

AC 2009-682: SERVICE LEARNING AS A PREREQUISITE TO ENGINEERING ENTREPRENEURSHIP

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Service Learning as a Prerequisite to Engineering Entrepreneurship

Introduction

Engineering Entrepreneurship is becoming more prevalent in engineering curricula and throughout engineering programs. At Florida Gulf Coast University (FGCU) the UA Whitaker School of Engineering incorporated Engineering Entrepreneurship as a required course for all engineering disciplines. The original curriculum at FGCU introduced Engineering Entrepreneurship in the second semester of the sophomore year. Engineering Entrepreneurship was a prerequisite to the Engineering Service Learning course, required of first semester juniors. In the original curriculum design, students in Engineering Entrepreneurship were tasked with providing an entrepreneurial solution for a predetermined client. The course instructors were tasked with identifying an acceptable community partner for the class. The project was then carried into Engineering Service Learning in the following academic year. Engineering Service Learning was designed to assist the students with the design, testing and implementation stages of the engineering design process.

Background

The FGCU mission statement includes statements regarding “valuing public service”, “encouraging civic responsibility” and a requirement of community service learning hours (FGCU Mission). In addition, the U.A. Whitaker School of Engineering vision states “This is accomplished in an entrepreneurial and innovative educational environment that values diversity, **service**, integrity, leadership, and **collaborations**” (Engineering Mission). In 2005 Florida Gulf Coast University (FGCU) welcomed its inaugural class in engineering with an innovative curriculum based on integrated lecture-lab classes and a mission statement that clearly identifies the value of entrepreneurship and service. The engineering programs at FGCU have been developed with engineering entrepreneurship and engineering service learning as foundation courses for all disciplines. The initial offering of Engineering Entrepreneurship was during the spring 2007 semester to the sophomore engineering students.

During the initial offering, the Engineering Entrepreneurship students were challenged to work with a local high school math department and the develop proposals for products or services that will stimulate interest in mathematics, with an ultimate goal of increasing awareness of technology fields such as engineering. The products or services will be developed and implemented as part of the service learning experience in fall.

In this version of the curriculum, Engineering Entrepreneurship was the prerequisite class for Engineering Service Learning. Students were tasked with completing service learning hours with the client, finalizing the design, testing and implantation of the heir projects and reporting the results.

Course Assessment

The school of engineering has implemented a formal course assessment plan for every course in the curriculum, every semester. Although overall the students were meeting the learning objectives of the two courses, course assessment as well as student feedback indicated a need to revise the course offering structure and sequence. Three issues were apparent after the initial course assessment data was collected, and reaffirmed with student evaluations: first, the course sequencing was not appropriate second, the project needed to be expanded beyond a single client and third, the courses needed to be offered in the same academic year.

The need to change the course sequence became obvious during the initial offering of Engineering Entrepreneurship. The course focused on identifying business opportunities, identifying and segmenting customers, financing a business, competitive analysis and protecting intellectual property. Due to the structure of the course, students had not had the opportunity to identify a customer or the customer need rendering discussions on identifying opportunities and needs pointless from a student perspective. Likewise, during the Engineering Service Learning course, topics such as project management and product liability were too late to be relevant for the projects which had been underway since the previous semester.

A second challenge encountered during the initial course offering was the project. The lead engineering instructor was new to campus, arriving from out of state one week prior to the start of classes. The co-teacher, from the school of business, was not familiar with engineering based service learning and entrepreneurship. Due to these limitations, the instructors chose to limit the project to one client with a pre-identified need. It was decided that the engineering students would work with a local high school to identify products or services that improved awareness and/or enthusiasm for math, in particular the math skills necessary to study technical fields such as engineering. The impetus for this project stemmed from the severe math deficiency for students entering the FGCU engineering program. This project fit the service learning definition of Hatcher and Bringle, “students participate in an organized service activity that meets identified community needs”. Furthermore, the project contained the components illustrated by Lima and Oakes which includes service to an underserved people (identified through the demographics of the high school), academic content (students were using engineering principles to support the high school math program), partnership and reciprocity (this outreach was the beginning of a very good working relationship between the high school and FGCU), mutual learning (the engineering students learned from the high school teachers as the FGCU students taught mathematical applications) and analysis and reflection (analysis is part of the engineering design process and reflection was a required component of the class). Unfortunately, the project design was not as successful for the entrepreneurial aspects of the design. The primary component missing was passion. Barringer and Ireland state “The number-one characteristic shared by successful entrepreneurs is passion for the business”. The predefined aspects of the project severely limited the chance of any one particular student being passionate about the project, much less a team of students.

A third critical factor in the course design was the timing of the classes. State requirements, program requirements and prerequisite structures were the original determinants in the decision to place the 3-credit Engineering Entrepreneurship course in the spring semester of sophomore year and the 2-credit Engineering Service Learning course in the fall semester of junior year. In an ideal works, the students would be working diligently on the project all summer and return to classes in fall with a solid prototype. In the real world, students forgot about the project entirely over the summer, a few students decided not to return to classes in fall, and the high school had personnel changes that impacted the FGCU student projects. In hindsight, this was simply poor planning. From the initial planning stages the courses were intended to share a project, the decision was based solely on convenience of scheduling rather than a structure that would enhance student learning.

Course Design and Justification

As a result of the course assessment and student evaluations the courses were redesigned, and the sequencing was reversed. The Engineering Service Learning course is now the prerequisite for Engineering Entrepreneurship. Both classes are required in the junior year for all engineering students. Students in Engineering Service Learning are expected to use the engineering design process to identify a community based need, work with a client to identify design criteria and constraints, develop alternative solutions and develop a basic business plan for one of the solutions. Engineering Entrepreneurship will provide the students with experiences in conducting a market analysis, testing and implementation of the design. The students are required to have a product, process or service that will be given to the client as the final project.

