Year-Long Service Learning Projects in Capstone Design at South Dakota State University

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This paper is submitted as background for one of the presenters in a panel discussion entitled "Diverse Models for Incorporating Service Learning in Capstone Design." The paper details recent experiences with year-long capstone service learning projects at South Dakota State University. Additionally, the author discusses briefly the impact of international service learning experiences at Ohio Northern University.

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Background Theory

Researchers have called upon academics to strengthen opportunities for synthesis of knowledge perhaps by using capstone-like design experiences while increasing student exposure to societal context and interdisciplinary team work[5]. Engineering academicians are exploring constructivists' theories of student learning to address some of the perceived shortcomings that have occurred in the design of traditional engineering educational curriculum around a concept of linear development of increasingly complex stages of understanding. Constructivists postulate a more interrelated and diverse view of how people learn and rely on facilitating students' experiences to help them construct a rich understanding of a subject[6]. Brown[4] stated "that our understanding of content is socially constructed through conversations about that content and through interactions around problems or actions. In addition, social learning concerns not only "learning about" the subject matter but also "learning to be" full participants in the field." Abbot[1] discussed that people worldwide would "need a whole series of new competencies" that quite likely wouldn't be developed in the classroom, but rather through real-life experiences. However, Zlotkowski[7] warned that interesting but unconnected service learning experiences could be "mis-education", not leading to deeper understanding, perhaps even cutting off interest in future experiences.

Engineering programs throughout the country have been experimenting with the ideas of integrating domestic and international service learning opportunities into their curriculum and extracurricular activities in an effort to address stated program outcomes such as graduating students that understand the impact of engineering solutions in a global, economic, environmental and societal context[2]. Additionally, all accredited engineering programs have stated program education objectives (PEOs) that are broad statements that describe the career and professional accomplishments that the program is preparing the graduates to achieve[2] at some point, perhaps 3-5 years into their career, when they are ready to become a professional engineer. Engineering programs also typically describe the supporting relationship between the accomplishment of their program educational objectives and college and university mission statements.

While a fair amount of written narrative and presentations have been dedicated to describing the construction of international service learning experiences, very little research or discussion has been focused on the longitudinal evaluation of how the collegiate experiences have impacted engineers in their careers and personal lives[3]. That is to say that most publications have focused on the immediate measurable outcome of these experiences during the collegiate experience rather than the "PEO-type focus" 3-5 years into the professional career.

One method used throughout service learning, and perhaps the concept that enhances a service project to the level of service learning is the activity of "reflection." Reflection is the activity or time spent by a student thinking about and discussing or writing about his/her service experience.

This paper will discuss the recent implementation of a service learning component in the Senior Capstone Design course in the Civil Engineering Program at SDSU including the use of reflection in the preliminary feasibility design phase and formally

in the final written report. Finally, an example of feedback from the first attempted use of an international capstone service learning project at Ohio Northern University (ONU) will be discussed.

Capstone Service Learning Component at SDSU

The CE Program Senior Capstone Design course consists of engineering design projects which are submitted to the SDSU Capstone Course coordinator by community groups and local engineering firms with an identified community member or engineer acting as a knowledgeable other person to work with the students during the project. A request for proposals (RFP) for all submitted projects is distributed to the student design teams for their consideration. Design teams prepare statements of qualification (SOQ) and technical proposals in response to the RFP. The community member or engineer is designated the "project mentor" and the amount of time and duration of contact with the student teams varies by project. By anecdotal observation, the students typically have more continuous involvement throughout the project with community member mentors, whereas they have a high level of involvement with engineering mentors during the feasibility phase of the project but not as much during the final design phase. Mentors are invited to oral and poster presentation events. The student teams also have a faculty advisor throughout the year that meets with the student design team on a weekly basis.

