Exploring how engineering students learn the process of problem identification for community development

Nathan E Canney P.E., University of Colorado Boulder

Nathan Canney is a doctoral candidate in Civil Engineering, with a research focus on engineering education. Nathan has bachelor's degrees in civil engineering and mathematics from Seattle University and a master's degree in structural engineering from Stanford University. His current research focuses on the development of personal and professional social responsibility in engineering students.

Kaitlin Litchfield, University of Colorado, Boulder

Kaitlin Litchfield received her undergraduate degree in Civil Engineering at the University of New Hampshire and is currently pursuing a Ph.D. at the University of Colorado at Boulder in the Civil, Environmental and Architectural Engineering Department focusing in engineering education.

Molly Victoria Shea, University of Colorado

Molly Shea is a dual degree candidate receiving her Ph.D. from the School of Education, Learning Sciences and master's of business administration. She specializes in studying distributing cognition in out of classroom settings. Her dissertation focuses studying on learning for innovation in sustainable business.

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Abstract

This paper focuses on how students learn to become culturally responsive engineers for development within a graduate-level engineering course entitled Sustainable Community Development (SCD). A new type of engineer is required for the ever-increasing global demands to address the problems of equitable access to energy, nutrition, shelter, clean water, sanitation, and many other basic human needs. Given this context, engineers will need to play a more critical role in meeting these demands around the world and in local, historically marginalized, and economically struggling communities. Therefore we believe that becoming an engineer means developing dispositions that view engineering solutions as an outcome of collaboration between community members, engineers, funding organizations, and many other stakeholders.

The SCD course was specifically designed to address engineering solutions for sustainable human development and poverty reduction. We studied students as they moved across locations, namely the engineering classroom and the local non-profit situated within a low-income community, in order to better understand how students come to identify problems and subsequent engineering solutions.

Using a person-centered approach to learning, we focused on two students' experiences as they grappled with the process of problem identification within other communities, prior to developing engineering solutions. We concentrated on how students reorganize knowledge across contexts (the classroom and the community) as a basis for understanding learning. Specifically, we examined how these students negotiated the elements of problem identification including: moving from an abstract understanding of problem identification in the classroom into the situated understanding in the community, collaboration with a community partner, and managing goals between the classroom and the community.

Introduction

The history of engineering projects for community development is rife with stories of failures, wasted money, and communities that end up in the same place, or worse off than before [1, 2]. Research on project success or failure in developing communities has focused on identifying key success factors such as project team communication [3] employing proper evaluations throughout the project life [4], and knowing the political context of the project [5]. The majority, however, downplay the importance of community involvement throughout the engineering process. One report justified the exclusion of the community from a list of key stakeholders, saying:

> "It may come as a surprise that the real client does not appear on this list. In multilateral aid projects, the client is usually the country's residents or a sub-set thereof called 'the beneficiaries.' The beneficiaries, who may sometimes participate in the project identification phase (needs assessment), can rarely be effective as clients once a project is in execution. This is due to the lack of representative authorities or organizations, especially when it comes to validating the quality of the project outputs. There are exceptions" [3] (p. 239).

Counter to this traditional view, we argue that design *in and with* the community throughout the entire engineering process is central to project success for development. The SCD course was designed to marry classroom learning about community appraisal with field experience during the class through project-based service-learning. This design followed what Amadei and Sandekian [6] wrote about their work with Engineers Without Borders-USA, that "it was clear that field experience was necessary but not sufficient for training the students interested in community service and development" (p. 85). This approach set up an unpredictable and open ended situation, where students were learning about tools and methods for community appraisal, while simultaneously using them in a 'real world' context. The ways in which students reorganize the information gained from the classroom context into the separate community context exemplified learning. When students reorganized information, they applied the skills, tools, and practices that they were exposed to in the classroom, to their problem identification work within the community, adjusting for the new context in which they were experiencing these elements.

