AC 2011-795: PROJECT-BASED SERVICE LEARNING AND STUDENT MOTIVATION

Lauren A Rockenbaugh, University of Colorado, Boulder

Lauren Rockenbaugh is a PhD student at the University of Colorado at Boulder. Her research involves project-based service learning and student motivation. Lauren is also the co-director of Engineering for American Communities, a multidisciplinary engineering student organization whose mission is to perform entrepreneurial engineering design work to create affordable living innovations for people in need in local communities.

Daria A Kotys-Schwartz, University of Colorado, Boulder

DARIA KOTYS-SCHWARTZ is the Faculty Director for the Mesa State College-University of Colorado Mechanical Engineering Partnership Program and an Instructor in the Department of Mechanical Engineering at the University of Colorado Boulder. She received BS and MS degrees in Mechanical Engineering from The Ohio State University and a PhD in Mechanical Engineering from the University of Colorado Boulder. Dr. Kotys-Schwartz has focused her research in engineering epistemology, engineering student learning, retention and diversity. She is currently investigating the use of Oral Discourse Method for conceptual development in engineering, the impact of a four-year hands-on design curriculum in engineering, the effects of service learning in engineering education, and informal learning in engineering.

Derek T Reamon, University of Colorado, Boulder

DEREK REAMON is Co-Director of the Integrated Teaching and Learning Program, and a Senior Instructor in the Department of Mechanical Engineering at the University of Colorado Boulder. He received his PhD in Educational Interface Design from Stanford University and has won numerous outstanding teaching awards. Dr. Reamon's research interests encompass the foundations of educational theory, the practical issues involved in curricular improvement, and the assessment techniques required to measure the effectiveness of new methods.

Project-Based Service-Learning and Student Motivation

Abstract

We know from motivation theory that enhanced motivation in students is positively correlated with engagement and active learning, interest, and value. We know less about the types of instructional strategies and curricular interventions that work to enhance student motivation in a typical engineering course. Grounded in motivation theory, the purpose of this research is to evaluate how the context of project-based service-learning affects aspects of student motivation (particularly interest and engagement) in a required undergraduate Mechanical Engineering course.

Our research aims to answer: 1) How does project-based service learning affect students' motivation as compared to conventional (non-service) project-based learning? 2) Do students find the context of project-based service-learning more interesting and/or valuable than conventional project-based learning? 3) How does project-based service-learning affect student engagement in the course as compared to conventional project-based learning?

The research, which began in 2009, is being completed over a three-year period. The students and activities in Component Design, an existing junior-level course, will serve as the research focus. Specifically, project-based service-learning curriculum will be implemented into a required design and build activity for Component Design students. Using a conventional design project as the control, how the context of project-based service learning affects aspects of student motivation will be studied. A mixed-methods assessment strategy will be employed: quantitative data from pre- and post- project surveys and shorter surveys administered during the semester will be combined with qualitative data from student interviews and focus groups.

This paper will discuss the research design, theoretical framework, and the results of a pilot survey administered in February 2010.

Introduction

Part of the theoretical framework for this research includes project-based service-learning (PBSL). PBSL is a form of active learning where students work on projects that benefit a real community or client while obtaining a rich learning experience (Duffy, et al., 2009). Many engineering educators are embracing alternative instructional strategies like PBSL in an attempt to respond to major shifts in the engineering profession and practice. Today's world is a global market and a place of rapid technological change. Newly graduated engineers often find themselves working in teams with people very different from themselves, where they must engage in more entrepreneurship and integrative thinking.

Although PBSL opportunities are expanding at educational institutions nationwide, much of the findings on their impacts are anecdotal and qualitative. Some faculty have begun to assess PBSL programs and have found that PBSL does, in fact, cultivate stronger learning outcomes, entrepreneurship, cultural awareness, and community-mindedness. However, comprehensive and rigorous assessment methods have not yet been implemented (Bielefeldt, et al., 2008). Also, given that the number of students participating in PBSL activities may be small or unrepresentative of the undergraduate engineering student population at large, it is difficult to draw conclusions that can be generalized about this promising instructional strategy.