In the 2008-2009 academic year, the CE program at SDSU initiated a service learning component in the senior level Capstone Design course. The university's service learning director and Vista volunteers were invited to the Capstone Design course group meeting during the first semester (feasibility study phase) to discuss the concept of service learning with the engineering students. This initial presentation was probably too theoretical and historical based, and not enough information was disseminated about the practical aspects of service learning for the engineering students to begin reflecting on the service learning aspects of their capstone projects. The experience was fairly stilted for both the presenters and the engineering students, and probably it is fair to say that the Vista volunteers had approximately as much experience dealing with engineering students as the engineering students had dealing with service learning. However, a service learning reflection section was included in the final written design report that year. Some of the groups made a fair attempt at discussing the service aspects of their project and how their interactions with the community groups had impacted their considerations during the feasibility study and the final design.

In the 2009-2010 academic year, the service learning component of the Capstone Design Course has been expanded and has shown considerable more impact on the student projects. Instead of inviting the university service learning office and Vista volunteers to present to the design teams about service learning, the course coordinator discussed the concepts relating service to engineering design. During the feasibility study phase of the project the students were required to prepare and present a poster session detailing the service learning aspects of their project. The service learning poster session was conducted by the university service learning office, and the CE program represented 11 team posters of the over 60 posters presented. Students were instructed to consider the following information in the development of their poster:

- Social problem or community need addressed
- Learning objectives
- Learning and service outcomes
- Future directions for the work (for you or the organization)
- Connections between your service and future academic and/or career plans

Figure 1 shows one of the 11 posters that was prepared by the CE program design teams. Although the CE program projects were quite different from many of the other posters in the type of service being provided to the community, two of the CE posters were chosen for "Peoples Choice Awards" during the poster session. The attendees that selected these posters represented a very diverse cross-section of the university community.

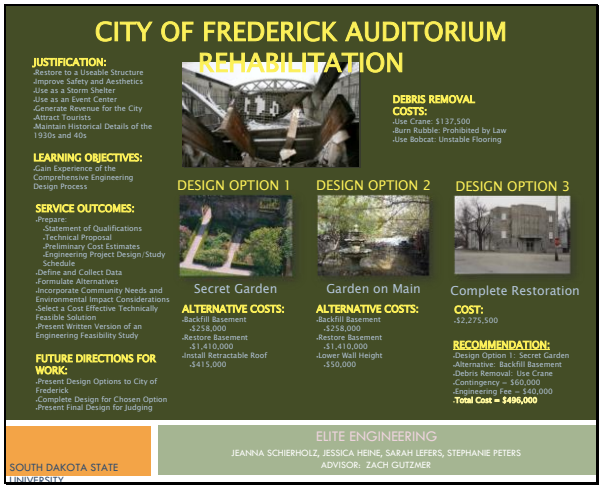

Figure 1. City of Frederick Auditorium Rehabilitation

In the second, detailed design phase, of the capstone experience, the student teams will complete the detailed design of their chosen alternative from the first phase. The final design project will include an oral presentation of the design, a poster presentation at the Engineering Dean's Spring Expo, and a detailed written design report with a service learning reflection section. The reflection section will include the following discussion topics:

Service Learning Reflection

A. Describe the actual experiences that you had with your clients, mentors, advisors, and others in the community that you talked to and gathered information from during your research and project development.
   a) Is there a difference in the way you view problems as an engineer and the way people in other professions view them? Describe the differences and discuss why you think they exist.
   b) Give examples of non-technical information that you learned about the project from the people you were involved with during the project development process. For each example, discuss why the information was or wasn't relevant to your work.
B. Discuss why it is important for Civil Engineers to work with community members to solve problems. Give examples from your project.
C. Discuss how your thought process as an engineer affects the way you view social issues. How will social issues impact your work as an engineer?
D. Discuss roles and mechanisms that you can use after graduation to continue providing assistance to your communities as you define them. Why are these activities important to you?

