From Charity to Solidarity: A Model for Shifting Service Learning in Engineering

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Service learning in engineering has been criticized on the basis that it often reproduces colonial and globalist tendencies that ultimately undermine already-marginalized communities. A major problem with sending engineering students into communities of which they are not members is that student learning often takes precedence over project outcomes, and community partners suffer as a result. The motivation for developing this course was to alleviate this problematic aspect of service learning. A curriculum was designed with the goal that students would see themselves in solidarity with, instead of separate from or better than, struggles in their home or campus communities.

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INTRODUCTION

"Engineering to Help" (ETH) is a term coined by Schneider, et al., (Schneider, et al., 2009) to encompass the growing number of collegiate programs- including service learning, humanitarian engineering, sustainable development, and others- that share a mission to "help" communities "in need". ETH programs have been broadly criticized on the basis that they often reproduce colonial and globalist tendencies that ultimately cause harm to the communities that were meant to be "helped" (Schneider, et al., 2009), (Nieusma, et al., 2010). For instance, Nieusma and Riley (Nieusma, et al., 2010) use two case studies to illuminate ways in which problematic assumptions about technology's role in community development can impede social justice goals. One case study examined a Product Entrepreneurship course in partnership with two Nicaraguan universities. Despite a strong faculty effort to frame the project educationally around process rather than product, emphasis on product prevailed as students' preconceived assumptions about the value of product over process were not challenged consistently enough, and structural influences like funder interests reinforced the emphasis on product. Additionally, students made the problematic assumption in their economic proposal that what works under consumer capitalism in the U.S., where a high percentage of the population has expendable income, would work in the very different economic circumstances of Nicaragua. The project was ultimately stalled at the proposal stage because of disagreement about this point.

By the time they reach their senior year, engineering students have often had few- if any- courses that require them to consider approaches to designing for a client or community whose racial, ethnic, national, socioeconomic, or other demographic background differs from their own. This experience gap is made especially apparent when students are asked to enter communities that differ from their own and do not have the tools or life experience to understand the needs of community members. Even as students have

good intentions, there is a tendency to focus on what seems solvable over what community members say is important. This is likely a result of years to decades of an education that has prioritized hard skills over relationships. In the absence of meaningful relationships, it is easy to lose sight of the purpose of community engagement. Technologies that students create do not serve the needs of community partners, and community partners suffer as a result.

At the same time, engineers' desire to help and strong work ethic lend themselves well to working on issues of social justice (Riley, 2008). In recent years, critical pedagogy has influenced service-learning programs as educators have attempted to engage the action-reflection-transformation model proposed by Freire (Freire, 1970). Further, Santiago-Ortiz (Santiago-Ortiz, 2009) suggests that community engaged pedagogical approaches are not necessarily bad, but that "Perhaps service-learning requires shifting its "service" approach to a more horizontal and solidary community–university partnership. The former implies a hierarchical relationship from the outset, and the latter opens the door for epistemic disobedience that transgresses colonialist understandings of knowledge and relationships."

The goal for the development of this course was to explore whether asking students to address problems of equity and social justice with engineering solutions in a "horizontal" context- i.e. in their own communities- would alleviate the reproduction of globalist and colonialist tendencies, instead encouraging students to see themselves in solidarity with struggles in their home communities. In this case, "solidarity" borrows from Freirian pedagogy and refers to the act of people from different social locations working together to transform social conditions, and "community" was defined by students at the outset of the project. The phrase "solidarity over charity" has become a refrain recently among solidarity organizing projects, and the idea is usually attributed to Uruguayan journalist Eduardo Galeano.

COURSE DESIGN AND EXECUTION

A course titled "Community Engaged Design" was introduced as a senior design capstone at a small, liberal arts college. Fifteen senior students from three majors (Civil Engineering, Engineering Studies, Mechanical Engineering) enrolled by choice in the two-semester, project-based course.

Students were introduced to the topic of community engaged design by completing a discussion-based identity mapping exercise in which they were encouraged to consider how "community" is defined by thinking about what communities they belong to. In the first group meeting, the instructor asked students to free-write about communities they belong to: What are those communities? What defines them? Who are the members? How does one come to belong? After sharing, students discussed initial ideas of what it means to do an engineering project that is "engaged with a community".

