Engagement in Practice: Adding Service Learning to an Online Introduction to Engineering Course

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A wide body of research shows increased student engagement and student retention from the use of high-impact practices such as learning communities, first-year experiences, undergraduate research, or service learning. However, many of these practices pose challenges on a virtual college campus or in an online classroom. This paper explores a case study where service learning projects were incorporated into two introductory engineering classes, one taught in a traditional face-to-face format and the other taught online. In this case study, the face-to-face students worked in small groups with a local historical society to create interactive museum exhibits. The online students engaged in a wider variety of projects, either based in their home communities or matched with the community of the instructor. This paper explores some of the challenges involved with engaging online students with community-based service learning projects, including those that were unique to the online environment and those shared with the face-to-face class. This paper will also discuss lessons learned in adapting online groups to work on a service project and the importance of interpersonal dynamics with geographically dispersed team members. The two classes were similar in size and followed comparable course content in their respective modes of instruction. Assessment of the students and their progress is ongoing.

Background and Motivation

Service learning is an approach that uses community engagement to help students gain understanding of academic course content. Studies have shown that service learning in engineering helps students develop professional skills related to teamwork, problem-solving, and working in professional environments. Students also gain a broader understanding of engineering in the context of community and have the ability to see themselves as "doing" engineering (Huff, Zoltowski, and Oakes, 2016; Thompson, Oakes, and Bodner, 2005). For the classes described in this paper, the service learning was incorporated as a semester-long project. Project-based learning in engineering has also been shown to have long term positive impacts on professional skills such as teamwork, communication, and the ability to integrate information (Heinricher, Quinn, Vaz, and Rissmiller, 2013).

Though there are many benefits to service learning, it's not readily adopted in online classes despite the rapid growth of online as a learning platform (Waldner, McGorry, and Widener, 2012). It's important to investigate how community engagement could be used to benefit students in that environment. Using the typology provided in Waldner et.al., this paper describes a traditional service experience (face-to-face instruction and face-to-face service) in one class and a mixture of "extreme e-service-learning" (online instruction and online service) and "hybrid e-service-learning" (online instruction, on-site service).

There were several motivating factors for adopting a service learning project in the introductory engineering classes. First, a single project spanning the semester provided a common thread for uniting topics that sometimes seemed disjointed to students. The introductory engineering course is a breadth class; and as such there are a lot of individual topics to cover. Though some content blends seamlessly (teamwork, project management, and scheduling, for example), the lack of

overall connectivity of topics had been mentioned on past student surveys. In addition to the noted benefits associated with service learning, a single semester project would serve as a main focus for homework assignments and a means to apply the content knowledge to a specific problem. Other motivating factors included using service learning to as a means to strengthen community among students in the online course and giving students an opportunity to work in a design situation that mimicked a professional setting.

Course Description and Demographic Details

The service projects were incorporated into two introductory engineering courses at the University of Wisconsin Colleges: a traditional class at a brick-and-mortar campus, and the same class offered via the UWC Online Campus. The course catalog description states, "*This course is designed to equip engineering students with the necessary tools and background information to prepare them to be successful engineering students as well as a successful practicing engineer. Topics covered in this course include project management, team work, technical writing, working with data and using spreadsheets, creating presentations, engineering design, and a thorough understanding of the engineering profession.*"

The content and pacing of topics in both courses were aligned, with the online course designed first, and then the traditional course was revised to match. The classes were assigned identical homework problems and given the same assessments to the maximum extent possible (differences occurred in approximately 10% of total graded assessments).

The enrollment in both classes was similar, with 26 students in the face-to-face (F2F) class and 25 students online (ONL). Students self-selected the class modality (they were not randomly assigned). Also, students in the face-to-face section would have had the ability to enroll in the online course, but not all online students would have had the option to take the course at a brick-and-mortar campus due to their geographic location. Both classes were predominantly male (96% F2F, 92% ONL), however the online class had significantly more non-traditional students than the face-to-face class (15% F2F, 60% ONL).

Service Project Design and Execution

The face-to-face class was approached by a community partner about a service project that included designing interactive museum displays for the Neenah Historical Society's upcoming exhibit. The exhibit focuses on the town of Neenah, WI, during the Progressive Era and opens in the spring of 2017. The Historical Society director wanted to show the shift from flour milling to paper milling on the Fox River that occurred at that time. So, the class was 'hired' to make interactive exhibits that demonstrated how an 1870's flour mill worked.

It was a unique opportunity for the class, because they were able to interact with a client, including touring the space, creating prototypes, having the client request design changes, and finally building the exhibit. Partnering with the students also helped the Historical Society receive two local community grants to support the exhibit. At the end of the semester, the director of the Historical Society reviewed the student projects and accepted 4 of the 5 projects for inclusion in the exhibit. Though some work remained with the projects to create a uniform

look and include text panels that matched the rest of the exhibit, the director was overall very pleased with the work done by the students.