It is unclear exactly how to design learning environments that facilitate students in adopting this community centered disposition. There are few programs around the country attempting to cultivate this new type of engineer and the majority use some form of project-based or client-centered design methodology. These programs are relatively new and there have been few studies about the learning that is occurring in these contexts and how to develop appropriate learning metrics.

We look at this context of problem-based service-learning to see where students struggle and how they come to an understanding of their role as an engineer working in the context of community development. If these programs can better understand how students learn the problem identification process, then educators can better tailor their programs to guide emerging engineers to lead community development projects towards more robust community outcomes. In this preliminary qualitative research study, we aimed to identify how engineering students struggle, given the expectations of new roles in society, and to help form a foundation for further studies into how other students learn the process of problem identification. Focusing on the process of problem identification is critical because it breaks from traditional engineering education where the problem is given and the difficulty is in developing the engineering solution. For development work, engineers must give significant time, working with the community, to identify the problem before developing an engineering solution. This is new for many engineering students and is therefore important to examine.

Study Approach

This study focused on a graduate-level engineering course at a large, public institution, titled Sustainable Community Development (SCD). The course focused on student participation in the field as a means to sustainable human development and poverty reduction. This year, students participated in a year-long project partnering with a local, low-income, historically marginalized Latino community in the U.S. Students in the course were challenged to adopt a participatory framework as a way to understand and propose engineering solutions for the community's built environment. As a proxy for the community, students also partnered with a local non-profit

organization, Transformation International (TI) [1], who had worked within the community for three years. This unique course offered a context to study how students engaged with this new approach to engineering and a setting to help answer the research question of how engineering students learn the process of problem identification for community development.

The community that the students worked with had approximately 16,000 people, mostly Latino with some Vietnamese and Somali Bantu communities. The majority of the households in the community were family residences, with half of the families as renters. A significant portion of the community was children (37%) under the age of 18. Some of the main concerns of the community included safety and health issues. There were few street lights or sidewalks in the neighborhood, making pedestrian and bike travel unsafe. This community was also considered a food desert, meaning that the nearest grocery stores with fresh produce and meat were at least three miles away, which was why TI was focused mainly on access to healthy food and improved nutrition.

Our approach to studying learning was to observe and work with engineering students as they make sense of authentic engineering for development contexts that are "representative of situations likely to be encountered in professional practice" [7]. This marked a departure from traditional approaches to engineering education, which focused mostly on students' acquisition of abstract knowledge that is meant to be transferred to and applied in relevant contexts. This traditional approach has typically meant separating students from the real-world conditions in which they will eventually apply this knowledge [8]. More recently, researchers in engineering education have drawn on work originating in the learning sciences aimed at producing "usable" knowledge by situating learners in authentic contexts where abstractions of engineering sciences are not assumed to directly transfer across settings [9]. In engineering education, such authentic contexts have been developed through "problem based" and "project based" activities [10]. Among the advantages of such approaches are that students have greater opportunity to be mentored and practice aspects of engineering for development that are often missed in the "core curriculum" of traditional engineering education. Specifically, through "project based" engineering education, students work to:

- formulate and solve ill-defined problems under complex conditions;
- understand professional and ethical responsibilities associated with these complex conditions;
- communicate with other engineers and with non-engineering professionals and the general public; and
- develop their identities as engineers, through greater understanding of actual practices of engineering and enculturation into these practices [11, 12].

In this study, we explored the challenges students face as they worked to formulate and solve ill-defined problems in and with community members. The three emergent themes that are discussed in this paper reflect the advantages of "project based" engineering noted in the literature and align with the practices of development in engineering. We explored these challenges as students moved across contexts to make sense of a wider range of practices integral to becoming an engineer [6, 13].

[1] Pseudonyms are being used for community partner and student names to protect participant anonymity.

