Keys to Successful Implementation of Service Learning in a First-Year Seminar in Engineering

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A two-credit First-Year Seminar in Engineering is offered once a semester during the fall term for students majoring in mechanical engineering, electrical engineering, environmental engineering, undecided engineering, or environmental science. This course is designed to orient new students to the university and to introduce them to engineering careers. To comply with university requirements, the course seeks to (a) establish the connection with the Liberal Studies Core, (b) assist in the transition from high school to university life, and (c) encourage the development of academic, personal, and spiritual aspects of the student's life through nine dimensions. This course is employed in this paper as a successful example of how a course can be modified to incorporate a semester-long, engineering service learning project.

In the fall of 2010, modifications were made to the structure of the seminar by including topic modules and engineering design projects with a small service learning component. The design projects were to serve as a common thread to bind the topic modules together. Due to the differences in the types and complexity of the projects, the lack of oversight, and the time required for liberal studies core requirements, this first model did not achieved the expected outcomes. In the fall of 2012, the topic modules were revised and one common community-based engineering design project was selected, the Little Free Libraries. The project became the central theme connecting the modules, providing continuity to the delivery, and building engineering competency as well as personal confidence. Emphasizing the service-learning aspect of the seminar, the learning becomes relevant and the first-year students excel as they share the intellectual, problem-solving aspects of design. To monitor the progress and assess the performance of the students in the projects, evaluations were adapted from the EPICS program.

This paper presents an overview of the course re-organization, topics and their linking to the community-based engineering project as it acts as a core theme. The methods used to evaluate the student performances are presented clearly outlining their connection to the community-based engineering project. Keys to successful implementation are discussed in the lessons learned. The impact of the seminar activities is supported by the students' self-reported increased appreciation for the aspects of engineering design and understanding of engineering solutions in a societal context.

Keywords: Engineering through Service, lessons learned, first year seminar

1. Introduction

Research has found that adding a service-learning component to a project can enhance learning, especially in the areas of social and moral development[1-3]. Bielefeldt et al. present a conceptualization of the impact of project-based service learning on the knowledge, skills,

attitudes, and identity of the participants[2]. Service-learning challenges students to translate classroom lessons into the "real world," while providing a tangible benefit to the community. Under this premise, the First-Year Seminar in Engineering, a Liberal Core two-credit require course, was restructured to incorporate a community-based engineering project as the common theme for the course.

The First-Year Seminar in Engineering comprises of modules of engineering and non-engineering topics delivered in twenty eight 55 minute sessions in the fall semester. The enrollment in the course ranges between 45 – 60 students any given academic year. The majority of the students are engineering majors. As the community-based engineering project was integrated, topics offered were modified to support this core activity. The students' engagement in hands-on team-based engineering problem-solving reinforces their classroom experiences.

This paper presents how the course was redesigned to incorporate a core community-based engineering design project. Section 2 presents the course description and course outcomes. Section 3 discusses how the course content and the assessment were modified to support the project. Section 4 describes the community-based service learning projects. Section 5 summarizes the course assessment. Lessons learned and conclusions appear in Section 6.

2. Course Description and Course Outcomes

The description and outcomes presented in this section are specific to the author's university but aspects of the seminar can be adapted and implemented in other courses. The course description for the First-Year Seminar in Engineering, as stated in the course syllabus and the university's undergraduate catalog[4], follows.

"The *First-Year Seminar in Engineering* is designed to orient the new student to Gannon University, to introduce engineering as a professional field, to connect with the Liberal Studies Core and LIFECORE, to assist in the transition from high school to university life, and to encourage development of academic, personal, and spiritual aspects of the student's life. The First-Year Seminar in Engineering will stimulate and enhance the student's interest in and their understanding of engineering."

Additionally, the design process, problem solving and systems approach to engineering design are presented. The interface of engineering with economics, environmental concerns, ethics, health and safety are discussed. The experimental component of the course is intended to review the foundation of scientific experimentation and reporting and to introduce various measurement devices and methods used in engineering. The importance of experience, observation and analogies in problem solving is emphasized. Various skills needed for problem solving in engineering are discussed and practiced throughout the course. These skills include teamwork, perspective of quantity and size, communications skills and basic computer skills.

