2023-10-10

A Community-Based Context Learning Approach To Promoting Social Justice In Teaching Engineering Communication

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A COMMUNITY-BASED CONTEXT LEARNING APPROACH TO PROMOTING SOCIAL JUSTICE IN TEACHING ENGINEERING COMMUNICATION

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Conference Key Areas*: Embedding Sustainability and Ethics in the Curriculum; Engagement with Society and Local Communities*
Keywords*: Community-based Context Learning, Engineering Communication, Social Justice*

ABSTRACT

The research suggests a community-based context learning approach which engages students with marginalized cultural communities to investigate how technological artifacts, models or systems marginalize these cultural communities and propose for change. The goal of this approach is to increase engineering students' awareness of that engineering work can marginalize certain groups of people. The approach integrates social change to an engineering communication course and considers student learning and transformation are as important as community problems and solutions. It brings transformative learning outcomes to students, increasing their awareness of the fact that engineering is never neutral, and their engineering profession is associated with unjust social issues. With the increased awareness of social justice, students will become agents in their future workplaces to challenge and change unjust structures.

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1 INTRODUCTION

Community engagement and service-learning has been emerging as an unofficial movement in higher education in the U.S.A. It involves various learning approaches such as domestic/ international service learning, civic engagement learning, experiential learning, etc. Scholarship on community engagement and service-learning mainly focuses on positive effects on students' academic learning, increasing cultural difference awareness and intercultural competence, personal and professional development, etc.[2] However, some scholars point out that such community-engaged service learning merely emphasizes service and many students work as volunteers to do some specific tasks without attention to systems of inequality, and as a result, community engagement learning is just about offering charitable service, which is involved with no or little social justice work and even reinforces established hierarchies[3]. As these scholars realized that the charitable and depoliticized service cannot get students' attention to the root causes of social inequality and make social change, they started advocating a social justice approach to conducting community engagement and service learning. With the approach shift, students are encouraged to work as agents of social change to respond to social inequality and community issues.[4]

Social change involves "[addressing] tremendous inequalities and fundamental social challenges by creating structures and conditions that promote equality, autonomy, cooperation and sustainability."[5] Community engaged-learning practitioners who want to adopt a social justice approach must rethink their course design such as the types of service-learning projects and assignments that can challenge and change the structures perpetuating some social issues, as well as facilitating students' investigation and understanding of the root causes of them. In order to answer the above advocates' call, this research suggests a community-based context learning approach without real service. This approach maintains social justice orientation with a focus on raising engineering students' awareness of association of issues of equity with their field and profession and help them promote social change.

2 THE COMMUNITY-BASED CONTEXT LEANING APPROACH AND ITS RATIONALE

The community-based context learning approach without service is put forward in the context in which engineering scholars and modern engineering curricula espouse technical-social dualism.[6] In the book *Engineering Justice Transforming Engineering Education and Practice*, Leydens and Lucena elucidate several factors that make

[2] Eyler, Giler, Stensen and Gray, 2001.

[3] Ginwright and Cammarota, 2002.

[4] Stoecker, 2016.

[5] Langseth and Troppe, 1997, 37.

[6] Leydens and Lucena, 2018, 50.

social justice is invisible in engineering education and practice, two of which lie in engineering scholars and curricula. They reveal that “entire fields of scholars have reiterated the existence of technical-social dualism… For technical-social dualists, not only are the technical and the social separate, but they exist in a hierarchy: technical dimensions are highly valued and social ones are far less values or even irrelevant.”[7] They also point out that in modern engineering curricular, engineering sciences dominate the engineering courses. By comparison, humanities, engineering design, and social science courses are far fewer included to engineering curricula. “Not only do students recognize that disparity, it becomes part of their identity as engineers.”[8] Leydens and Lucena argue that engineering problem solving never occurs in a social vacuum, instead, it is conducted in a sociocultural context that shapes technical problem-solving processes and outcomes. Future more, they indicate that there are “linkages between engineering artifacts, systems, and models and issues of equity”[9]. In order to eliminate the separation of the technical and the social and increase engineering students’ awareness that “engineering is never neutral”, the community-based context learning approach engages students with marginalized cultural communities to investigate how technological artifacts, models or systems marginalize these cultural communities and proposed for change. This approach does not engage students with real work because an unjust issue caused by technology is always involved with several stakeholders and it cannot be resolved within one semester or through one project assignment. The goal of this approach is to increase engineering students’ awareness that engineering work can marginalize certain groups of people. For example, when they develop a technological artifact for users, they can collect data from the widest range of audiences, avoiding sorting through people by skin color, gender, age, disabilities and other characteristics. Or if they identify a certain device or software excludes certain groups of people, they can use their engineering expertise to fight against such forms of exploitation, oppression and exclusion.

Unlike community-engaged service learning that emphasizes student outcomes over social change, the community-based context learning approach integrates social change to an engineering communication course and considers student learning and transformation are as important as community problems and solutions. It organizes a community-based context research project that involves engineering students in an entire research process: identify a research topic related to engineering artifacts or systems that marginalize specific cultural groups in local community, develop research questions, design methodologies, collect primary data from the specific community and secondary data from previous scholarship, do the analysis and employ their engineering expertise to make recommendations for change. Students use the previous scholarship sources, discussion, and other writing assignments and

[7] Leydens and Lucena, 2018, 50.