We view learning as changes in participation in a (changing) community of practice over time [14, 15]. This means that people gain knowledge, skills, and develop new dispositions toward activities in a community through their engagement in the valued practices of the community. Shifts might be observed in how people talk about problems, notice relevant dimensions of situations under study, engage with collaborators in working on problems, and use representational technologies to articulate and solve problems. For the SCD course, students were engaged in an authentic community appraisal with TI in order to learn the practices of the community of development engineering and we operationalize our theory by examining these four elements in student behavior and interviews.

Methods

In order to study learning as changes in participation over time we collected data that would allow us to see what students were being exposed to in class, how they interacted with the community (or TI), and how they reflected upon the similarities and differences in their experiences between those two contexts. Data collection included the conduct of student interviews, classroom observations, and participatory observation of community events. We relied on in-depth interview data to identify the tensions that emerged for students as they negotiated these under-developed skills associated with engineering for development [6, 13].We chose two students from the class of sixteen with whom we conducted in-depth ethnographic interviews, using a person-centered study approach [16]. Our analysis focused primarily on the in-depth interviews in order to identify tensions students negotiated as they learned how engineers approach engineering solutions with community members from marginalized communities. The interviews were conducted as part of a more comprehensive study of how people reorganize social futures in the local food movement. This research was part of a larger study aimed at improving engineering learning environments to promote citizenship and more effective engineers for development.

The two engineering students (Sally and Ryan) were chosen based on their educational backgrounds (social science and engineering, respectively), gender, high engagement level with the project, and interest in the aims of the course. We conducted the first interviews with Ryan and Sally mid-way through the first semester of class and followed-up with two more interviews after the end-of-semester presentations. Sally was enrolled in the masters of engineering program, but her undergraduate degree was in the social sciences. She was one of thirteen females in the course and was highly engaged in class, spoke up often, and took a leadership role in her group. Sally left her job as an elementary school teacher and came to the engineering program because she was "interested in other ways that people approach poverty internationally because I think there can be a lot to learn sort of from all sides of it…" Ryan had an engineering background and was one of three males in the class. He also volunteered to work with the local non-profit (TI) to enter survey data into a database for the resource-limited organization. Ryan came straight from an engineering undergrad and was drawn to this program, saying "I figured out that I don't want to do structures (structural engineering design on buildings/bridges) with my career, I want to do something broader, solve some more problems that affect more people." We chose these case study students to explore how two students with different backgrounds, but with high-engagement in the class grappled with the challenges of learning in a project-based setting.

At the point of the mid-term interviews, the students were deep in the collection of secondary data about the community, with only vague ideas of what social issues community members faced. Most of that information came from TI's website and one introductory meeting with members of the non-profit. By the end of the semester, students were able to visit at least two families in the community with TI staff members, in addition to more meetings with the TI staff. They had also submitted their community appraisal documents (a community appraisal report, problem identification, and preliminary proposed engineering solution) and given presentations in class where representatives from TI and other project partners were present and gave feedback. Through these interviews we explore how the students' relationship to the course project changed and how their understanding of the role of community engineers' became more nuanced overtime.

Analysis

Interviews were conducted by one member of the research team and focused on students' expectations for the course and their interactions with the community and partner NGO. The initial questions served as entry points to a discussion about the class and how the students took up and used ideas and practices they were learning into their work with the community. Students' responses were audio recorded and reviewed by the research team for emergent themes. The themes that emerged focused on the process of problem identification, specifically, moving from the understanding of problem identification in the classroom into the community, difficulties and limitations of partner collaboration, and challenges in identifying the final goals of the project, straddling the classroom-community divide. These three elements are discussed in detail in the following sections, drawing mainly from student interview excerpts.