Developing service opportunities for the online students was a greater challenge, and a fair amount of time was spent determining how to incorporate service learning into an online environment. Ultimately, it was decided to take a student-led approach, where teams were given an opportunity to develop and implement their own project ideas. As a back-up plan for this pilot, there were options for groups that were not able to come to a consensus. Of the project groups, two teams developed their own ideas (website for engineering students, STEM Day activities for middle schoolers) and one team took an idea from the instructor (helping a local K-12 school coordinate an heirloom plant sale). Four students worked individually on projects of special interest to them (building an owl box for a local non-profit, preparing an introduction to engineering talk for elementary students, collecting hygiene items for the homeless shelter, and holding a food drive at an employer). All 4 individual projects and 3 of the 4 group projects were considered successful by the community partners.

Since one specific motivation for adopting service learning had been to connect content with the community projects, several course assignments were tied to the service projects during semester. Specifically, those topics included: teamwork, formal brainstorming, project charters, work breakdown structures, project scheduling, flowcharting, success metrics, technical writing, and technical presentations. These topics represented approximately 46% of the total course homework assignments. Stated differently, students were able to apply almost half of the content directly to the semester service projects.

Unfortunately, a technical difficulty with administration of the student surveys for the online course rendered them invalid for the fall semester. Low survey response rates generally make it difficult to extrapolate student experiences in online classes, therefore it's not certain that a conclusion would have been evident in either case. Overall course indicators for the face-to-face class did increase by 20% (same instructor, before and after revision). The instructor will continue to gather feedback as the course runs every semester in the online environment and every fall semester on the brick-and-mortar campus.

Challenges

There were two primary challenges incorporating the service projects into the classes. The first was unique to the online environment (geographic dispersion), and the other was shared by both groups (interpersonal/group dynamics).

The online class was designed to have students develop projects on their own. The hope was that students would make connections in their own communities, which would improve their engagement in the projects and provide a more meaningful experience. One anticipated challenge of this approach was that each of the seven projects had a slightly different schedule, different metrics, and different end product. This required additional work on the part of the instructor to oversee the group work and monitor what each of the teams was doing at any given time. The projects for the face-to-face class were significantly easier to manage. Even though each group had a different component of the flour milling process to model, they were all working with the same community partner on the same timeline.

One unanticipated effect of encouraging online students to engage in their home communities was that a few students became very engaged in a meaningful project that was either difficult to complete as a group, or was not of interest to other students in the class. The engineering department has held group work and teambuilding as important tenets of the introductory student experience. Working individually meant that the students missed the opportunity to practice some of the consensus-building and conflict resolution skills that other groups were doing. Also, it increased the workload for the student involved, as the assignments and timeframe were the same for groups and individuals. This created an interesting tradeoff of local community engagement for an individual student versus the interpersonal professional skills gained through focused group activities in class.

In at least one case, a student chose to work independently due to a conflict within the initial assigned group. This highlights the challenge shared by both classes: interpersonal dynamics. Students in both classes were placed in groups according to when they were available for team meetings (in person or online). This approach eliminates one common barrier for groups, which is conflict over finding a time to get together and work. Forming groups this way (especially in the online environment) helps ensure that group assignments are completed by the entire group and not an individual representative, and it eliminates scheduling conflict as a reason for an extension request or failure to complete an assignment.

However, scheduling is only one of the many barriers to successful teamwork. Group members have different personalities, working styles, skill sets, and motivational levels. In the online environment, those problems can be magnified due to the asynchronous nature of electronic communication. To combat these problems, all groups (online and face-to-face) were required to make a team contract and perform some small, fun teambuilding exercises to increase cohesion among the members.

These activities were more successful in the face-to-face class, with 4 of 5 teams building good working relationships (as measured by an end-of-semester rating system). The online class struggled more, with 2 of 5 original teams forming good working relationships. It's important to note that some groups were shuffled in the online class to allow for independent work and students who withdrew from class. Building community in the online class was one of the goals of adopting service learning, and overall the results were mixed. The two successful online teams rated their teamwork as positively as top face-to-face groups. However, there were fewer successful groups formed in the online class compared to the face-to-face class.

Continuing Work

The course will continue to run online as a service learning course. The instructor is in the process of getting an official service learning designation associated with the class for transfer purposes. The overall low numbers of students participating in the online and face-to-face course create a challenge for long-term study on learning outcomes or course effectiveness. However, the instructor does intend to collect data on student perception of learning gains in the course and will continue to monitor the student surveys of instruction in the service learning class as compared to the other introductory engineering courses taught across the institution. Feedback from this past semester indicates that students overall found the experience to be positive.

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