Combining Service-Learning and Systems Engineering for a Win-Win-Win Situation in the Classroom

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Abstract

At the University of San Diego (USD), Industrial and System Engineering (ISE) students are required to take an Introduction to Systems Engineering course. The course material includes the introduction to the theory and methods used for problem identification, description, modeling, solution and implementation using the principles of the system development life-cycle (SDLC). To make the material meaningful the students need to apply the knowledge and information learned in the classroom in a real world environment. Service-Learning provides a "hands-on" opportunity for students to develop these skills.

In the Fall of 2000, a community service project was identified with the Business Process Redesign (BPR) group at University of San Diego (USD). The Oracle corporation is implementing new a enterprise resource planning system throughout USD. The Business Process Redesign group assists each department at USD in defining and documenting of their current as-is processes because the departments are overwhelmed with current day-to-day operations and do not have the time or expertise to document their current processes. During Fall 2000 and Fall 2001, ISE students enrolled in the Introduction to Systems Engineering course, acting as external consultants, have provided the necessary resources for the BPR group to assist the departments. The result has been a win-win-win situation for all participants.

The participating departments at USD win by having their processes documented by an unbiased consultant. The students win by applying textbook knowledge and by being exposed to a broader knowledge of professionalism and ethics than from textbook exercises. The ISE program wins through visibility across campus.

This paper presents details on how we implemented the service-learning projects in the Introduction to Systems Engineering course. The benefits of service-learning for students and clients are discussed along with their assessments of the overall process. Finally, suggestions for identifying and implementing service-learning are discussed.

Introduction

Students attend universities across the nation with the intent to gain knowledge so that they may contribute to society upon graduation. Steven Covey stated, "the definition of a liberal education-the ability to examine the programs of life against larger questions and purposes and other paradigms."[1] Service-learning provides an avenue to apply skills, lessons and course knowledge to a real life situations. There are many definitions for service-learning with slight variations in their description.

American Association for Higher Education (AAHE) defines service learning as "… a method under which students learn and develop through thoughtfully organized service that: is conducted in and meets the needs of a community and is coordinated with an institution of higher education, and with the community; helps foster civic responsibility; is integrated into and enhances the academic curriculum of the students enrolled; and includes structured time for students to reflect on the service experience."[2]

The University of San Diego (USD), understanding the need to develop community-service activities, established the department of Community Service-Learning in 1994. The department has three main "Learn and Serve" goals:

1. To provide services to members of our community that respond to real needs as identified by agencies, schools, and those people acquiring service.
2. To extend USD learning opportunities into the community, by integrating community service with course content.
3. To develop a network among faculty, students, and the community who support the community service-learning process.[3]

The incorporation of service-learning into the classroom is an important part of the University of San Diego growth and awareness of service-learning. Over 70 faculty have integrated community service-learning into 130 courses. It is also necessary for instructors to take an introductory curriculum development workshop and then participate in ongoing service.

The ABET accreditation for engineering departments include criteria to cover the ability to apply knowledge.[4] As a tenure-track faculty, consideration for reappointment is based on four criteria which includes university and public service. All are very important reasons to include service-learning in a course, but the most important benefit is for the students. The students can take lessons learned in the classroom and apply the knowledge in a real life situation.

Service-Learning Course

Each Fall, the Industrial & Systems Engineering department offers the course, ISE 120 – Introduction to Systems Engineering. The catalog description describes the course as the "Introduction to the theory and methods used to design and analyze systems. Principles of problem identification, description, modeling, solution and implementation." The course is targeted for junior level students and requires no major prerequisites. The learning objectives of the course are as follows:

1. Think of systems of related entities rather than individual components.
2. Understand the principles of the system development life-cycle (SDLC).
3. Be able to apply life-cycle principles to design, produce and maintain systems that efficiently satisfy user's needs.
4. Identify and apply some fundamental systems design and implementation techniques.
5. Understand the need for and develop models to support system design.
6. Understand the importance of measures of effectiveness in system evaluation and how they can be used to compare competing solutions

The third and fourth objectives are difficult to complete without some form of course project.

In the Fall of 2000, a community service project was identified during conversation with Larry Gardepie of the Business Process Redesign (BPR) group at University of San Diego (USD). Currently, the Oracle corporation is implementing new a enterprise resource planning system throughout USD. The BPR group is responsible for coordinating and planning for the new Oracle system into each department enabling a more efficient and streamlined implementation process. More specifically, the Business Process Redesign group assists each department at USD in defining and documenting of their current as-is processes because the departments are overwhelmed with current day-to-day operations and do not have the time or expertise to document their current processes.