Moving from abstract to situated understanding of problem identification

Taking the time to identify a community's needs is critical as it forms the foundation for the subsequent engineering design, implementation, and overall project success. Students working to formulate and solve ill-defined problems are one of the ideal practices of the community of engineering for development. Both students were direct about their confusion regarding the process of problem identification, in their experiences in the class and with the task of community appraisal in general. When asked about the process of problem identification, Sally explained:

> "I feel very much like I don't have necessarily a good idea of what exactly we're doing, but it seems like we have a partnership and the idea right now is that we are collecting data on TI and kind of all that's going on in [the community] to get a picture of what the community is like, and what the community needs are so that we, as a class, have a really clear understanding of what the problems are in the community, what the root of the problems are."

When Sally responded to the question to "describe the project as you understand it now," she responded first with the notion "that she feels very much like I don't have necessarily a good idea of what exactly we're doing". This opening sentence began with a strong expression of uncertainty. In the second half of the sentence, Sally indicated a reluctant trust in the class process. She suggested that "it seems like we have a partnership" and then established some structure to the process, saying "the idea right now is that we are collecting data". While the

overall process may have seemed vague and uncertain to Sally, she still strove to offer some answer to the question by talking about the more immediate task of data collection. She continued to label the intended purpose of that data collection as "to get a picture of what the community is like, and what the community needs are".

Because this interview was conducted before much field work had been done in the community, Sally's response was rooted in the view of community appraisal experienced in the classroom context. The first three 'stages' of the project design framework presented to the students are seen in her words: 1) Project Initiation ("we have a partnership"), 2) Holistic Appraisal ("collecting data"), and 3) Analysis and Synthesis ("to have a really clear understanding of what the problems are in the community"). She also drew from language used in class lectures, "roots of the problem," to name the objectives of the problem identification process.

Difficulty with the ill-defined nature of problem identification wasn't limited to Sally. She later talked about how members of her group were dealing with this "vague" approach in different ways, saying that some members just wanted to "get an understanding, make a decision, and move forward," while others felt the need to "keep talking about everything and see where it goes…" She said that this brought up some conflict in her group, struggling to respect people's time, while also giving due diligence to the process of understanding the community. Without being given clear objectives, or perhaps a clear direction, the students were left on their own to forge a path. Straying from traditional engineering problems in school, the community appraisal that was expected of them had few intermediate objectives and was mainly guided by the students.

As Sally gained more experiences working with the community partner, she began to express more and more that this level of uncertainty and the vague nature of the work was a factor of the community development process rather than the organization of the class. In one of the class sessions, each group was asked on the spot to share about their team visits with one of the TI staff members. Reflecting on this "mini presentation", Sally said that it started to clarify the process for her and her team about the process of problem identification, the open-ended nature of which often caused frustration in her group. She said,

> "Yeah, I mean I think I was feeling really frustrated earlier this week that we, like with the community appraisal and feeling like we didn't have a lot of direction in how we were supposed to do that. But the more… and so I thought about it and then kind of the presentation that we had [yesterday], I like the format in some ways because it's more realistic in terms of if you approached a community to work with them, it would be incredibly vague, like what you were supposed to do and who you were supposed to talk to and people wouldn't necessarily all be on board and you'd have to form new relationships, so I think in terms of building a set of skills to work with a low-income community to do development, this is incredibly helpful and very realistic in terms of what you would have to do. I think it's frustrating."

Her frustration was partially with the unexpectedness of the "mini presentation", but also with the more general feeling of not having direction in how to do community appraisal. She started

to then present a counterfactual, "but the more…" and then changed her thought to how the presentation in class exemplified the way she was beginning to gain clarity about the process. She was beginning to recognize that the lack of direction may in fact be "more realistic in terms of if you approached a community to work with them, it would be incredibly vague". At that point she seemed to see that the frustrations with the class, the lack of direction, mirrored the realities of community development work and the process of problem identification that she was experiencing when working in the community and with the community partner. Sally is gaining an understanding of the community of practice for development engineering. Sally's initial frustration and subsequent recognition that the process of problem identification is inherently unclear showed how she was learning the process of problem identification and how she was relating the abstract classroom experiences with her situated community based experiences.

