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Using Academic Controversy in a Computer Science Undergraduate Leadership Course: An Effective Approach to Examine Ethical Issues in Computer Science

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Abstract

The technology field today, with continually emerging social media and communication platforms, is highly impacted by controversy and ethical considerations. It is imperative for computer science undergraduates to be prepared to face these issues as they enter the workforce. This paper describes how the design and pedagogical tools applied in a leadership course led to growth in the ability of these students to effectively confront ethical issues and handle controversial topics. With U.S. Department of Education funding, an interdisciplinary, multicultural team of faculty, researchers, and evaluators implemented an equity-oriented pilot course in leadership for undergraduate computer science students. The site of course implementation was The University of Texas at El Paso, a Hispanic-Serving Institution with over 85% Hispanics enrolled in undergraduate studies, including computer science. Some 90% of the students in this project were Hispanic. The course was piloted over four semesters, which allowed the instructional team to perfect the approaches that were most successful for student success. The leadership course integrated two primary approaches: 1) a relational model of leadership used to examine complexities that arise when technology professionals encounter multiple perspectives and diverse ideas; and 2) cooperative learning approaches, including constructive academic controversy model, used to develop leadership skills while contextualizing the role of ethics in computing. The course culminated in an academic controversy exercise where student teams examined the Facebook /Whistleblower controversy. The teams gathered research-based arguments, debated with each other, changed sides, and debated again. Eventually, they developed and presented an informed consensus of positions. Throughout the process, students practiced critical professional skills such as effective team communication, active listening, and perspective-taking—effective tools for team communication and diversity appreciation. This approach to leadership education has significant implications for equity with a focus on student thinking, perspectives, and values.

Introduction

This project was designed to address the needs in computer science to broaden participation, especially for those from minority groups, such as Hispanic students, and to develop professionals who possess equity-minded leadership skills to work collaboratively in managing emergent ethical issues in computing [1], [2]. An interdisciplinary team of computer science [CS] faculty with expertise in cooperative learning and a group of qualitative researchers piloted an equity-oriented leadership course specifically to address these needs. An external evaluation team assessed this leadership course by using a mixed methods design to understand changes in leadership students' (i) understanding and attitudes, (ii) opportunities to develop and practice their leadership skills, and (iii) satisfaction with the course.

The course was based on the relational model of leadership [3] that varies from traditional leadership approaches as it posits the importance of the "relational and ethical process of people working together to accomplish positive change" (p.13). In a survey of CS faculty, Quinn [4] found most respondents teach ethics in various courses to comply with accreditation requirements and suggested that most of the courses are likely discussion oriented. In contrast, the relational model of leadership highlights the relevance of engaging students in ethical processes that support inclusive, justice-centered, and equity-oriented understanding of complex ethical dilemmas. Thus, the course at this Hispanic-Serving Institution focused on the development of interpersonal skills and used an integrated active, cooperative learning as the pedagogical approach to support interpretation and inquiry. This allowed students to investigate leadership theories, the role of values and ethics in leadership, and the importance of interpersonal skills development. The approach also improved students' openness to others' perspectives and understanding of ethical responsibility and social justice relevant to innovations in technology. Also foundational to the course was the constructive academic controversy pedagogical approach [5], which actively engages students in examining various perspectives of a historical or existing controversy.

The following provides background literature on the relevance of ethics in CS and describes the implementation of cooperative learning strategies leading to the constructive academic controversy. Evaluation and research data show that these approaches were instrumental in deepening students' understanding of ethics and the role of ethics in technological advances.

Background

In this course, an alternative approach was developed for addressing ethics, one that was equity-minded and emphasized the importance of inclusiveness in ethical considerations. It is imperative for CS students to understand the role of ethics in their personal and professional lives, given the significant social implications of the tech industry and the rising number of ethical scandals in this industry [6]. The CS leadership education classes were created to examine current ethical conflicts such as the following:

- Should corporate employees of social platforms such as YouTube and Facebook who become whistleblowers be taken seriously, or not [7];
- Is the Amazon machine-learning algorithm used for recruiting discriminatory against women, or not [8];
- Should controversial public people be banned from Twitter and other social media platforms, or should the First Amendment protect them [9]; and
- Should ChatGPT be embraced in school settings, or should it be banned [10], [11].