The BPR group identified an opportunity where Industrial and Systems Engineering students could assist select USD departments with the defining and documenting procedures. ISE students, acting as external consultants, provide the necessary resources and unbiased perspective to assist the department. The students gain hands-on learning of consulting methods, learn about the day to day operations within each department, and apply the concepts of the system development life-cycle (SDLC). The project also provides the avenue for ISE students to learn and practice the business process redesign process.

The community partner for the service-learning project in the Fall 2000 semester selected by the BPR group was the International Student Resources department. The community partners selected for Fall 2001 semester were the Athletic department and the Community Service-Learning department. There were several improvements incorporated after the first year and are discussed later.

Methodology

The class was divided into five two-person teams with two teams working with the Community Service-Learning (CSL) department and three teams working with the Athletic department. The teams were given the following instructions:

1. Create or revise the departmental organization chart. In addition, briefly list each person's tasks or duties under the person's name. The objective is to understand the focus and structure of the department.

2. Document each process by:
   a. Interviewing the person/people who perform each specific process.
   b. Creating a process map (flowchart/process flow) showing the steps of the process and who performs each step.
   c. Complete an information sheet for each process. The Worksheet defines the process and helps everyone understand the scope of the process.
   d. Collecting documents related to each process (e.g., forms, lists, labels, reports, test cases). · Complete a "Data Elements Log" for each process – list the data (field names only) that is being collected (e.g., first name, last name, street address, city, state, zip code, country code).
   e. Create an Abbreviations Legend showing working position titles and abbreviations used on process maps.

3. Review and revise documentation with the person/people whom you interviewed, review the process map, analysis worksheet, and data elements log. They should

check that all documents are included. Revise the paperwork if they have any corrections.

4. Analyze the process: list the recommendations your team would suggest to the department in order to make the process more efficient, more customer-friendly and less redundant - decrease the paper flow (e.g., decrease the number of times a form is handled or passed between people or department

Each team will be responsible for establishing a weekly meeting with their respective departments for interviewing and reviewing process information and documentation. A status report with completed weekly tasks, assigned weekly tasks, and project concerns is required to be submitted every week to the professor. Each team will have three milestone presentations describing their current consulting efforts to fellow students, the professor, the BPR group, and their respective departments. The final report includes all process documentation for the department.

Service-learning Course Assessment

Course assessment is an important tool for the evaluation of a course. It helps instructors determine what tasks work well in class and concepts students learn. A course assessment by students and faculty both prove useful in the development and refining of future courses.

Student Assessment

The students had several methods to communicate their assessment of the course. The students provided feedback of the course project via weekly status reports, in-class presentations, and project evaluations. The Community Service Learning department provided a student evaluation of the project. The students also evaluated the course project on anonymous midterm and final course evaluations.

The weekly status reports provided more immediate concerns of the students with regard to the project. There were some reoccurring concerns with the students. The most prevalent concern was scheduling with their group and department contact. The students at USD must enroll in heavy class loads in order to finish their degree in four and half years due to the fact that USD is a private liberal arts university which requires students to obtain a dual bachelor of arts/bachelor of science degrees. The departments also had trouble scheduling meetings with students in their already busy schedule. Some comments and concerns are listed below.

"The second week of the project and we have not been introduced to our third contact."

"Scheduling concerns (as always)"

"It's getting tough finding time for the three IE projects we are presently involved in. "

"the department has not been very cooperative (unresponsive to requests for documents)"

Another major concern is dealing with access to software necessary for the project. The students were required to utilize software not available to them at home thus requiring use of engineering labs to complete project work. The engineering labs are not open on weekends or late at night. Here are some examples from student responses.

"Software issues with Visio and MS Project and lab access to proprietary software"

"Worried about the time allotted to complete the Gannt Chart"

The students were required to complete evaluations of the service-learning project at the end of semester. The evaluations included three questions to assess the projects value to the students. The questions and examples of responses are listed below.

What did you like/dislike about the project?