One example of incorporating PBSL into engineering curriculum is the *SLICE* (*Service-Learning Integrated throughout the College of Engineering)* program at UMass Lowell, where all engineering students are exposed to service-learning in every semester (Duffy, et al., 2009). Extracurricular programs like *Engineers Without Borders*, *Engineers for a Sustainable World*, and *Engineering World Health* provide other opportunities for engineering students to participate in PBSL while providing a direct benefit to a target community – most often a developing or underdeveloped community outside the U.S.

A drawback to these extracurricular programs is that participation is difficult for many engineering students and faculty. Barriers to participation include cost and time of travel, difficulty in operating and maintaining projects, and language and cultural differences that must be understood before any design work can begin. Because it is typically easier for students and faculty to become involved with local communities, implementing PBSL into existing university courses makes the benefits of this instructional strategy immediately accessible to a broader audience. We have our own communities in need within the U.S., so it makes sense to apply our resources to help communities close to home. In either case, the benefits of PBSL should be similar.

One of the main differences between project-based service-learning and conventional project-based learning is the addition of a community as a full partner. This added authenticity adds "real world complexity", causing the project outcomes to be less defined initially (Bielefeldt, et al., 2008). This challenges students to "use their functional skills related to technology along with their critical thinking and interpersonal skills to gain an understanding of the problems they must solve in their projects" (Brescia, et al., 2009). The integration of technical skills to dynamic environments challenges students to immediately apply and make sense of what they have learned in the classroom. This process has shown to promote four areas of outcome, including personal efficacy, awareness of the surrounding environment, personal value identification, and a greater engagement with the learning content (Astin, et al., 2000).

Now let's turn to motivation theory – the second leg of the theoretical framework for this research. Motivation is a theoretical construct to explain the reason or reasons we engage in a particular behavior (Barkley, 2010). According to Brophy, students enter a "state" of motivation to learn when their engagement in a particular activity is guided by the intention of acquiring the knowledge or mastering the skill that the activity is designed to teach. Motivation, then, is so highly valued because it *produces*. Hence, it is of paramount concern to educators, who are constantly tasked with inducing students to learn, perform, and persist. Fortunately, educators need not resign themselves to the role of passive observers to students' motivational patterns. In fact, educators can be active socialization agents capable of stimulating the general development of student motivation and its activation in particular situations (Brophy, 1987). What is the connection between PBSL and student motivation? That, in a nutshell, is the driving question behind this study. Assessing the impact of *any* new instructional strategy on student motivation is a worthwhile endeavor.

According to self-determination theory, people at their best have an innate inclination toward mastery, spontaneous interest, exploration, and curiosity. This "intrinsic motivation", which is a type of motivation characterized by doing an activity for the inherent satisfaction of the activity itself, seems to be part of human nature. However, intrinsic motivation requires supportive conditions to persist (Ryan and Deci, 2000). Other theories emphasize different (although related) conditions that support or thwart motivation. But, in general, supportive conditions can include a person's feelings of autonomy, relatedness, and competence, accompanied by a sense of interest and value. Hence, we see that motivation is not a single construct; rather, it is a synthesis of many constructs. The table below presents several of these constructs and their relationship to the learning context of PBSL, where some of these motivation constructs seem to emerge naturally.

Table 1: Connections between motivation and PBSL

Constructs of Motivation	**Characteristics of PBSL**
Autonomy: characterized by choice, acknowledgement of feelings, and opportunities for self-direction. A sense that one's actions are self-determined, or self-authored (Ryan and Deci, 2000).	As opposed to more traditional engineering projects that often spell out the design challenge and much of the required solution (i.e. "design a spring-powered machine to launch a tennis ball 50 yards"), PBSL is inherently more open-ended due to the "real-world" context. That there may be a number of feasible solutions to a service-learning project gives students greater freedom to pursue a design solution that resonates with their skills and interests, hence directing their own learning.
Relatedness: caring for and being cared for by others,	Preliminary research carried out by the authors showed that most students felt somewhat a part of their university community but

