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Multidisciplinary Service Learning in Guatemala
Course Description and Lessons Learned

Abstract

Multidisciplinary experiential and service learning courses offer opportunities for students from multiple and disparate backgrounds to work together and learn from the experience, the faculty, and each other. This paper describes a multidisciplinary service learning course in which students from business, engineering, and liberal arts majors participate. Faculty from business and engineering backgrounds co-teach the course. The semester-long course, which has been conducted for several years, culminates in a two-week service learning trip to Guatemala. During past courses, students have worked in teams on projects including hospital clinic construction and service, coffee cooperative construction, reforestation, potable water delivery systems, alternative energy study, surveying for water piping projects, and research of water delivery project financial records. During the two-week trip to Guatemala, students experience learning from service projects, cultural exposure, and historical presentations provided by Mayan and Ladino hosts.

Because the course has been conducted for several years and has been revised and improved over time, the paper discusses course design and implementation, delivery of integrated multidisciplinary projects, student feedback, lessons learned, and course improvements.

Introduction

Historically engineering programs have utilized classroom teaching with traditional textbook-based learning over hands-on learning approaches. The Carnegie Foundation for the Advancement of Teaching recently published a study showing that 6 American Universities continue “widespread emphasis on textbook-centric theory over hands-on practice”\(^1\),\(^2\). Brakora et. al. state that this approach discourages many students and leaves them unprepared for real-world problems\(^2\). Fortunately ABET accreditation requirements are beginning to affect changes in the teaching and learning paradigms leading to more emphasis on hands-on learning. Three of the criterion 3 requirements are having significant impact on engineering education. First, the students’ ability “to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability”\(^3\); second, the emphasis on multidisciplinary teamwork; and third, students’ understanding of the “impact of engineering solutions in a global, economic, environmental, and societal context”\(^3\). The confluence of these three accreditation program outcomes has been a dramatic increase in the number of engineering programs incorporating service learning projects in engineering education.

In the past decade, many engineering programs have embarked on service learning projects to enhance the learning experience of undergraduate students. Among these projects, many engineering programs have incorporated international service projects\(^4\),\(^5\),\(^6\),\(^7\),\(^8\),\(^9\),\(^10\),\(^11\). In his Ph.D. dissertation regarding humanitarian aspects engineering in the engineering curriculum, Vandersteen provides an eloquent history of the evolution of engineering education discussing
how the profession has evolved to see the interconnection between technology and humanity. He further states that the “2000s (have seen an) increased interest in social, environmental impact of engineering”\(^2\). In fact, six years after the advent of ABET’s EC-2000, the fundamental change in engineering accreditation, the *International Journal for Service Learning in Engineering*, published its first volume. In the first publication, Al-Khafaji and Morse show a graph depicting the dramatic increase in service-learning articles between 1995 and 2005\(^3\). According to their search, there were no engineering articles on service learning published prior to 1995 and from 1998 to 2005 there was a 14x increase in the number of articles published. Even though the Carnegie Foundation for the Advancement of Teaching found that there is still widespread emphasis on textbook-centric learning\(^1,2\), based upon the increase in programs including service learning and the increase in publications on the subject, the emphasis seems to be clearly shifting toward a learning model that includes a more hands-on service learning model.

**Background**

Since 1994 Professor Bruce Clemens has been leading service learning trips to Guatemala. Beginning in 2004, Western New England College started to offer multidisciplinary courses that involve business, engineering, and liberal arts undergraduate students. These courses are now required of all undergraduate students. Some of these courses also involve international experiences with service learning components. The course described in this paper is a multidisciplinary international service learning experience that is co-taught by business and engineering faculty. Over the past three years, the course has been refined to enhance the students’ experiences by providing more interdisciplinary interaction between the students of different backgrounds.

**Course Structure and Content**

This section discusses the course structure, content, objectives and assessment. The course involves in class learning, literature review and research, and multidisciplinary service learning during a two-week period in Guatemala, and culminates in a research paper. During the semester, students meet with the professors every other week to learn about the science and social aspects of the projects and to discuss the interactions of engineering and social impact of the projects. Because the majority of the students in the course are non-engineering students, design of complex projects is not a goal of the course. This aspect differentiates the course from traditional engineering service learning courses that are project driven.\(^4,6,7,8,10,11,14\) One of the main goals of the course is to integrate social, engineering, and professional issues. More specifically, the course examines the following issues through field study including:

- examining cultural, economic and social issues related to the provision of rural environmental sanitation projects and rural water delivery projects;
- examining the management and engineering involved in rural environmental sanitation projects and rural water delivery projects;
- investigating cross-cultural communication barriers; and
- examining the reasons for poverty in the third world.
During the classes preceding the travel, students studied reading material and the course met for an hour and a half every other week for lectures followed by in-class discussions. During the 7 meetings the following topics were covered:

- **Week 1** – Syllabus, course goals, establish teams, assign literature reviews, logistics and immunizations, personal travel after the course, and planning for fundraising.
- **Week 3** – Lecture on history of Guatemala – plantations and land tenure, civil war.
- **Week 5** – Lecture on people, language and culture.
- **Week 7** – Lecture on geology, climate, fuel sources, and deforestation.
- **Week 9** – Lecture on public health related to housing conditions.
- **Week 11** – Lecture on construction, sanitation, and water delivery programs.
- **Week 13** – Student presentations of literature reviews and final preparations for departure.
- **Week 16** – Depart for service learning trip.