> I really enjoyed the "real life" experience. I felt like a professional engineer going into the interviews with prepared questions and then presenting our work. The people we worked with made it really easy to feel comfortable attacking the tasks at hand, which was nice.
>
> I liked how we were in a professional environment and how we had to think like an engineer would. This is the first time I have really applied something that I have learned in the classroom to industry. I liked how we got progressively better with interviewing and presenting. I don't really think I disliked too much about this project, it went very well and helped my grow as an engineer.

What changes would you make?

> Project definition seemed like it was a big hurdle for everyone, at least at first.
>
> I would change the agencies that we work with. Maybe go outside the school and pick an agency in industry that needs help.

What aspects of the project contributed most to the classroom learning?

> Again, I think the "real world" experience was most beneficial. Things like conducting interviews, filling out appropriate forms, and presenting data are tasks that ISEs would be expected to do. We were able to practice different techniques in interviewing, and I am sure our presenting skills got better.
>
> I think the process maps helped the most because we got to use Visio and develop an understanding of the logic that goes along with many different aspects of system analysis. I also think that the interviews helped allot because we got to see what it's like to conduct and interview and how the tips in the book helped us out.

Students also completed evaluations provided by the Community Service-Learning department. A copy of the student evaluation form is presented in Figure 1. The results from the student evaluation are shown in Figure 2. The scores from the student evaluation confirmed the positive experience students received from the service-learning project. The students scored better than 4 out of 5 for the level of satisfaction regarding the project experience. As expected, the scores were not as high for the cultural issues because the nature of the project was not focused on social or economic issues.

STUDENT EVALUATION

OFFICE FOR COMMUNITY SERVICE LEARNING

A. General Information

1) Course Title: _____ 2) Professor/Section: _____

3) What was your placement agency?_____

B. Community Service-Learning Experience

Service-learning in the classroom

1) To what extent were you satisfied with how reflection on service-learning...	Very dissatisfied	Somewhat dissatisfied	Neither satisfied nor dissatisfied	Somewhat satisfied	Very satisfied
a)... linked with theory presented in class	1	2	3	4	5
b)... enhanced course-related learning	1	2	3	4	5
c)... enriched classroom discussion	1	2	3	4	5
d)... met the stated service-learning objectives	1	2	3	4	5

Comments:

Personal response

2) To what extent were you satisfied with how service-learning helped you...

a)... work productively with persons you might not otherwise encounter	1	2	3	4	5
b)... challenge stereotypes, assumptions, and prejudices	1	2	3	4	5
c)... identify and analyze complex social problem(s)	1	2	3	4	5
d)... think about yourself as a resource to the community & the community as a resource to you	1	2	3	4	5
e)... examine your values	1	2	3	4	5

(adapted from Service-Learning 2000 questionnaire)

Comments:

C. Future and Prior Community Service Experiences

	Definitely Not	Unlikely	Would Consider	Probably	Definitely	Not applicable
1) Would you enroll in another service-learning course?	1	2	3	4	5	6
2) Do you plan to engage in future community service:						
a)... while a USD student?	1	2	3	4	5	6
b)... after graduation?	1	2	3	4	5	6

D. Demographic Information

1) Year in school: ___1 Fr ___2 Soph ___3 Jr ___4 Sr ___5 Grad

2) Race/ethnicity:

___1 White, non-Hispanic ___4 Alaskan/Native American
___2 Black, non-Hispanic ___5 Hispanic/Latino(a)
___3 Asian/Pacific Islander ___6 Other *(Please specify)*_____

3) Sex: ___1 Male ___2 Female

Figure 1. Student Evaluation Form

Proceedings of the 2002 American Society for Engineering Education Annual Conference & Exposition

Fall 2001 Student Evaluation Summary

1/11/2002

1 through 5 - 1 is very dissatisfied and 5 is very satisfied

A. General Information

Count 10 evaluations

INTRO TO SYSTEMS ENGINEERING **PERRY**

3.) What was your placement agency?