having a sense of belongingness , both with other individuals, and one's own community (Deci and Ryan, 2002).	very little a part of a greater community. PBSL can help students see that their engineering talent is an essential aspect to improving people's quality of life in the greater community, hence enhancing feelings of relatedness.
Competence: feeling effective in one's interactions with the social environment and experiencing opportunities to exercise and express one's capacities (Deci and Ryan, 2002).	PBSL requires a breadth of skills, including non-technical engineering skills (i.e. the ability to work with a client, the ability to present ideas to a non-technical audience) that may not be emphasized in traditional engineering projects. This gives students with strong non-technical skills (those who may take the back seat in traditional engineering group projects) the opportunity to further develop and demonstrate their competence. At the same time, PBSL can be just as technical as traditional engineering projects to ensure students with stronger technical skills will also feel effective.
Value: the belief that the learning task is relevant to satisfying personal goals (Vanasupa, et al., 2009).	Engineering students, like any other subset of people, have diverse personal goals. For example, preliminary research by the authors determined that many students who expressed the desire to pursue a career in engineering also expressed anxiety about not having adequate "real-world" engineering experience. It may be reasonable to assume that students who participate in PBSL would then value its authenticity. Also, there may be other aspects of PBSL that are valuable – students may value PBSL simply because it provides greater autonomy or relatedness.
Interest: directly influences the desire to gain knowledge about a domain (Renninger, 2000). Interest can deepen if environmental factors promote the development of meaning and value (Harackiewicz., et al., 2009).	Similar to values, engineering students have diverse interests. Preliminary research by the authors also showed that many students are interested in engineering pursuits such as working as an engineer for non-profit organizations, designing assistive technology devices, and participating in organizations such as *Engineers Without Borders*. If it resonates with their interests, infusing PBSL into Mechanical Engineering curriculum may motivate a greater number of students to gain additional domain knowledge.

It is important to note that there are many different motivation theories, and the table above is a brief overview of the motivation theories that are most relevant for this particular research study. It is also important to note that the relationships presented between motivation and PBSL have not yet been verified (at least not by these authors). The hypotheses above are based on existing literature on motivation theory, literature on PBSL, and the authors' own experiences with

PBSL. Evaluating the correlations between these motivational constructs and PBSL is a goal of this research.

Student motivation to learn is also tied to student engagement in the learning process. Similar to motivation, the term "engagement" has been defined in many different ways. According to Barkley, students who are engaged in the learning process "really care about what they're learning; they want to learn" and they "exceed expectations and go beyond what is required". These statements about engagement reflect a view of engagement that is rooted in motivation. Barkley also describes student engagement with statements like "engaged students are trying to make meaning of what they are learning" and "engaged students are involved in the academic task at hand and are using higher-order thinking skills such as analyzing information or solving problems" (Barkley, 2010). These statements relate engagement to "active learning", which takes place when students are engaged in thinking tasks such as analysis, synthesis, and evaluation. Students are doing things and thinking about what they are doing (Bonwell and Eison, 1991). Active learning can be facilitated by collaborative learning, undergraduate research, and problem-based learning activities (Edgerton, 1997).

Essentially, student engagement is a product of motivation *and* active learning. The contexts of project-based learning and project-based service-learning fulfill the active learning portion of this relationship. However, before we can determine whether PBSL has an impact on student engagement, we must evaluate the extent to which PBSL affects student motivation to learn.

Research Setting

This research is being carried out at a public university in the Rocky Mountain region. The research subjects are junior-level students in a required Mechanical Engineering course – Component Design. A major aspect of the course is an eight-week design project that all students are required to complete in teams of five. In spring 2010, the control group participated in a conventional project-based learning (PBL) by completing a more traditional engineering project – to design, construct, and test a machine to launch a baseball through the uprights of a standard field goal post. In spring 2012, the treatment group will participate in PBSL by completing a service-learning engineering project – to design and build agricultural tools for developing communities.

Methods

A pre-project survey was piloted in February 2010 to determine a baseline for Component Design students' attitudes toward engineering as a practice and profession, attitudes toward service-learning and community, sense of belonging in engineering and "seeing" themselves as engineers, confidence in technical skills specific to Component Design and non-technical skills including teamwork, communication, and technical writing. All of the students in the course were required to complete the survey for a portion of their homework grade. The 21-question survey was administered halfway through the semester, one week before the students began the conventional design and build activity in Component Design.

The survey was designed using a "mixed-methods" approach, defined as follows:

> A mixed methods study involves the collection or analysis of both quantitative and/or qualitative data in a single study in which the data are collected concurrently or sequentially, are given a priority, and involve the integration of the data at one or more stages in the process of research (Creswell, 2007).