The bulk of the service learning is, of course, learned during the trip. The first day of the trip is long and arduous. An early morning flight to Guatemala City is followed by a four to five-hour van ride to the sponsor in San Lucas Tolimán. It is during this trip that the cultural learning begins. Guatemala City is a typical large Central American city that has dilapidated infrastructure, crowded diesel-soot filled traffic patterns, billboards everywhere you look, security bars and retractable gates blanketing every business, and weapon-wielding security guards posted outside of banks. It is always interesting to see the reactions of the students when they first encounter the third-world environment. Even after reading about it and discussing it before the trip, they are awestruck by their first encounters.

At lunch, the students are instructed to order well-cooked food “sin lechuga y tomates, por favor” (without lettuce and tomatoes, please) and they cleanse their hands with hand sanitizer before consuming their food. It is at lunch that the students first learn that the instructors will provide little help with translation except where health and safety are concerned. Every year, students comment about their appreciation for “not being babied” when it comes to their interaction with the local population.

After the group arrived at the sponsor’s location, the group was assigned a hotel and checked-in. Then the students had dinner and orientation. Half-way through the trip, the group traveled to a second sponsor, Agua del Pueblo in Quetzaltenango (Xela) Guatemala. Since 1972, the second sponsor, Agua del Pueblo has developed over 900 sanitation and water projects in Guatemala. For the group’s daily work assignments, the local sponsor either redevelopment project or in the offices of the San Lucas Mission or Agua del Pueblo, in provided a service project for our group. Based on the interest of the group and the needs of the project, the group was able to choose from a variety of volunteer activities including, but not limited to:

- Construction of water supply projects, a clinic, or a coffee cooperative
- Data-mining sanitation and water project financial and management records (in Spanish)
- Surveying and annotating surface geology for future water supply projects
- Support for health-care professionals in the local hospital
- Assistance in a reforestation project
- Support to the local coffee cooperative

At the end of each day, the class ate communally to discuss the day’s activities and the learning opportunities. During the dinner, the instructors began by asking a student to summarize their day and to relate it to one of the readings or lectures that occurred prior to the trip. Mixed in with the service work, the instructors also arranged for historical presentations provided by Mayan and Ladino hosts. The talks allowed students hear first-hand accounts of Mayan culture; plantation experiences for Mayans; civil war; and societal improvements in land ownership, sanitation and water supply, and poverty as it relates to water potable water supply and land rights. The following talks were presented:

- Father Greg Schaffer spoke about Guatemalan history, civil war, having his life threatened by the authorities, a young boy saving his brothers and sisters after soldiers set their house afire, and Chona (who is currently a cook at the San Lucas Mission) taking Greg through security check points to get children to a safer location. On October 13, 2007, the president of Guatemala, “Oscar Berger, came to San Lucas to present Father Schaffer with the Order of the Quetzal. It was the first time in Guatemala’s history that an American priest had received the Order, and it was the first time that a Guatemalan President conferred the Order outside of the National Palace.”

- Father Greg spoke about land tenure and the vast majority of the land being owned by 2% of the population. Additionally, water, land ownership and poverty were discussed.

- Victor Racancoj from Tulan University spoke about the bare-foot engineers and the rural education process where teachers travel to villages. The challenges of females accessing advanced education were also discussed.

- Andres Tos Toy spoke for several hours about his leading of a strike against plantation owners, his life being threatened, beatings of suspected labor organizers, and being enabled to move from the plantation to their own land after Agua del Peublo and the San Lucas Mission through Projecto Amistad (Project Friendship) built a water delivery project to pipe water several miles to previously uninhabitable land. Andres Tos Toy is now the mayor of the settlement, las parcelas de Pompo Hila.

- Andres Chajil the water project manager of San Lucas Mission hosted the students to a traditional Guatemalan dinner and discussed growing up as a boy on the plantation, the strike against the plantation, leaving the plantation, working for San Lucas Mission and owning his own home.

- Toribijo Chajil gave a tour of and talk about the reforestation project and took the students to a traditional Mayan ceremonial area.