Sally also spoke about how experiencing this uncertainty in the classroom caused her and her fellow students to be frustrated. In the traditional classroom, it was expected that you received directions regarding the process, the problem statement is given to you, and the work lies in the challenge of the solution. Sally talked about this saying that her and others' experiences outside of school were probably similar with respect to the uncertainty, "but I think in the context of it being a class, it (the uncertainty) feels weird,… people want to be given information and then you give the information back and that shows that you know it… and so I think [the students] are uncomfortable with the idea of like this open-endedness to it, even though that's much more realistic…" In this context, the challenge, rather than being in the solution, rested in the process of identifying a problem to introduce an engineering solution.

One goal of this graduate course design was to provide a repertoire of tools and strategies to guide the process of problem identification in community development. Some of these tools included problem and solution trees to map 'root causes' and subsequent 'branch results' of problems that emerged from the community appraisal and multi-criteria decision analysis matrixes to rank-order different design options. In both follow-up interviews, Ryan and Sally spoke about the benefits of having some framework to guide them. Ryan spoke about how "it was interesting to learn about all the tools" and how the tools were one of the main things he was going to take away from the course. He also spoke about how it was the work with TI that helped clarify for him how to use these tools to guide a community appraisal. Sally spoke more about moving past ideas of a structured process leading towards a singular solution, to acknowledging the collection of tools as guides. When describing how her understanding had changed towards community development, Sally's responded,

> "I think it's changed because now in my head I have a more formal process of what to go through, because I'd sort of approached it as 'you talk to people, and then there's things, and then something happens, and it's like really vague.' So I feel like this has given me a very clear set of things you could do. And not necessarily like one you have to do over the other, but just options of how you could come to the solution in like a very systematic way."

When Sally talked about her understanding, she now spoke about how the tools of the class had given her focus through the process. She drew from the comfort in having a "systematic way" to do community appraisals, but at the same time she acknowledged the flexibility needed when she

says "not necessarily like one you have to do over the other, but just options of how you could come to a solution." In the first line of her response she also drew a contrast to her initial perspective which was rooted in the vagueness of the process – "you talk to people, and then there's things, and then something happens." Here Sally not only pointed out that her perspective had changed through the class, but she also intimated what her original perspective was.

In her follow up interview, Sally spoke a lot about the importance of going through the process of problem identification with the community before coming up with possible solutions. She said,

> "I feel like I learned a lot about the process of developing a project through community efforts as opposed to just deciding on a project and then coming in and doing it… It was really nice to get an idea of what that process is like, and how to come up with solutions, really think about everything you could possibly do and throw some stuff out and bring other stuff in, and really discuss and collaborate with people. And I feel like I learned about, just like that beginning process of like starting something for engineering. Like how that…what are all the pieces you need to start thinking about? And who are the people you're going to affect? So it's interesting to think about, kind of all the pieces coming together like that. So I think I learned a lot about that."

When Sally said "it was really nice to get an idea of what that process is like", she addressed how beneficial it was to apply the abstract ideas of problem identification ("it") to the community, moving to a situated form of knowledge ("what that process is like"). She continued to talk about an ideal situation where data would be collected and brought to the community, where they would give input and the project team would take that feedback and re-work the hypothesis, continuing this cycle until the team had a more comprehensive understanding of the community and the issues they faced. She engaged in the practice of moving between the classroom and the community contexts, reorganizing knowledge from one into the other in a cyclical, informative manner. She also recognized how she was limited by the context of a class project to do this in the full, ideal way.

She also indicated that she valued the collaborative and cyclical nature of the process later in the interview, talking about the importance of "community buy-in", "being able to meet with the community", and laying out the ideal process of getting feedback, re-working the issues, and coming back to the community until they reach consensus. Her original view was to "get an understanding, make a decision, and move forward," but her experiences working within the complexity of a real community helped her to recognize the need for an iterative process, rooted in an authentic collaborative relationship with the community.