Quantitative Methods

Seven of the survey questions required students to either rate a series of statements about engineering and society, service learning, and career values, or to rank themselves according to a given list of engineering skills, abilities, and concepts. Eleven questions were used to obtain information including: demographics, how often students work, volunteer, participate in engineering and non-engineering activities, and the level of commitment students have toward completing an engineering degree and pursuing an engineering career.

Because the primary purpose of the pre-project survey was to gather preliminary information about the sample population, a basic statistical analysis was performed. For each question, the mean and standard deviation were determined. The magnitude of the standard deviation was used to check whether the corresponding mean was the appropriate descriptive statistic to report. A normal distribution was assumed for each question, and a standard deviation of less than one indicated a normal amount of variability in students' responses. There were some questions for which the standard deviation was greater than one, indicating that future qualitative research may be needed to understand why such variability occurred for these particular questions.

Qualitative Methods

Three of the questions were open-ended and were used to gather qualitative data about how students "see" themselves as engineers, whether they feel like they "belong" in engineering, and the degree to which they feel like part of a community. Once the students' responses were collected, we carefully read through each one and generated several descriptive categories (different for each question) based on the general patterns present. We strove to examine the data without preconceptions to allow themes and categories to emerge naturally. Next, three people (unaffiliated with the research project) were asked to review the questions and rate each response according to the category that best described the response. The first rater is a political researcher whose research focuses on renewable energy. The second rater is a social worker. The third rater is a licensed Mechanical Engineer. We also completed this process of rating each student response according to the chosen descriptive categories. Last, for each question, we found the percentage of students that fell in each descriptive category.

Preliminary Results

The results of the pilot survey analysis prompted the authors to more directly focus the research on motivation and engagement. It became apparent that by their junior year, most engineering students have become adept at learning (although often quite perfunctory) any material put before them, even if they are miserable in the process. What is highly variable, and what *can* be affected, is student motivation and engagement. What follows are the relevant results of the pilot survey and the connections to PBSL.

Quantitative Results

A little less than half of the Component Design students (n = 108) surveyed in 2010 did not have a job during the school year, nor did they volunteer their time (for example, judging a science fair, helping at a sporting event, working at a campus event, etc.) Based on the qualitative data received (especially responses to the question "Do you feel like you are part of a community?") it is reasonable to assume that school consumed the majority of students' time and energy, leaving little for outside jobs, volunteering, and community involvement.

At the same time, although many students reported having little time for anything other than "sleeping and studying", nearly 75% of students reported moderate to extensive involvement in non-engineering curricular activities such as sports, hobbies, fraternity, sorority, civic, church or campus groups. Of course, many students need these recreational activities to stay well-rounded. Hence, the reality may be that students *do* have free time but do not want to spend it doing things that aren't enjoyable, or doing things that seem too much like what they do in the classroom. This could explain why almost 80% of students reported little to no involvement in extracurricular engineering activities such as engineering clubs or societies. If students were presented with more interesting or valuable extracurricular engineering activities, participation might increase.

There was quite a significant gap between students' certainty about completing their engineering degree (~90%) and certainty about pursuing an engineering career (~40%). This is another instance in which the qualitative data was used to offer possible explanations. Students' statements to the questions "Do you see yourself as a Mechanical Engineer?" and "Do you feel like you belong in engineering?" indicate that many students are: uncertain that they know what engineers do in the real world, concerned about their level of real hands-on design/build experience, fearful of becoming a "cubicle engineer", and worried that an engineering career may be too stressful or lead to an unhappy life. It is reasonable to assume that giving students more opportunities to participate in authentic design experiences would lessen students' trepidation about entering the engineering workplace. At this point, no conclusions have been made about which type of project-based learning (service-learning or conventional) may boost student confidence about pursuing an engineering career. However, a reasonable guess is that the best context would match students' top-rated career values, which were challenge, creativity, variety, and service.

When presented with a set of non-technical skills and abilities, students rated all five of these skills and abilities between important and crucial for "becoming a successful engineer". Clearly, most students recognize the importance of developing non-technical engineering skills in addition to technical skills. The two skills that students thought were the most important to becoming a successful engineer were *also* the two skills in which students felt the least confident. These two skills were "ability to identify the needs of a community client" and "ability to apply engineering analysis to real world problems." To help students feel more confident about their own ability to succeed in engineering, perhaps they should be presented with more opportunities to strengthen these essential non-technical skills. The next question is, of course, is PBSL an effective vehicle to teach these non-technical skills?