Following the initial meeting, students spent two weeks reading (out-of-class) and discussing (in-class) critiques of ETH projects, including references (Schneider, et al., 2009), (Riley, 2008), (Leydens, et al., 2009), and (Schneider, et al., 2008). The first week of readings were assigned by the instructor, while the second week of readings were generated by the class. They summarized their reading responses by defining a list of desired project attributes, which they categorized into "wants" and "needs". The project attributes the students chose are listed in Table 1.

After their background reading and group discussion, the team defined their shared "community" as the small city (~30,000 residents) in which the college was located. Other options considered included the hometowns of team members, the college campus, and other identity- and interest-based groups with which team members identified, such as the volunteer fire department, the soccer team, and the Black Student Union. To define their stakeholders, the team used a combined approach that included: soliciting input from community leaders, including city government officials, local business owners, city and campus police, and staff of nonprofits whose mission had to do with community development; and soliciting input from the public, where students surveyed friends, members in campus organizations, and canvassed in public spaces. After the project topic of bicycle safety was selected, students made a concerted effort to engage bicyclists through a local bike repair shop. Students initially used surveys (e.g. google forms) to gather broad community input, and moved to in-depth interviews after key stakeholders had been identified.

TABLE 1
STUDENT-DEFINED PROJECT ATTRIBUTES FOR THEIR COMMUNITY ENGAGED SENIOR CAPSTONE

Our project MUST...	We would LIKE our project to...
utilize existing skills of all teammates, from different majors	engage the "most vulnerable among us"
engage one or multiple community partners	[undergo] multiple prototypes
encompass a critical mindset about "helping" in engineering	be frequently used
NOT end up harming the community	[be a] long lasting solution or [have long lasting] impact, [be] easy-to-fix
be novel / innovative	have a social justice lens/impact
	[apply] to life after [college]

To define their engineering design problem, students used three rounds of topic and design ideation and selection to narrow their focus first to pedestrian safety, and then more specifically to driver awareness of cyclists at city intersections. Each round of design selection consisted of large group brainstorming of possible topics, small group researching and presentation of possible topics, individual ranking of the project's fit according to the project attributes (Table 1), and individual preference voting. The results of these selection rounds are presented in Table 2.

TABLE 2
PROJECT DOWN-SELECTION OCCURRED IN THREE ROUNDS OF BRAINSTORMING, COMMUNITY INPUT, DISCUSSION, AND TEAM VOTING USING THE ATTRIBUTES FROM TABLE 1 AS A FRAMEWORK FOR TOPIC AND DESIGN EVALUATION

Round I (topic selection)	Round II (subtopic selection)	Round III (design selection)
Mass Incarceration	**Cyclist Safety**	Bicycle Turn Signal
Homelessness	Blind Corners / Intersections	Pedestrian Laser Cage
Sustainability	Inclement Weather	Cyclist Crashpack (airbag)
Community (Dis)connection	Roadside safety for Fire/EMS/Police	Cyclist Safety App
Traffic / Pedestrian Safety	Speeding / Collision Prevention	**Driver Awareness of Cyclists at Intersections**
Fire Safety	Crosswalk safety	Low Profile Helmet

Community input influenced the project selection process at each stage but didn't drive it until the last stage. The lack of consistency in community influence was in part due to the timing (more stakeholder relationships existed by Round III as opposed to Round I), but in part because students struggled to develop appropriate questions about broad community values. In Round I, interview questions focused on what people thought needed improvement about the city and community, and the results were not easily translated into possible design projects. For instance, while it was broadly recognized that mass incarceration is a key problem in the community, it was very challenging to identify engineering design projects that would address the problem of mass incarceration.

By Round III, it was clear that the team would be working on a bicycle safety project, so developing specific interview questions for cyclists about their experiences navigating city roads was straightforward. Input was gathered continuously throughout the design selection process, but outreach efforts were inconsistent and inadvertently favored city residents who were associated with the college campus or living in the immediate vicinity. Students, most of whom had not taken any coursework in qualitative data analysis or quantitative methods in social sciences, struggled to make meaning of interview answers and survey results.

After the project was selected, efforts to maintain engagement with stakeholders were minimal. A few interviews with key stakeholders (whose narratives had driven project selection) were done, but the results did not meaningfully influence design choices made along the way.

For the remainder of the first semester, various technologies were researched and prototyped towards the goal of increasing drivers' awareness of cyclists at intersections. During the second semester, a final design was chosen, and a prototype built. The team's final product was a prototype of a system which detected and warned drivers of the presence of bicyclists.