Partner Collaboration

In this process of community appraisal both Ryan and Sally spoke about the difficulty of establishing and defining the relationship with the community partner and community members. Within the classroom context, a collaborative partnership with a wide view of stakeholders was strongly emphasized as is common in the community of practice. Many methods were discussed

to gain insight from the community partners, such as focus groups, community mapping sessions, interviews, or surveys. It was also emphasized to think about minority or underrepresented groups within the community and how to get their perspectives for a more complete appraisal.

The design of the class project, however, was different. The partner organization, TI, was used, generally, as a proxy for the community as a buffered connection between the community members and the students as they learned: all interactions with community members were coordinated through and attended by TI staff members. The reasons for this setup were discussed with students, but it still created a complex situation for students to cross between the messages in the course and their experiences in the community. The interviews showed that this limited the authenticity of the students' engagement in community development because they were forced to go through TI and to see the community problems mainly through the lens of TI.

When talking about the difficulty of gathering data, Ryan said "we've (his group) talked about not imposing too much on [the community], not going door to door…, we've been focusing on getting the secondary data at this point." In an attempt to gain better knowledge about TI, Ryan offered to volunteer with them outside of class time. He took this initiative himself, seeing it as an opportunity to learn more about the organization and to connect better with them, with the idea that it would empower him and his group to have a better product, but also to try to contribute something tangible to TI since they were "bending over backwards for us…" TI only took advantage of Ryan's offer for some data entry, and it never developed into a more significant form of community involvement. This was due less to Ryan's interest and perhaps due more to the organization and needs of the community partner.

In the follow-up interview, Ryan talked more about being unclear about the boundaries in community work. He said,

> "I mean I was surprised with [the instructor's] interactions with TI when we were there. I didn't expect him to ask questions that he did. Because we have all these ideas of how to interact properly with an NGO and a community, and then you kind of end up there in the spot and you break a lot of the rules that you learned from the various materials that we had."

Here Ryan talked about the struggle between what was learning in the classroom from reading textbooks, articles, and case studies, and what really happened when in the field. While Ryan didn't provide any specifics about what was surprising or what questions were unexpected, simply his comparison between what happens "there in the spot" versus "the rules that you learned" showed that he was working to translate classroom information into action, and that the translation was not always one-to-one.

Managing Course and Community Goals

Given the emergent nature of the SCD course project, end goals were not known a priori and were instead developed through the community appraisal. This created a complex situation where students (and instructors) were constantly trying to balance the course requirements, community needs, and feasibility of different engineering solutions. This balancing challenged

the authentic practice of problem identification, limited by traditional course schedules (semester system) and expectations (presentations, papers, and reports).

Both Ryan and Sally were asked to talk about project goals in terms of how they would define project success. In his first interview, Ryan tended to apply more traditional school metrics of success and goals to the project. He said that "a successful project is going to complete all the appraisal objectives that [the instructor] has put forward for TI, so a successful project would be a good appraisal." Ryan struggled however to see how producing "a good appraisal" would translate into real, positive affects in the community. When asked if he thought that they would be able to help in the community, he expressed doubt saying,

> "I don't know how our class is going to help. I know, so we're doing the appraisal, at least this semester, we're doing the appraisal of TI, so we'll give TI more information and see if they can use it or not. I don't know how much help we're going to provide through our class."

Ryan seemed unsure as to whether the class's efforts would benefit the community, saying multiple times that it wasn't clear how they would help. When pushed a little more regarding how the class will be able to help the community, he elaborated,

> "I don't know, it depends on the direction that it goes. I mean, if we're just going down and collecting information and write a report and present it to [the instructor] and TI, then and we give TI more information which is good, more information is better, but whether or not they use it, that makes a difference for whether or not we help [the community], so… if we provide information to TI, we're not directly helping [the community], we're helping TI which could then maybe help TI help [the community] more."