Students seemed to have a positive attitude, or at least a moderate degree of open-mindedness, toward service and community. About 30% of the students thought that academic coursework and community service learning should be combined, and 60% thought that it might be appropriate, depending on the class.

Qualitative Results

How Students "See" Themselves as Mechanical Engineers

The first open-ended question presented to the students was "Do you see yourself as a Mechanical Engineer?" There were a wide variety of responses to this question; however, most responses tended to fall in one of the six categories described in Table 2. Table 3 presents actual student responses that typify each category.

Table 2: Categories for Question "Do you see yourself as a Mechanical Engineer?"

Engineer at Heart: This student is always "thinking engineering" (for instance, this student often finds herself analyzing real life engineering situations). This student seems confident that she possesses the skills essential to engineering (problem solving, design, creativity, etc.). She seems to have a genuine passion for engineering, and she clearly identifies with engineering.
Career Engineer: This student seems to enjoy certain aspects of engineering, but engineering may not be his dominant way of thinking. Although he may picture his own career in engineering, he may not fully "see" himself as an engineer. Mainly, he describes the way he "sees" himself as an engineer in terms of engineering career goals and academic achievements

(for instance, "my goal is to work as a biomedical engineer" or "I think I could have a great career as an engineer").
Engineer in Training: This student is still not sure if she really "sees" herself as an engineer. She may still feel confused about what engineering is, or she may feel unsure about whether she possesses the skills needed to be an engineer. Still, she may express a desire to hone her engineering skills or to obtain more experience.
Better than the Alternative: This student "sees" herself as an engineer mainly because she can't really picture doing anything else. However, she doesn't describe what it IS about engineering that does (or doesn't) make her see herself as an engineer.
Undecided: This student may like Mechanical Engineering, but seems to want to pursue a non-engineering career. He is still "weighing his options". He is unsure whether he sees himself as an engineer in any capacity.
Not Interested: This student is not very motivated by engineering. He may feel like engineering is too difficult or that it will not make him happy in the long run. He clearly sees himself as a "non-engineer".

Table 3: Example Responses to "Do you see yourself as a Mechanical Engineer?"

Engineer at Heart	"Yes. At this point I feel that I think and see everything in an engineering sense." "Yes. I enjoy design and thinking of how things work mechanically."
Career Engineer	"Yes. It is a broad degree that can be applied to many areas of science that I am interested in: biomedical and renewable energy." "Yes, well hopefully in the field of Biomedical Engineering."
Engineer in Training	"Not yet. I don't have the ability to engineer things correctly at this point in time." "Not yet. I see myself as a student of the profession."
Better than the Alternative	"Sure."
Undecided	"I'm not sure. I believe that I am a good engineer, but looking back, I'm not sure mechanical was the best choice." "I don't know. I am very interested in the artistic things in life, and if I find a career in Mechanical Engineering that offers me the satisfaction of being artistic, then yes, I will follow engineering through. It all depends on what the 'real world' ends up being like."
Not Interested	"No. It's just not fun anymore" "No. I've hardly had to engineer anything in my education. I have, however, learned some really sweet formulas."

Figure 1 presents the results. The “no majority” category was added after the analysis to deal with the fact that, for some responses, there was no majority. In other words, each of the raters either gave that particular response a different rating or there was a tie between ratings.