Acknowledging the relevance of ethics in CS education is not a novelty. In 1972, ACM released and adopted the first Code of Professional Conduct [12], with its last revision released in 2018 [13]. Discussions of professional and social responsibility in CS education have been part of professional forums for decades [14]. The 2017-2018 ACM code and ABET criteria for accrediting computing programs emphasize the crucial role of ethics in CS education [15], and

higher education institutions have addressed this need using different approaches. Some of these approaches include assignments that blend ethical and technical learning [16], [17]; incorporating ethics in CS from a social justice approach [18]; and teaching ethics in CS involving faculty from philosophy, political science, and CS [19].

The roots of cooperative learning date back to the early 1900s, when the social interdependence theory was proposed by social psychologist Kurt Lewin [20], [21]. This theory posits that individuals' interactions and outcomes are influenced by how social interdependence is structured. Using that theoretical lens, Johnson and Johnson [22], [23] investigated how group interaction structured around social interdependence led to positive outcomes and later, with colleagues, identified the five essential elements that eventually became incorporated into cooperative group work: positive interdependence, face-to-face interaction to promote all members, individual accountability, social skills development, and group processing. A meta-analysis of existing research identified the following outcomes of cooperative learning: higher achievement, increased retention, greater intrinsic motivation, increased perspective-taking, more positive heterogeneous relationships, higher self-esteem, and greater collaborative skills [24]. Although Kilgo et al. [25] and Kuh [26] identified cooperative learning as a high-impact practice in undergraduate education, it is implemented in limited university settings.

Johnson et al. [21] identified four types of cooperative learning: formal cooperative learning, informal cooperative learning, cooperative base groups, and constructive academic controversy. Research has shown that cooperative learning supports students in developing critical thinking, communication, and collaboration skills due to the active role they take in cooperative learning [27], [28], [29]. More specifically, previous studies have pointed out how including cooperative learning has supported HSIs, in particular, in cultivating professional skills growth in Hispanic CS students [30], [31]. In addition to academic benefits, research has shown the positive outcomes of cooperative learning enhance students' sense of belonging [32] and support diversity and inclusion [24]. Students participating in cooperative learning develop a broad sense of moral inclusion, equity view, and scope of justice [33].

Constructive Academic Controversy

One very effective approach used in cooperative learning settings—constructive academic controversy—engages students in deep and dynamic discussions, resulting in an inclusive understanding of intellectual conflicts. Previous research has pointed to the positive outcomes of using constructive academic controversy in a wide variety of subject areas in higher education, such as economics [34], nursing [35], life sciences [36], engineering [37], and computer science teacher education [38].

Through the implementation of these pedagogies in the leadership course, the instructors sought to develop in CS students an awareness of the impact of technological advances in society, an increase in confidence, and a sense of empowerment in their ability to handle conflict in a positive manner as they develop into future computing professionals. The pilot leadership course integrated cooperative principles in all classroom activities, in particular, the purposeful

and intentional development of skills for leadership. Komives et al. [3] argue the importance of these skills for leadership, especially perspective-taking, communication, reflection, active listening, and conflict management. As such, using academic controversy was a natural extension of the pedagogical framework for the leadership course.

Over several semesters, the course activities were designed to direct students' attention to the role of ethics in computing by confronting them with controversial situations framed as ethical dilemmas. The instructors, with input from students as one of the in-class course group assignments, selected current and challenging topics that represented ethical dilemmas in computing. The leadership course followed the constructive academic controversy implementation format from Johnson and Johnson [39] that incorporates the five essential elements of formal cooperative learning mentioned above. Each of these elements is noted in the academic controversy format, per Johnson and Johnson, as follows:

1. *Form Groups:* Randomly select groups of four students comprised of two pairs who will work together to prepare and defend an assigned position of the controversy, i.e., for or against.
2. *Conduct Research and Prepare a Position:* Each pair investigates/researches the position assigned and finds relevant information to defend the position. To provide support, the pair joins another pair who are assigned the same position. Pairs are encouraged to compare notes and use the best arguments to advocate their position. They share new understandings with each other to present the best case possible to the opposing pair. (Cooperative Elements: Face-to-face promotive interaction, positive interdependence, and individual accountability)
3. *Present and Advocate Each Position:* Each pair is allotted time to present supporting arguments for their assigned position, arguing forcefully and persuasively for this position, presenting as many facts as they can to support their point of view. Both members of each pair are expected to actively participate in the presentation and are encouraged to be as persuasive and convincing as possible. Members of the opposing pair are asked to take notes and listen carefully to the presented information. Then each team member is expected to paraphrase each point made by the presenting pair. The active listening and paraphrasing are signals indicating they value others' perspective—an inclusive practice. (Cooperative Elements: Individual accountability and social skills development (active listening))
4. *Reverse Perspectives:* The pairs reverse perspectives to defend the position they previously argued against (regardless of their personal preferences or beliefs). Students are given time to further research their new position and are encouraged to add any new information to make their argument compelling. They follow the same process as in #3. (Cooperative Elements: Positive interdependence, individual accountability, and social skills development)
5. *Synthesize and Integrate the Best Evidence into a Joint Position:* The four members of the group drop all advocacy to synthesize and integrate what they learned. Each group creates a synthesis of what is now known; our experience is that they do not have difficulty with this, possibly because of the dual perspectives they have taken. They

summarize a joint position to which both sides agreed. Subsequently, they (a) prepare a cooperative report with each member of the group selecting a topic supporting the synthesis and writing a paragraph supported by the research; (b) combine their paragraphs into a single paper and refine the flow of the paper; (c) present their conclusions to the class; and (d) reflect on how well their group worked together, how they could be more effective next time, and what each individual could do to make the process better. (Cooperative Elements: Individual accountability, positive interdependence, and group processing (reflection))

Through the research actions, students also learned how to generate an annotated literature review and create reference lists. For example, using the Facebook/Whistleblower controversy, students posted their literature review on Miro—an interactive online whiteboard—to create a repository of information used to formulate their arguments. They learned to follow the IEEE format for citations and references using online resources to familiarize them with the format structure of different kinds of publications in CS.

The constructive academic controversy approach is dynamic and flexible and can be adapted based on the purpose and objectives of each class. The instructors made slight variations in order to connect the academic controversy with the relational leadership model, focusing on inclusion through actively engaging diversity of views, approaches, and perspectives.

External Evaluation Methodology and Results

The external evaluation team gathered quantitative and qualitative data throughout each semester of implementation.

Methodology. By employing a concurrent mixed method design and drawing on evidence from both qualitative and quantitative data, the study provided evidence of Latinx CS students' development of interpersonal skills, in particular perspective-taking, through their active participation in the leadership course and, more explicitly, participation in the academic controversy exercise. In concurrent mixed methods design, data are collected and analyzed in parallel [40] rather than sequentially. Evaluators drew on this design because it provides triangulation and complementary data [41] that allows for more accurate feedback, in this case, to the leadership course designers and instructors.

The external evaluator team applied a 67-item Social Responsibility Leadership survey [42] as a pretest (before the start of the course) and posttest (at the end of the course). This survey assesses and identifies leadership capacities across eight domains: consciousness of self, congruence, commitment, collaboration, common purpose, controversy with civility, citizenship, and change [42]. For this specific study, we focused on the controversy with civility domain because it assesses students' skills for recognizing two fundamental positions of any situation or issue, differences in viewpoint, and willingness to hear each other's views. Qualitative data sources included classroom observations, transcripts of student interviews, and student artifacts

(e.g., homework, in-class reflections, and presentations). Data collected were analyzed through a constant comparative method [43], [44] in which data are coded, sorted, and organized in a structure to emerge into relevant themes. We used pseudonyms for all the students to ensure confidentiality.

Results. From the survey results, the external evaluator team found evidence indicating students had indeed learned and practiced valuable leadership skills; and their communication skills had improved. More specifically, the team found a statistically significant improvement in the controversy-with-civility domain between the pretest and posttest. This finding suggests that using the academic controversy exercise and the relational model approach to leadership are effective in promoting students' development of their leadership skills and, more specifically, students' perspective-taking. Furthermore, this finding suggests students' ability to embrace both intergroup commonalities and differences may increase Latinx students' opportunities to validate their viewpoints instead of orienting toward default discourses.