B. Community Service-Learning Experience

SERVICE-LEARNING IN THE CLASSROOM

1.) To what extent were you satisfied with how service-learning...

a.)... linked with theory presented in class	4.20
b.)... enhanced course-related learning	4.80
c.)... enriched classroom discussion	4.50
d.)... fit the stated service-learning objective	4.80

If you did not participate in community service-learning skip to Section D

PERSONAL RESPONSE

2.) To what extent were you satisfied with how service-learning helped you..

a.)... work productively with persons you might not otherwise encounter	4.60
b.)... challenges stereotypes, assumptions, and prejudices	3.80
c.)... identify and analyze complex social problem(s)	3.70
d.)... think about yourself as a resource to the community and the community as a resource to you	4.20
e.)... examine your values	3.33

C.FUTURE AND PRIOR COMMUNITY SERVICE EXPERIENCES

1.) Would you enroll in another service-learning course?	4.50
2.) Do you plan to engage in future community service:	
a.) while a USD Student?	4.10
b.) after graduation?	4.33

E. DEMOGRAPHIC INFORMATION

1.) Year in school

Freshmen	
Sophmore	
Junior	9
Senior	1
Graduate	

2.) Race/ethnicity

1. White, non-Hispanic	7	4. Alaskan/Native American	1
2. Black, non-Hispanic	1	5. Hispanic	2
3. Asian/Pacific Islander		6. Other	

3.) Sex:

Male	8
Female	2

Other Comments:

Figure 2. Student Evaluation Results

Client Assessment

The students reported to several clients; Business Process Redesign group, Athletic or Community Service Learning department, and course professor. It was their job to satisfy all three clients each with different objectives.

The Business Process Redesign (BPR) group is responsible for reviewing the final product from the students and submitting to Oracle. The (BPR) group was very satisfied with each team's performance and quality of material. The BPR group stated:

> "This fall's class did a superb job in interviewing the departments as well as pulling together the various documents, process maps…I was very impressed with the three class presentations….it was wonderful to see each team improving in their project-related and presentation skills as the semester progressed."

The Athletic and Community Service Learning department both had several comments regarding the performance of the students. One common recurring theme was that the students were very professional and were a pleasure to work with. Both departments were very satisfied with the finished product.

Professor Assessment

The community service-learning project provided an enhanced learning experience for the students and all participants. The service-learning project was incorporated into the course from day one. The students were introduced to the project during the explanation of the course syllabus. The project requirements and expectations were described thoroughly with an overview of service-learning. The semester long project began the third week and continued until final presentations on the last day of class. The first three weeks of lectures provided the foundation for the students to begin the project. Each lecture thereafter contained concepts and lessons related to the project. Examples and homework were also related back to the project whenever possible. The students were continually encouraged to share their project experiences with their fellow students in and out of the classroom. The students shared many lessons and learning experiences that are not found in textbooks.

The students' involvement within the University of San Diego community provided the catalyst needed for students to take the project very seriously. The students, acting as ambassadors of the ISE department, behaved differently than if it was only their peers. In the beginning of the project, the student-consultants were nervous and unsure of themselves, but soon developed confidence in their application of interviewing and presentation skills noticed by all of their clients. A learning objective of the class was to be able to apply the system development life cycle which entails system planning, analysis, design, and implementation. Upon completion of the course project, the students experienced how to plan, analyze, and redesign a system within a department at USD.

Course Successes/failures

During the second year of the service-learning project, there were many changes from the previous year creating a much smoother integration into the course. There were several changes

to help with scheduling so that the students could keep on track. The first improvement implemented was the selection of teams. Scheduling proved to be a major obstacle the previous year. In Fall 2001, teams were selected based on similar work and class schedules making the scheduling of meeting times more possible. Students were also required to schedule a meeting time weekly with their respective client. This provided a set time for each team to meet with their client and have their necessary deliverables ready for the meeting. Weekly status reports replaced weekly presentations from the previous year. Weekly presentations, although only five minutes each, were very time consuming. The weekly status reports also provided checkpoints and feedback of their project progress to the professor and to the team.

The teams were required to make three presentations that provided milestones for project deliverables. At each presentation the students would be expected to complete and present thirty percent of the final product so that the students would not procrastinate until the final weeks of the semester. It also provided an opportunity for students to polish their presentation skills in front of their respective clients. Their clients would review and verify the material being presented providing the necessary incentive for student teams to take their presentations very seriously. The involvement from the clients is very important! It encourages both the students and the clients to take the project more seriously. It also helps both parties to keep on schedule.

Conclusions/Summary

Community service-learning provides an opportunity for students to apply words and ideas presented in textbooks in a real life setting. There are many learning experiences gained by students in a service-learning project that can be very helpful in society after school. To finish, a quote from the late Dr. Hans Selye, his research on stress stated in short, "a long, happy life is the result of making contributions, of having meaningful projects that are personally exciting and contribute to and bless the lives of others."[1]

Bibliography

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