LESSONS LEARNED

Allowing Students to Define Their Own Community and Project Attributes Was a Successful Technique.

The identity mapping exercise and assigned background readings, coupled with discussions guided by the instructor, were useful in fostering an environment in which students could come together across their own differences to generate shared values around their capstone design project. For the attributes listed in Table 1, there was very strong consensus among the team.

Inviting Social Identity Into the Design Process Necessarily Invites Conflict as Students Navigate Differences in Social Position Among Themselves.

One of the concerns with ETH projects is that "privileged" students will perpetrate unintentional harms upon "less privileged" communities. When students were asked to see themselves as a community, and to see themselves as members of broader communities (e.g. campus, city), differences in social position among the students entered the design process.

For instance, one of the project ideas that students proposed involved working closely with city police. Some students had been taught as young people that the police were trustworthy and kept people safe; others had been taught that the police were dangerous and made people less safe. Others were indifferent, and it's possible that some students came from countries or neighborhoods with little to no police presence. It is not a coincidence that these differences in perspective occurred along axes of social identity (race, gender). While the generation of shared values had resulted in strong consensus, the interpretation of which possible topics and designs achieved those values resulted in relatively weak consensus. Neither the students nor the instructor were adequately equipped to navigate conflicts resulting from deep-rooted societal inequities.

To mediate some of the conflict arising from societal inequities, the instructor implemented monthly feedback conferences with each student. These meetings were coupled with peer evaluations and were used to discuss positive and critical feedback about intergroup dialogue skills, e.g. listening. They also served as an opportunity to discuss topics like racism and classism with some of the more privileged students in a setting where the onus to do so was placed on the instructor, not on the students from less privileged backgrounds. These conferences helped considerably and should have been implemented from the start of the course.

Several Students Saw the Community Engagement Aspects of the Project as Being at Odds With the Technical Aspects of the Project.

This tendency among engineering students is not new or surprising. While the technical requirements of the project were adapted from the senior design requirements from the Mechanical Engineering

department, the requirements for community engagement were left open for students to define. There was widespread disagreement among the team about how, and how much, to engage.

For instance, taking time to do in-depth stakeholder outreach in between each round of design selection was seen by some students as delaying technical progress. The technical and relational aspects of the project would ideally be bound together in a holistic and unified vision. Additional scaffolding from the instructor following the first four weeks of planned activities and readings could have helped students prioritize and maintain relationships with community partners.

Additionally, the lack of experience in social research methods (on behalf of both students and the instructor) was a barrier to doing effective outreach, designing surveys and interviews, and interpreting qualitative results. A partnership with a faculty member, or the inclusion of team members, who have experience in social research methods would have strengthened the project considerably.

CONCLUSIONS

Asking students to see themselves as members of a community in solidarity with their fellow community members means that the classroom becomes a microcosm of that community. With that microcosm comes inequities existing in the greater community, for instance along the lines of race and class. This was a major tension in this course, as students have little experience in the engineering classroom thinking critically about what it means to share community with people whose identities and experiences differ substantially than their own, including their own teammates. While this tension was difficult, and while the lessons learned point to conflict resolution- ultimately, to more productive uses of that tension- the tension itself is a good thing. Multiple students wrote in course evaluations that some of the main takeaways from the course included the ability to consider others' perspectives and the ability to navigate disagreement. These outcomes were not what was originally intended from the course, but they are social justice outcomes that are sorely needed in engineering curricula.

A stronger emphasis on social justice, as an aspect of engineering ethics, should take place earlier in the curriculum. There are already many examples for how to do this, but few if any make the connection between social justice and intergroup conflict. Conflict resolution is sometimes taught in engineering curricula, but usually ignores oppression and domination as constituents of conflict. Actually, understanding social identity is a key component to conflict navigation (Hahn Tapper, 2013). Such relational skills would have helped students both in their stakeholder relationships, and with intergroup dialogue in team meetings.

This paper is intended to be a reflective account of ideas and lessons learned about community engaged design. However, it does not fully answer the question of whether the burden placed on community partners can be alleviated by teaching students to see themselves in solidarity with their home or campus communities. A more rigorous answer to this question would likely require a comparative study between design projects, including survey and interview data from students and community partners.

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