One of the qualitative findings of this course implementation was that students perceived improvement in their ability to assume different perspectives. At the end of the third iteration of the course, students were asked the following question, as they had taken different perspectives during the academic controversy exercise: Why do you think the ability to see different perspectives is important for leadership? Three themes emerged from students' responses: 1) different perspectives lead to better ideas, results, and/or conclusions; 2) different perspectives build more inclusive work environment; and 3) different perspectives lead to personal improvement.

Following are selected quotes to illustrate these dominant themes:

1) Different perspectives lead to better ideas, results, and/or conclusions:
   **Solutions that work for [the] the greatest number of people benefit more people.*
   **It creates a new angle to tackle a problem.*

2) Different perspectives build more inclusive work environment:
   **Know how each team member can excel.*
   **Fully take into consideration others' opinions and make everyone feel heard/safe.*
   **Safer environment where everyone feels at ease while sharing their ideas.*
   **Leader who listens has better work environment.*
   **Understand their viewpoints to better communicate.*

3) Different perspectives lead to personal improvement:
   **...do some self-reflection and realize you're not always right.*
   **We get to see different viewpoints and become less biased and judgmental.*
   **Listening to others' ideas helps you structure your thoughts.*

Semi-structured interview data highlighted that most students believed their participation in academic controversy allowed them to develop and practice their leadership skills as they voiced their ideas and considered different opinions toward ethical issues involved in CS. They

became aware of the relevance of their contributions in the leadership course and other CS contexts. With regards to the participation of Latinas in CS, we found the academic controversy exercise helped them to identify and position themselves as capable contributors, whether they played a positional or non-positional leadership role. For example, Carolina, a Latinx CS student, said:

> *I used to be very shy, and I never shared my perspective. However, participating in the controversies taught me how to share my ideas and feel confident about them. I learned how to communicate and collaborate with my peers from a different perspective. Now, I'm sure about my knowledge and ideas and how those are important to improve my group's outcomes here and in my other courses.*

In another example, Nopalita, a Latinx CS student, also explained how participating in the exercise helped her to develop leadership skills that allowed her to participate more actively in other CS courses. She said:

> *Participating in the controversies, I became aware of the importance of developing a position toward real world ethical issues and seeing others' perspectives. But, more importantly, I set the skills to dig deeper into a topic by doing research not only for this class but for my other CS courses. So, I learned how to build and communicate my arguments, complement my ideas, include my teammates' ideas, and prevent or solve conflicts.*

As these accounts show, CS Latinx female students honed leadership skills that allowed them to develop their sense of belonging and thrive in CS education, a space where they are prone to feel like an outsider or invisible due to the lack of representation [45], [46].

Conclusion

This paper described the process and results of implementing cooperative learning instructional tools, especially the constructive academic controversy approach, in a CS leadership course at an HSI. This approach allowed CS students, who were primarily Latinx, to analyze, discuss, critique, and develop a research-informed view about the role of technology in controversial social justice, ex/inclusion, and in/equity issues. These findings are consistent with prior studies of cooperative learning approaches that support students in developing their professional skills due to the active role they play [28], [29]. Also, consistent with prior research, we have identified Latinx students, more specifically Latinas, who have enhanced their sense of belonging and confidence in CS [32]. We extend prior research by pointing out how students increased their understanding of the unique aspects of professional computing environments and learned to embrace different perspectives—aspects crucial to developing a leadership identity. We have also highlighted how students interpreted the impact of being able to communicate their ideas and perspectives when working with their peers [3], not only in their leadership courses but in their other CS courses. We also illustrated the importance of supporting students' development of their listening skills to increase their understanding of the unique aspects of professional computing environments as they learned to embrace different perspectives—aspects crucial to developing a leadership identity—which is especially striking because of the lack of representation of Latinx in CS [46].

In sum, the findings in this paper, while not intended to be generalizable, do provide a clear understanding of the ways Latinx students experienced the impact of being reflective, challenging, caring, purposeful, and consultative when working through ethical dilemmas [3] in a leadership course at an HSI. Given the majority of the students were Latinx undergraduate CS majors, academic controversy served to create a strong sense of belonging among students, especially Latinas, and was an empowering additive to the relational leadership model.

Because our focus was on the outcomes of interpersonal skill building, particularly the skill of perspective-taking, we were limited in gathering evidence on how learning in this course had implications for students' academic growth. As such, an in-depth longitudinal study is in the planning stages to understand the impact of this course on former students' trajectories in their academic and professional lives.

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