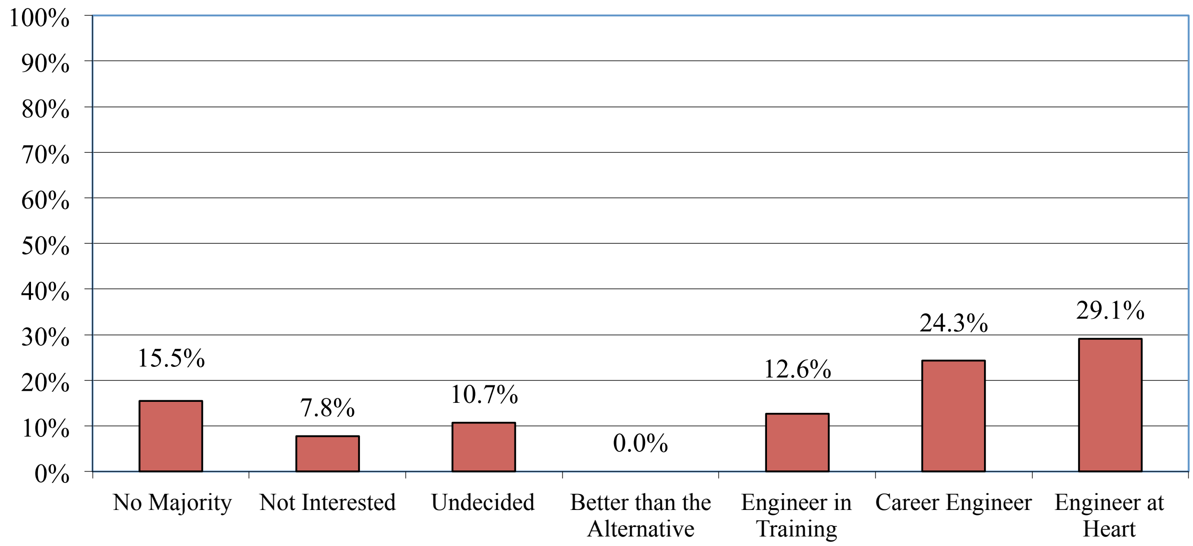

Figure 1: Results for question “Do you see yourself as a Mechanical Engineer?

It is encouraging to see that more than half of the students fell in the “Career Engineer” or “Engineer at Heart” category. It will be interesting to explore whether a “conventional” vs. a service-learning context affects the way the remaining half of the students “see” themselves as engineers.

Students’ Sense of Community

The second open-ended question posed to students was “Do you feel like you are part of a community? Please explain.” The responses generally fell into one of the four categories described in Table 4.

Table 4: Categories for Question: “Do you feel like you are part of a community?

Engineering Community: This student feels like she is part of the engineering school community. Her community is comprised of her fellow engineering peers, her courses, and the experiences she shares with other engineering students. She may express involvement in other aspects of community as well; however, she explicitly describes engineering as part of her community.
Beyond Engineering Community: This student finds community outside engineering school. For example - sports, church group, student organization, etc. Although his community exists

outside of engineering, this student still feels like part of a community.	
Partial Sense of Community: This student feels a partial sense of community. She may express wanting more involvement with community but has constraints (time, school, etc.)	
No Community: This student feels minimally connected to any type of community.	

Table 5: Example Responses to Question: “Do you feel like you are part of a community?”

Engineering Community	“Yes, a community of students that attend University of [X] and a smaller community of engineers.” “Yes. I feel like I am part of an engineering family.”
Beyond Engineering Community	“I am part of the varsity volleyball program. I feel more a part of the athletics community than the engineering community.” “Yes. I am a volunteer at Radio [X] and an Eagle Scout.”
Partial Sense of Community	“Yes. I take care of the people who live here during my job. As an engineer I do not feel part of this community.” “Not during the school year. My course load prevents me from doing anything other than homework, studying, etc. When I go home for summer, I am very involved with my community because I have time to be.”
No Community	“No. I’m too busy to volunteer my time. It would cost me more than it would benefit.” “No. Between engineering and work, there isn’t time to do anything else.”