During Father Greg’s talk on the history of Guatemala and how it relates to service provided by groups such as our students, Father Greg told the students about an experience he had at the death-bed of the local Mayan leader. In the talk, Greg said that the leader asked him to “listen to my people”. By this, he meant that helpers should not provide help they think indigenous populations need; rather, they should be patient and listen to the people to discover what it is that the people “really” need. This lesson resonates strongly today; in lessons learned presented by many papers on service learning, authors reiterate that service groups need to listen to the input of the populations they are helping. Polito and Husfeld state that groups should do advanced planning and site visits to determine what the populations need before attempting to provide
help while Soerens and Gattis state that “the real motivations and ‘mental models’ of the community are often missed”.

Figure 1: Students with Guatemalan children in San Andres in the municipality of San Lucas Tolimán

Figure 2: Two students working on a kitchen foundation.

Figure 3: Toribijo Chajil in the reforestation nursery of the San Lucas Mission.

Figure 4: Transportation on the way to a work site.

Figure 5: Andres Tos Toy talking to students about his experience leading a strike.
The course also required a final project. Students performed a literature search, wrote and annotated bibliography, and finally wrote a research paper that related their research topic to their personal experiences and observations during the service learning trip. In the past year, four different research topics were considered:

- A comparison of the costs and benefits of effective management of potable water supply and irrigation programs.
- An analysis of the financials of Agua del Pueblo, a non-profit technical assistance firm established in 1972 that has completed over 900 rural environmental sanitation projects and water delivery projects.
- The benefits of effective management of potable water supply programs and other development initiatives.
- The impacts of management of renewable energy sources on public health and economic development.

The purpose of the term-paper was to document the learning that occurred during the service learning trip. The paper built upon the annotated bibliographies and wove them into a paper on the particular management and development issues assigned.

Finally, the students were assessed based upon the quality of their participation in service learning projects, the quality of their participation in discussions related to service projects and talks given by the Mayan and Ladino speakers, and their literature review presentation and final paper. Table 1 summarizes the course objectives and assessment.

**Delivery of Multidisciplinary Projects**

One of the challenges in teaching a course in which more than half of the students are non-engineering students is how to balance the technical aspects of projects with the social and environmental impact of the projects. During the most recent trip to Guatemala, when the group was at Agua del Pueblo, the instructors taught technical sessions on sanitation and water delivery systems. The material was covered in a topical manner during week 11 of the pre-trip course.
work. However, during the service learning trip, the faculty ran a technical workshop on designing water delivery systems where in students were exposed to general hydrodynamics calculations – laminar and turbulent flow, classification of movements, and formulas for tube calculations.

Table 1: Course Objectives and Assessment

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<tr>
<th>Competency</th>
<th>Assignment</th>
<th>Assessment</th>
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<tbody>
<tr>
<td>1. Ability to explain or utilize the approach or method of analysis in the perspective.</td>
<td>Carry out community development and rural water supply or other development activities.</td>
<td>-Quality of participation in daily activities</td>
</tr>
<tr>
<td>2. Ability to identify key elements of the discipline of perspective area.</td>
<td>Identify key elements of community development and rural water supply or other development projects.</td>
<td>-Quality of participation in daily activities and discussions -Final Paper and presentation</td>
</tr>
<tr>
<td>3. Ability to recognize some of the contributions or perspective area to contemporary issues, other phenomena relevant to the students’ experience or to personal career aspirations</td>
<td>Ability to recognize some of the contributions of community development and rural water supply or other development projects to contemporary issues, other phenomena relevant to the students’ experience or to personal career aspirations.</td>
<td>-Quality of participation in daily activities and after dinner discussion -Final Paper and presentation</td>
</tr>
<tr>
<td>4. Ability to compare and contrast values and assumptions of your own perspective to those from the other two disciplines</td>
<td>Ability to identify the values and assumptions of community development and rural potable water supply or other development projects and to compare and contrast those values and assumptions.</td>
<td>-Quality of participation in daily discussions -Final Paper and presentation</td>
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For the non-engineering students, the reactions to the concepts and abilities to understand the concepts varied greatly, ranging from complete fear of calculating the simplest trigonometric equation, to full engagement and understanding that surpassed a few of the engineering students.

Engineering students, who had studied fluids prior to the course, having previous experience with the material, had the best success understanding the computations. By the end of the workshop, the instructors observed that, from the purely technical perspective, intuitive understanding of project design may be more valuable for the mixed population in this course.

From a non-technical perspective, however, the workshop proved to be more valuable. Faculty observed the interaction between the students of different majors to be quite interesting. One of the students who resisted learning the technical material became agitated during the work shop and near the end of the session quipped, “Why do I need to know about any of these equations and design?” The reply from an engineering student was “Well, I don’t care about how it affects the people; I just want to design the system and put it in place.” This interaction opened the door to an hour of so of lively group discussion on why it is important to understand, but not necessarily master, the knowledge of the other disciplines. The business students, discussed project financing, planning, and management and why these aspects are important. The liberal arts students discussed and reiterated Father Greg’s statements about listening to the needs of the
people and considering the human, societal, and environmental impact of projects. And the engineers discussed the importance of designing efficient sustainable solutions.