Here again Ryan was wrestling with the real limitations that exist because this was a project within the context of a class. In the classroom context, writing a report is a traditionally acceptable final product, but when Ryan tried to translate that result into the community, he found it difficult to see how it would benefit the community other than by giving them more information. His phrasing, specifically his use of the model verb "could" and "whether or not" to suggest alternative possibilities, indicated that he was not completely comfortable with it. These issues of how the results of the course-based service project will affect the community are not isolated to Ryan's struggles and are a continuing concern for project-based service learning in engineering [17].

Sally spoke more broadly of a vision of success, going beyond the requirement of the course to the actual project and its long-term effects on the community. She defined success for this first semester as "hav[ing] a better picture of kind of who's in the community, what they community needs are, and hav[ing] a better understanding of kind of where the root causes of all these issues are coming from." She never talked about reports, or fulfilling the instructor's requests, instead her view of the project had gone beyond the bounds of the classroom, and her definition of success was more project-focused, than classroom-focused

In the mid-term interview, as Sally worked more and more through the process of data collection towards informed problem identification, her words migrated towards a more complex view of the process and the end results. In the beginning Sally talked about working towards "a clear idea of what the issues are", suggesting that there was one clear vision or perspective on the issues affecting this complex community and, moreover, that such a vision can be obtained in three short months by an outsider. Later, when describing her vision of success further, she expanded her ideas of what was obtainable, using "a better understanding" when talking about their gained knowledge of the community. She said that they hoped to have "a better picture", deviating from her earlier language of "clear idea", suggesting that she was beginning to recognize the nuances and difficulties in community appraisals. Furthermore, she said that a validation of their appraisal would best come from community members, who would see their assessment and say "yeah that seems like an accurate assessment of what we need and what's going on", acknowledging that their approval may only be "for the most part." She acknowledged that the students' outsider perspective and limited time frame would probably not allow them to gain a "clear picture" and that even what they would produce would only be partially accurate to a community member. This perspective aligned well with the objectives of the course of viewing the community partner as an essential component in the process, not just as "beneficiaries". It also spoke to how Sally was able to reorganize the course expectations of having solid deliverables (reports and presentations) into the community context where the iterative process with the community members would be needed to reach the final goals.

How these elements were realized in the class project

It is telling to note how these three elements played into the final problems that the student teams identified. Through interviews with community members and TI staff, and using the tools presented in class, Sally's team came to community safety as a "root problem" that was critical for the community. They switched their focus to home insulation, however, because they felt limited in their ability to address the issues of community safety due to time restrictions of working within the semester and funding. Home insulation aligned better with how TI wanted to work in the community, but fell fourth on the list of community needs that the teams created earlier. They used class concepts to reach their list of community needs, but the limitations of the course goals (and capacity) forced them to change their focus from community safety. They changed to home insulation because of the influence of the community partner (TI), and desiring to provide useful information to them.

Conclusion

The SCD course design pushed students to work between two different contexts, the classroom and the community, where they would need to reorganize knowledge from one to the other. By focusing on how two students crossed these boundaries and engaged in the practices of the engineering for development community, we examined the learning that happened with respect to community appraisals, specifically, and engineering for community development more generally. This case study allowed us to see, in-depth, the ways in which two students struggled through this process. Students were seen to engage in practices of engineering for development through how they talked about problems, engaged with collaborators, and used course tools to articulate and solve issues in problem identification.

The course design was able to create authentic experiences for students with respect to situated experiences of problem identification. It also, however, created limitations to that authenticity by using a proxy to the community in TI, and by falling within academic norms of term limits and course deliverables. The two students that we studied exemplified learning with respect to the process of problem identification by how they reorganized the abstract knowledge from the classroom into the situated knowledge in the community, participated in community partner collaboration, and managed course and community goals. This type of course is a new emerging field in which studies of learning have not been conducted. This paper explored that learning process by looking at two students carefully and has set the stage for future exploration into how to develop effective engineers for development.

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