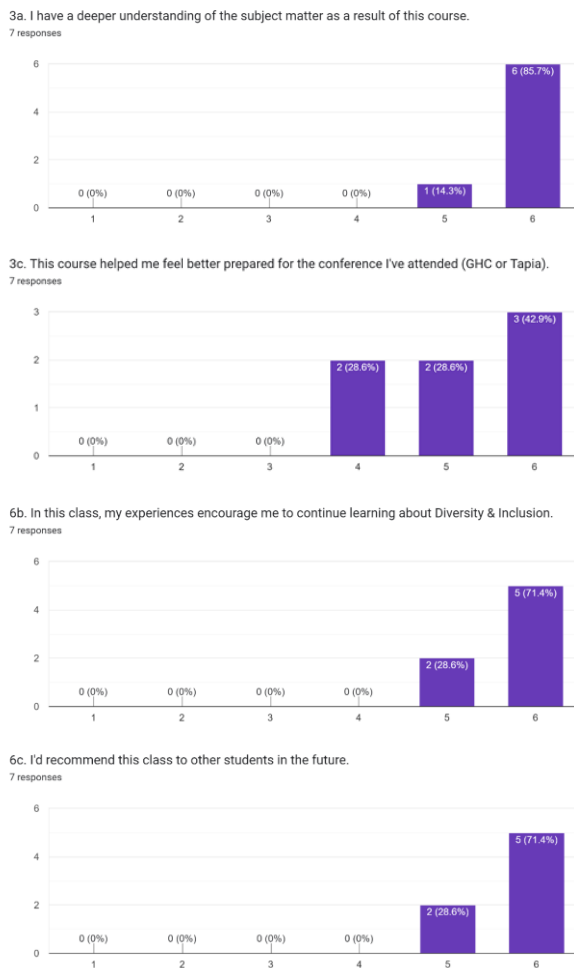


Figure 1: Sample responses to questions from the End-of-Semester survey

Sample answers to “How do you think this course will impact your involvement as a student in this department?” include:

- “I now know in which ways I can make an impact, and what matters to students who need guidance and mentorship.”
- “I feel more inclined to make [this department] a better experience for all students”
- “I am more aware of the resources and opportunities available to help me grow.”
- “The knowledge gained from this course will be important if applied towards promoting diversity and inclusion in CS.”

Additionally, sample answers to “How do you think this course will impact your future career?” include:

- “... All this learning would help me inculcate those values as a researcher, mentor and leader in the future.”
- “... Encourages me to join BRGs [Business Resource Groups] in the workplace.”
- “[the course] gave me a chance to get out of my comfort zone and voice my opinions in to people I am not familiar with.”

Despite the positive feedback from the respondents, there were still comments about the need for the course (and the conferences) to be in-person, so that students can benefit from the “real life” interaction opportunities. Some students also suggested announcing the course meeting times early during the summer so that they can plan for any potential conflicts with other classes.

6 RECOMMENDATIONS

Although most of the students’ reviews were positive, there is still room for improvement. The recommendations provided below are based on what we think has worked well for us, and what we think should change because it did not work quite well for us.

- Start preparing early for the course, and make sure to announce it at the same time as you announce the availability of the diversity conference registration tickets.
- Voluntary participation makes students feel more “in charge” of their decision to commit to the course.
- While advertising for the course, indicate the number of meetings, meeting dates and times, and attendance policies (especially if it is a 1-credit course)
- Provide clear expectations before students commit to taking this course (including number of meetings, rough estimate of reading and writing assignments, grading scheme, and whether there will be any required presentations).
- Engage students in planning for the following sessions and incorporate their feedback into course content and activities.
- Since the goal is not “testing” students in the subject matter, a Pass/Fail grading scheme gets students to focus more on participation than worrying about grades.
- Plan your class meetings in a way that allows you to meet with students before and after the conference. For in-person conferences, there could be an option to have a during-conference class meeting as well.
- Diversity-focused icebreaking activities are crucial, especially in the first two meetings.
- Including undergraduate and graduate students in the same class provides a multitude of different views and allows students to realize that there are other perspectives to be considered.
- Inviting guest speakers helps students connect what they are learning to what is actually happening in the real world.

7 CONCLUSION

In this paper, we provided an overview of the current state of diversity in the CS field, and the role of offering diversity courses in narrowing the racial and gender gaps in the computing fields. We introduced the experience of planning and implementation of a diversity-focused course in which diversity conference attendance was a key element. Conference attendance can become an effective pedagogical approach to promote diversity and engage students, and more work needs to be done to incorporate conference attendance and other out-of-classroom learning opportunities into CS and diversity courses.

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