Polito and Husfeld state that in their international service learning project, the engineering students also benefited from the presence of non-engineering majors who helped the engineers “recognize the importance of building relationships with members of the host community, to take the local culture into consideration, and to think more deeply about the long-term sociological affects of the project.” The value in the technical workshop during the service learning project, discussed in this paper, came from providing students an opportunities to see their peers’ perspectives – in a manner of speaking, they had to figuratively walk a mile in someone else’s shoes. Only from the dialog and interaction during the lively debates, arguments, and discussions, did the course help increase the students’ understanding of other discipline perspectives. The students came to realize that in order to work effectively as a multidisciplinary team, individually they had to view service projects from multiple perspectives.

Student Feedback, Lessons Learned, and Course Improvements

Student feedback for the past three years has been generally very good. The results of summative evaluation show that in last year’s course 91% strongly agreed and 9% agreed that the course contributed toward making them a more educated, informed person. The survey also showed that 100% strongly agreed that the course stimulated their interest in multidisciplinary subject matter. An even more important measure of student feedback is their collective response to the service projects and the talks given by the hosts. For the service projects, it is clear that students had a better experience engaging in projects in which the students worked directly with the Mayan’s in their homes, helping them to build kitchens, than in projects not specifically linked to individuals. 82% of the students strongly agreed that the kitchen projects provided an excellent learning opportunity while only while only 50% of the students strongly agreed that the more general projects were excellent learning opportunities. The best indication of student learning came from the analysis of the feedback on the talks given by the Mayan and Ladino hosts. Table 2 summarizes the student feedback on their rating of whether the talks provided an excellent learning opportunity.

| Table 2: Analysis of Student Feedback on Perceived Learning from Hosted Talks |
|-------------------------------|----------------|----------------|
| **Talk** | **Provided an Excellent Learning Opportunity** |           |   |
|         | **Neutral** | **Agree** | **Strongly Agree** |
| 1       | 0%          | 36%      | 64%       |
| 2       | 10%         | 45%      | 45%       |
| 3       | 0%          | 9%       | 91%       |
| 4       | 9%          | 9%       | 82%       |
| 5       | 0%          | 18%      | 82%       |
| 6       | 9%          | 18%      | 73%       |

It is clear from the results in Table 2, that the vast majority of the students believe that the talks presented an excellent opportunity for them to learn. For this reason, the future sessions of the course will include the talks. One of the lessons learned from Table 2, although not explicitly
shown in the data, is that the students felt they learned more from the Mayan speakers than from the other speaker. This will be considered when running the course in 2010.

Negative feedback in written comments has also been used to improve the course. The primary reason the instructors implemented the technical sessions on general hydrodynamics was due to feedback from former engineering students. Many of them complained that there was not a significant technical design component in the course. In the past, instructors felt that it would be too cumbersome to teach the non-engineering majors about design aspects of water delivery projects. However, due to engineering student feedback, last year the technical workshop was incorporated. As discussed in the Delivery of Multidisciplinary Projects section, the results of the workshop were mixed. The downside was that some of the non-engineering majors did feel overwhelmed by the material. The upside, however, was that the workshop forced non-engineering students out of their comfort zone and helped to inspire a rather lively discussion on the different roles of the disciplines and the necessity for students to understand other disciplines’ perspectives.

Conclusion

A multidisciplinary experiential and service learning course in which students from business, engineering, and liberal arts majors participated was described in this paper. The course content and structure were described in detail along with the learning objectives and assessment methods. The most valuable content of the course are the service projects in which students interact directly with the Mayan’s they desire to help and the talks given by the Mayan hosts. The course has been improved by including technical training for non-engineering students with the major benefit of affecting a higher level of multidisciplinary interaction and understanding of the perspectives of different disciplines.

Ongoing and Future Project

Western New England College is currently engaged in a long-term project to provide water to the saddle point between two mountains in the San Lucas Tolimán area of Guatemala. The project is in the feasibility stage and will take several years to complete. The goal is to provide potable water to upwards of 3000 future residents. The project will require pumping water from Lago de Atitlán to a saddle point around 2800 feet above the source. The sponsor, the Redevelopment offices of the San Lucas Mission prefers that the project fully or partially utilize alternative energy sources such as geothermal, solar, or wind. In a feasibility study for a similar project in Guatemala, Granich and Elmore found that for economical and land utilization reasons, alternative energy for pumping water was not practical. Nevertheless, the feasibility portion of project in San Lucas will continue because the circumstances of the land use and the terrain of the region are different.

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