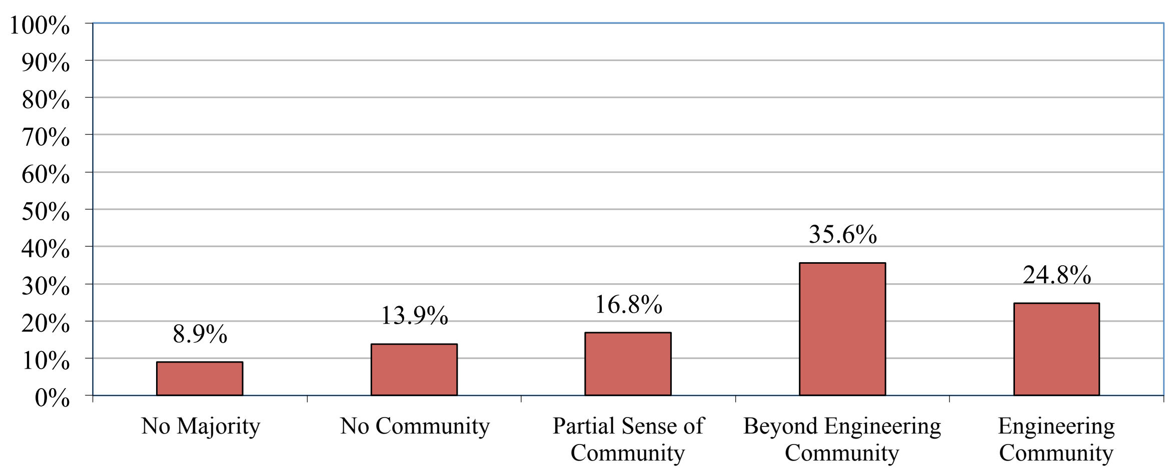

Figure 2: Results for question: “Do you feel like you are part of a community?”

As Figure 2 shows, most students do feel that they are part of some sort of community. However, only a quarter of students identified engineering as part of their community. One might expect that, because undergraduate engineering curriculum is so rigorous and time-consuming, a greater percentage of students would identify the engineering program and their engineering peers as a more significant part of their community. Because its purpose was to gather baseline information, this particular survey did not gather information about *why* students did or did not identify engineering as part of their community. Moving forward, it will be interesting to explore how students' identification with community changes after a service-learning experience.

Students' Sense of Belonging in Engineering

The last open-ended question posed to students was "Do you feel like you belong in engineering?" The categories for rating the students' responses to this question are presented in Table 6, and example student responses are presented in Table 7.

Table 6: Categories for question: "Do you feel like you belong in engineering?"

Engineer at Heart: Engineering is this student's calling. Doing engineering feels good, it resonates with who this student is as a person, and it suits her lifestyle. She has a passion for engineering.
Career Engineer: This student enjoys the coursework but still relates to engineering in terms of a career, rather than a way of looking at or being in at the world. Mainly, he describes the way he sees himself as an engineer or belongs in engineering in terms of engineering career goals and academic achievements.
Engineer in Training: This student feels confident with some but not all engineering skills and concepts. This student may feel like only part of himself "belongs" in engineering; however, something indicates that this student is progressing toward a deeper feeling of belonging in engineering.
Better than the Alternative: This student may see himself as an engineer because he can't really picture doing anything else. However, there doesn't seem to be a particular type of engineering or part of engineering that really motivates this student (for instance, a student who simply responds "yes" to the question).
Undecided: This student is concerned about her engineering skill level (for instance, she may express hesitation about applying engineering analysis to real-world problems). She may also worry that engineering will not lead to a happy life - she may feel like her interests are very different than a "typical" engineer's interests, and this makes her feel like an outsider. She expresses uncertainty about belonging in engineering.
Not my Home: This student lacks confidence that he will make a successful engineer. Engineering may make him unhappy. He may feel like the material is too difficult and that he is "behind" his peers. Overall, the student doesn't feel like he belongs in engineering.

Table 7: Example responses to question: "Do you feel like you belong in engineering?"

Engineer at Heart	"Yes. I have known for many years that engineering is my calling. I enjoy it, and I am good at it. I am proud of my engineering accomplishments, and I couldn't see myself doing anything else." "Yes. I am always thinking engineering."
Career Engineering	"Yes, I feel like engineering challenges me and is something I would love to do as a career." "Yes. It seems to fit me better than any other major/occupation – at least for practical purposes."
Engineer in Training	"I feel like I belong in some aspects of engineering – that which involves solving technical problems and critical thinking. I do have a feeling of disconnect from what I am actually doing at times (ex. designing something which I do not understand the purpose or basic principles behind).
Better than the Alternative	"Sure." "Why else would I be here?"
Undecided	"I don't know. I enjoy designing and building things, but if a professional engineering workload is this, I wouldn't be able to do it." " I am still deciding that. I feel as though I could find success in engineering, but I do not know yet if I 'belong' in it."
Not my Home	"Absolutely not. I am finishing so I can move on to something else." "Not as much anymore. I don't enjoy the material like I used to. I don't see myself being happy as an engineer."