[8] Leydens and Lucena, 51.

[9] Leydens and Lucena, 216.

activities to have a comprehensive understanding of the issue existing not only in the community context but in a larger social structural context as well. “Such a vision is compatible with liberatory forms of pedagogy in which a goal of education is to challenge students to become knowledgeable of the social, political, and economic forces that have shaped their lives and the lives of others.”[10] Collins points out that “people experience and resist oppression on three levels: the level of personal biography; the group or community level of the cultural context created by race, class and gender; and the systemic level of social institutions.”[11] This community-based context learning approach emphasizes the three levels as potential sites to make (social) change. For example, at the personal level, this approach allows engineering students to interact with the community individuals (like having an interview or doing usability tests) to explore how a technology design denies a person’s identity through a feature such as dark skin color. Such a design seemly is not merely limited to causing personal pain, rather, it involves in race in the cultural community level. Through interacting with the community individuals, reading previous scholarship and data analysis, students will understand the real-life issues and concerns and the systematic causes resulting in them. The community-based context learning approach acknowledges how technology design can marginalize cultural groups of people and how unjust systems function in our society. This can bring students attention to social change through leveraging their engineering expertise.

Although students do not provide any real service to the community that they interact with, this approach can bring transformative learning outcomes to students, increasing their awareness of the fact that engineering is never neutral, and their engineering profession is associated with unjust social issues. Further, it skips simply doing charitable service to challenge students to investigate the root causes of inequality and use their expertise to mitigate issues and realize a more just society. In addition, social change involved in service takes time, and it will not be achieved through a course project or in a single semester. The goal of the approach is “to empower students to see themselves as agents … and create social change.” [12]As functionalist theory believes that “social change results form the accumulation of individual behaviors, is generally the result of cooperative action, and is gradual.”[13] With the increased awareness of social justice, students will become agents in their future workplaces to challenge and change unjust structures.

3 METHODOLOGY

The research was conducted in a three-credit and required course “Engineering Communication” in Cornell College of Engineering Communications Program in 2021 Fall and 2023 Spring. It obtained the approval of the university’s IRB. All the students

[10] Rhoads, 1998, 41.

[11] Collins, 2022, 557.

[12] Forbes et al., 1999, 167.

[13] Stoecker, 2016, 80.

enrolled in the course were seniors. 43 students (17 femals and 26 males) participated in the research. In the course, there were four projects and the research was focused on Project Four that lasted 4 weeks. The students worked in groups with 4 students per group. They were required to write a 5-8 page long recommendation report and give a poster presentation. They started by identifying a problem in science/technology design or other technological artifacts and an audience/decision maker who could implement recommendations. The problem should be focused on how a certation group of people were marginalized by using the product or obtaining accurate information. The assignment included a mixture of primary and secondary research. The secondary research should mostly serve to frame the issue the students focused on. The primary research should be focused on the specific marginalized group in the local community and the students collected the information (primary date) through interacting with the marginalized group through research methods such as interviews, questionnaires, surveys, usability testing. The final deliverables included a group poster presentation, a formal proposal, and an individual reflective essay. The individual reflective essay assignment was used to assess the students' social justice awareness. In this research, the participants' final proposals and their individual reflective essays were collected for data analysis.

The research adopts a grounded theory approach to analyzing the content of the students' essays. The "inductively derived" grounded theory provides a systematic method for generating hypotheses from qualitative data. The goal of utilizing it in this research is to generate themes that can explain and demonstrate what the students have learned from the project and whether they have increased their awareness of social justice in the engineering setting. With the open coding process, I read the students' essays and marked the lines with key phrases, then grouped the similar key phrases together to generate a theme, and finally divided the themes into several categories. I repeated the process three times to improve the coding validity and reliability of the research.

4 FINDINGS AND ANALYSIS

The participants engaged with several topics related to technology and engineering settings in their proposals. Through their investigation, they interacted with various kinds of cultural groups of people (see Table 1).

Table 1. Proposal Topics and Cultural Groups Engaged

Proposal Topics	Cultural Groups Students Engaged With
Genger (in)equality in STEM majors	Female students in an engineering college
Accessibility of insulin pumps	Diabetics with visual impairment
Digital divide in U.S.A	Local residents from rural areas
Online privacy awareness of technology-illiterate users	Local illiterate technology users aged 55 on average
Non-English speakers with accents struggling with using voice assistants	Local non-English speakers from India, China mainland, and Hongkong.
Inequitable design in the Hirevue	College students of color

As this is an engineering communication course, in the students' reflective essays, the themes that emerged repeatedly were mainly focused on collaboration, communication, and ethics. Specifically, the themes consist of seven categories as follows: 1) team/individual accomplishments; 2) team/individual challenges; 3) project management; 4) effective communication; 5) diversity awareness and sensitivity; 6) ethics and social justice; 7) transfer and transformation

All the students believed that effective communication helped resolve all the challenges and issues that emerged in their teamwork. They also believed that the project management plan helped them outline the expectations and allocate tasks evenly among team members and each team member made equal contributions to the project. During interacting with the cultural groups that they worked with, they kept diversity awareness in mind and adapted themselves to communicate with the community individuals by adopting strategies such as using respectful language, active listening others' feedback and showing empathy to the individuals who were suffering from the issue. These findings demonstrate that the students have increased diversity awareness and cultural sensitivity in collaboration and communication.