ONU Early Experiences

During the 2006-2007 Academic Year the CE program at Ohio Northern University (ONU) tried to implement an international service learning capstone design project for one design team as a pilot program. Kate Johnson was a student at that time and was one of the driving students behind developing the international service learning concept at ONU. Kate participated in a longitudinal narrative reflection[3] attempting to qualitatively evaluate the impact international service learning experiences had on subsequent engineering careers. Additionally the participants commented on whether the success of the service project impacted their desire to continue international engineering service during their career. An excerpt from Kate's comments is as follows:

"As an undergrad at ONU, I was eager to find a way to contribute. Most of my volunteer work was done locally, but I never wavered on finding an international project. I also wanted to work in a francophone country because I am fluent in French. Dr. Berdanier mentioned his work in Haiti. I desperately wanted to be a part of it, but travel at that time was considered dangerous."

"My senior year, I finally had the opportunity to contribute. My capstone project was to design a springbox system in the Artibonite valley. The project was very challenging. Installing and maintaining a sustainable project in a developing country requires thinking out of the box. I discovered that in some ways, this project was more difficult than one in the US both because of its simplicity and complexity. Data that is normally available in the US for a project of this type simply did not exist in Haiti. To remedy this, a site assessment trip was proposed. Funding was secured, and dates were set. We were ready to go….until the Dean of the College of Engineering stepped in and pronounced that Haiti was too dangerous for a school sponsored trip."

"The project in Haiti only made me more passionate to find another project. I found the solution as a founding member of Engineers Without Borders Central Ohio Professionals. In August 2008, I adopted a project in Cameroon. A February 2009 site assessment was conducted. It touched me in so many ways. It's easy to see this sort of thing on TV or in movies, but when personal connections are made, it rips at the soul. I knew what kind of conditions to expect, but I didn't realize the emotional impact it would have on me. Most of my emotions included guilt for living such a luxurious life while millions of people live in squalor. I was very overwhelmed and didn't think that I could make a difference."

Kate has also continued her development in international service through participation in the ASCE International Activities Committee (IAC) as the official delegate to the Young Engineers International (YEI) in the World Federation of Engineering Organizations (WFEO). She is also responsible for the international content in the ASCE newsletter and magazine. This spring she will travel with a group of EWB professionals to implement the first phase of their water project in Cameroon. ONU has gone on to develop at least one service learning project which is currently initiating in Kenya.

Conclusion

As engineers we generally evaluate outcomes or long term educational objectives using quantitative thresholds, assessments, evaluations, and continuous improvement. The paper we prepared for an American Society for Engineering Education (ASEE) meeting last fall[3] represented our first foray into the use of reflection and development of a rich narrative context to describe longitudinal outcomes. International service work can develop so frustratingly slowly and the needs are so great. I have thought often of Zotklowski's[7] and others warnings of the need for connection of experience so that the "fire" in these young people is not quenched. Domestic service learning experiences at SDSU through Senior Capstone Design provide an opportunity for immediate connection of a service experience to engineering design theory and accompanying reflection. The use of service learning experiences in capstone design courses at SDSU is currently evaluated through indirect assessment using student-developed narrative in the final design report, indirect surveys, as well as directly through the accomplishment of the design and the service learning poster presentation as evaluated in the course rubrics.

The reflections of former students at various points in their professional careers after having completed BSCE degrees[3] qualitatively indicate the impact and impressions that international service learning has had for them personally and professionally. They visited Haiti at different times, or didn't get to visit because of administrative decisions. They completed various engineering studies for Haiti and have moved forward in their professional and personal lives. Most of them have been involved in multiple international and domestic engineering service projects to address defined needs of specific populations and are continuing their service involvement in Haiti, as well as the US and other countries. Overwhelmingly, the longitudinal reflections speak to a direction of continued and increasing service in their lives, to an appreciation of specific needs of indigenous populations, and to the humbling recognition of our limitations in effecting major change despite our physical wealth and knowledge.

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