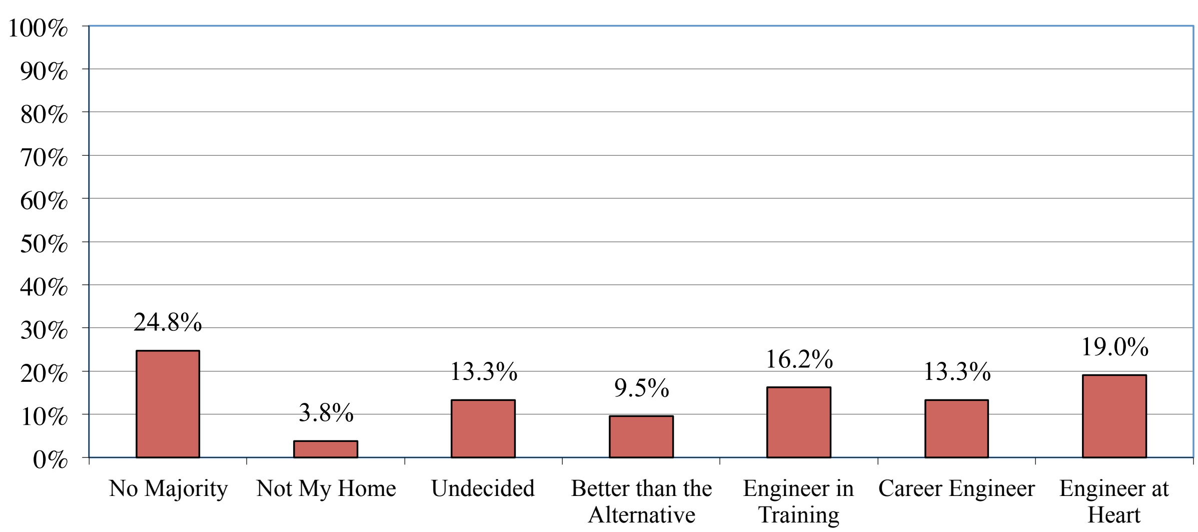

Figure 3: Results for question "Do you feel like you belong in engineering?"

As seen in Figure 3, students are distributed moderately across all categories. Out of all three open-ended questions, this question resulted in the greatest percentage of students in the "no majority" category. Students' responses tended to be slightly longer and more contemplative for this question as compared to the other two – this may have made it more difficult for the raters to assign a single category to each response. Or, the categories may not have reflected the general patterns found in students' responses as well as expected.

In any case, this data does indicate that, overall, students have mixed feelings about "belonging" in engineering. This particular question elicited the greatest amount of hesitation, uncertainty, and even concern about the future - especially in regard to engineering leading to a "happy" lifestyle. In fact, achieving happiness was a major concern for many students. According to self-determination theory, happiness, or personal well-being, can only be achieved when the basic psychological needs for autonomy, competence, and relatedness (three of the motivational constructs discussed previously) are met (Ryan and Deci, 2000).

Perhaps the context of service-learning in engineering will help some of these students find their niche in engineering and, hopefully, cultivate a stronger sense of belonging. On the other hand, it may be unrealistic to expect that one eight-week immersion in PBSL can reconstruct students' subjective experiences in engineering. However, it is quite possible that the context of service-learning will help some of these students find more fulfillment in engineering, cultivating a stronger motivation to learn and become more personally engaged in their work.

FUTURE WORK

The main goal of this research is to provide a deeper understanding of the effects of project-based service-learning on engineering education. If PBSL cannot be integrated into every undergraduate engineering course, there are still specific elements of altruism/service-learning that we *can* identify and correlate with student motivation and engagement. It is possible that these smaller elements can be distributed throughout the undergraduate experience to meet the need for more entrepreneurial and service-oriented engineers.

CONCLUSIONS

Based on the preliminary research reported in this paper, we conclude that many students possess the desire to be more involved with the surrounding community, to develop essential non-technical engineering skills, and to lead a fulfilling and meaningful engineering career. Many students are also concerned about belonging in engineering, their capacity to do engineering in the real world, and their happiness as a practicing engineer. At this point in their education, after all the time and energy they have invested, it would be encouraging if students expressed more engagement in learning, and more value, interest, and motivation for engineering. It is certainly worth exploring the type of instructional strategies that help foster these qualities in students.

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