Engineering Service Learning has been redesigned with three phases: Need Identification, Engineering Solutions, and Preliminary Business Plan. The justification for this design is pulled from the goal of engineering which is to service the community. Service to the community is considered fundamental to success and growth of the engineering profession. A driving factor I the course is to increase student awareness of engineering in society. As stated by Lima and Oaks, “engineering is, by nature, a profession with a societal context leading to social responsibility.” Engineering Service Learning promotes the concepts of social responsibility in the engineering profession.

The new course sequence begins with Engineering Service Learning in the fall semester of junior year. Completely restructured, the new course requires the students to propose at least two projects with engineering service learning content using a project assessment form, Figure 1.

Engineering Service Learning Initial Project Proposal	
Your Name	
Date	
PROJECT ORGANIZATION/LOCATION	
Please provide the name and a brief description of the organization or location.	
PROJECT OWNER	
Please provide the name and title of the main project contact/project owner.	
BRIEF DESCRIPTION	
Please provide a brief description of the proposed project.	
PRELIMINARY NEEDS STATEMENT	
Please provide a clear, concise and succinct needs statement.	
ENGINEERING CONTRIBUTION	
Please briefly describe the engineering related tasks that are necessary to complete this project.	
SERVICE CONTRIBUTION	
Please explain how this project would contribute a necessary service to the organization and list at least two learning outcomes.	
PRELIMINARY IDENTIFICATION OF DELIVERABLES	
Please describe the deliverables that would result in successful completion of the project.	
CONTACT INFORMATION	
Please provide the necessary contact information for key project personnel.	

Figure

e 1 – Project Assessment Form

The project summaries are then distributed to the entire class, and the students use the project application form, Figure 2, to apply for a particular project. Students may apply for up to three projects. Teams are formed by the course instructors. Every effort is made to place students in one of their top two choices, however the declared major of each student is also considered. Teams comprised of all one major, for example all civil engineers, are not allowed.

The Engineering Service Learning curriculum covers the engineering design process, engineering analysis skills, teams, conflict resolution, project management, business plan basics and reflection and self discovery. The deliverable at the end of the first semester is a business plan that includes identifying the customer need, primary and secondary customer identification, market size, growth, potential and competition, basic financial data including quick ratio calculations and a project timeline.

Engineering Service Learning Project Application
Your Name
Date
RESUME AND COVER LETTER
Please attach a current one page resume and a one page cover letter.
FIRST CHOICE
Project Name: Project needs statement: Identify three aspects of this project that are of interest to you and how, specifically, you can contribute to this project. Do you have experience with similar projects or organizations? If yes, please explain. What do you consider the biggest challenge for this project and why?

Figure 2 Project Application

Upon returning in the spring, the juniors are required to take Engineering Entrepreneurship. Designed to be co-taught with a faculty member from the college of business, the emphasis of this course is to bring the previous business plan to fruition by the end of the semester. The course begins with elevator pitches presented to representatives from the Small Business Development Center (SBDC). Feedback, both peer and from the SBDC representatives, is provided immediately following the elevator pitch. Engineering Entrepreneurship is front loaded with guest speakers with expertise in entrepreneurship. The guest speakers include experts in intellectual property, venture financing, legal issues including copyrights and patents and members of the SBDC. Also included in the curriculum are lectures and activities in business models, the financial aspects of business, building a venture team and marketing.

Continuous Improvement

Improvements for both classes will continue. Preliminary assessment of Engineering Service Learning has led to further refinements for next year. As currently structured the course has too much required work that does not lead to productive aspects of the project. The next time the

course is offered, spring 2009, several assignments will be removed and course milestones will be used to assess project status. The first milestone will require a Needs Justification. The Needs Justification will require a minimum of 5 documented client contact hours. Within the first milestone students will report the needs justification statement, a minimum of five tasks completed to identify the needs, a minimum of five sources researched and project objectives. The second milestone is based on Constraints and Criteria and will require identified project constraints, project criteria, analysis, assessment documentation and identifiable solutions to pursue. The third milestone, Alternative Solutions, includes brainstorming activities, documentation of alternative designs, market research and assessment of this data. Finally, the fourth milestone is the final project report in the form of a preliminary business plan that will be used to start the engineering entrepreneurship course.

Results from Engineering Entrepreneurship are not available at this time, however the students appear more enthused about their projects; one team is definitely planning to pursue their business opportunity and a second team is in the process of applying for a provisional patent.

Although still a work in progress, the concept of requiring Engineering Service Learning as a prerequisite to Engineering Entrepreneurship appears to be successful. The engineering students have proved they are capable of identifying engineering needs in the community and are in the process of designing products, processes or services to meet these needs. These courses have also provided an opportunity for the engineering program at EFG University to reach out to the community and become actively involved.

1. "FGCU Mission." Vision, Mission, and Guiding Principles. Florida Gulf Coast University. 2 December 2002. 20 January 2009 < <http://www.fgcu.edu/info/mission.asp>>.
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3. Hatcher, J.A. and Bringle, R.G. Reflection: Bridging the Gap Between Service and Learning, *College Teaching*, 45(4), 153-158, 1997.
4. Lima, Marybeth and Oakes, William. *Service Learning Engineering in Your Community*. Wildwood, MO: Great Lakes Press, Inc., 2006.

5. Barringer, B.R. and Ireland, R.D. *Entrepreneurship Successfully Launching New Ventures*. Upper Saddle River, NJ: Prentice Hall, 2008.