Significantly, the students became to realize the importance of engineering ethics. Through the project, they identified how technology could discriminate against a certain group of people or even perpetuate existing biases and oppression in society. They leveraged their engineering expertise to propose for a change. For example, one team explored how using artificial intelligence in evaluating job applicants has unforeseen racial biases. They investigated a screening software that many companies use to sift through application materials. By interviewing their peers who were applying for jobs and internships to see what implicit bias the software has, what caused the problems and made recommendations to improve the software. One student reflected on the project and said, "I leveraged my interests in machine learning and realized that the screening software tried to be racially unbiased by not using race as an input parameter and using a training set that was 17% black while only 11% of the software users are black. Nevertheless, factors such as dispersion of features can lead to the generated model not assigning the proper weight to characteristics that are most commonly expressed by successful people of color because race is not included as an input variable in the dataset. This discovery was critical because most people who are not familiar with data science would consider including race as an input parameter giving one group an advantage, but in certain situations, it is needed for clustering that allows people of different races to be evaluated on an equal basis". Another student on the team associated the case to a higher level—the society. He said that "ethics are of the utmost importance in engineering as they ensure that the work of engineers is done in a responsible and trustworthy manner. Engineers have the power to shape the world around us, and it is their ethical duty to use this power for the benefit of society and the greater good. Our project 4 was a great example of ethics in engineering. When looking at the screening software, it was clear that their AI was biased against candidates of dark

skin tones. While this isn't a matter of life or death, it is clearly unfair and needs to be fixed."

Another team engaged in a systematic level of social institutions. The students of the team looked into how corporations failed to take ethical considerations seriously in digital divide in the United States, which would reinforce the existing oppression. In his reflective essay, one student wrote that "[t]hrough our research project, I observed the effects of corporations failing to take ethical considerations seriously enough in the case of access to digital technology and the Internet in the United States. Certain groups struggle to obtain a level of Internet access comparable to the rest of the nation, and as a result lack many privileges held by the rest of society, often referred to as the digital divide. I also gained a new perspective on how our society tends to view progress, and how it relates to ethics. Our definition of progress is often absolute, measured by the state of the most advanced project or group, rather than by an aggregate of all groups. The ethical disadvantage from focusing on the edge of progress is that those impacted negatively or benefitting disproportionately are too often forgotten".

Some students gained a critical awareness of technology design from working on the project. One student said, "[t]his class has definitely opened my eyes on the usability of products all around me. Before, I wouldn't really take a second glance at anything and question whether or not the product is suitable for everyone. This is an important part of designing to ensure that your design meets all standards, including those of people outside of a target audience". Another student pointed out problematic technology design and its solution. He said, "Through this research-based project I have learned that when most people are creating a new technology, they only test to make sure it works for them. This means that the product will most likely only work for people that are similar to that person, which is why it is important to use diverse testing sets to make sure the project can be applied to a wide range of people. Learning about issues such as this one has definitely opened my eyes up to other possible lack of ethics in technology, whether the problem is purposeful or not. More must be done to help make sure all technology is created for all people and works at the same level of quality for all".

Some students expressed clearly that they would transfer what they have learned from the project to their future workplaces. For example, one student wrote in her reflective essay, "I learned from this project that there is still much bias and discrimination against minorities in America and that as engineers, we must make sure that whatever products or technologies we work on in the future, that they provide equal opportunities and experiences for everyone when applicable. Even for something as simple as working together on a group project, we must continue to showcase these feelings of equality and consideration for diversity when communicating with each other. These are the kinds of lessons I want to take with me when I join the workplace or if I continue to go to school as that is the kind of positive influence and contribution I want to make to the world".

5 CONCLUSION AND LIMITATIONS

The community-based context learning approach encourages analysis, critical thinking and action. It can foster engineering students' critical consciousness of their work, allowing them to connect their profession to the lives of a specific cultural group/community and even to the entire society. Their interaction with communities makes them reflect on the impact of their personal action in maintaining and transforming social problems, becoming awareness of the systemic and structural nature of oppression. Further, the social change-oriented approach can directly get students involved in challenging and addressing structural inequality by proposing for a change with their expertise. Through the approach with a focus on social change, engineering students can look ahead and consider their own work that might lead to transforming social problems and sustainable change.

This research focuses on a small group of participants, which may not be representative. Because the research was very preliminary, I coded and analyzed the data on my own without validity from colleagues in technical and professional communication and community engagement and service learning, so the research reliability can be further improved. Future studies may focus on a larger group of participants to examine the efficacy of the approach.

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