Nine course outcomes, which map to the Liberal Core and ABET student learning outcomes, are associated with this course. Course outcomes 1-4 are discipline specific while outcomes 5-9 are Liberal Core requirements:

1. Comprehend the basic topics in mathematics, science, and problem solving tools common to the engineering fields
2. Comprehend the engineering design process and problem solving techniques
3. Comprehend how economic, environmental concerns, health and safety, communication, social concerns impact engineering
4. Demonstrate the ability to conduct experiments and analyze data
5. Demonstrate the ability to analyze one of the following LIFECORE dimensions including related activities and presentations: Intellectual (Quest for Knowledge), Life Planning (Balance), Cultural (Appreciation), or Political (Leadership)
6. Demonstrate the ability to relate the following two elements of Catholic social teaching to their own lives: (a) the affirmation of the fundamental rights and responsibilities of every person, (b) the protection of the dignity of work and the rights of workers
7. Demonstrate the ability to analyze what they learned from their engineering service learning experience
8. Demonstrate effective electronic communication and collaboration skills, including the ethical use of computing software and Internet technologies
9. Demonstrate the ability to evaluate personal study habits and develop goals to improve those habits

At Gannon University, the Liberal Core stipulates that first year students are required to participate in at least five (5) hours of service-learning as part of their First-Year Seminar class. Outcome number seven intentionally connects the service learning Liberal Core requirement with the engineering design process providing a basis for the community-based, semester long design project.

3. Re-structuring of the First Year Seminar

In 2010, the course content was organized into seven modules to obtain coherent flow within and across modules[5]. During this academic year, four *service learning projects* (refer to Section 4 and Table 3), with different levels of complexity, were introduced as part of the course. There was no direct correlation between the projects and the course modules and two presentations were the only deliverables required related to the service activity. Needless to say, the goal of connecting the projects to engineering design was not achieved. Students' course evaluations articulated the lack of continuity and weakness of content relevance. In 2011, the delivery of the course was revised through the use of six *engineering projects* with a very small service learning component to motivate and sustain student learning[6]. Projects are presented in Table 3. It was concluded that a better link between the course content (i.e. modules), the service learning activity, and engineering design was required in order to ensure a successful implementation.

After reviewing the 2010 and 2011 summative evaluations for the course, the following changes were agreed upon:

1. Lectures and Modules were eliminated to allow for more in-class time for topics related to engineering design and the semester-long project.
    a. Eliminated the History of Engineering topic (one session): This topic was relevant when the course was the 3-credit *Introduction to Engineering.*

b. Eliminated PC Applications (three sessions): Over 85% of the students suggested PC Applications should be eliminated since they use the software in high school. The resources were kept on the course management systems for those who were not familiar with the software.
c. Eliminated the Oral Presentation topic (one session): As part of the Liberal Core requirements all students must take 3 credits of speech. Freshmen are enrolled on a speech course during their first semester.

2. Select one or two community-based engineering projects that can serve as the core theme for the course.
3. Provide a structure that clearly defines deliverables to guide students through the different steps of engineering design as applied to the community-based engineering projects.
4. Incorporate topics to support the community-based engineering design projects: The following sessions were added: teamwork skills, project management, engineering design, engineering work experience, and service learning status report and assessment.
5. Create instructional material for each new topic.
6. Select a textbook for the course that provides assignments for the course content[7].
7. Modify the assessment methods to reflect the emphasis on the engineering design project.

Table 1 presents the course outline for the 2012 offering of the course. A connection was intentionally made with the community-based engineering design project in sixteen out of the twenty-eight sessions. This is a key factor to ensure that students realize the connection between the topics covered in class and the project. In-class construction time was incorporated in sessions 24-26 and 28. In the past, half of the students were free during those sessions; lab space only allows a limited number of students to perform the final project measurement. The free time was re-labeled as construction time and the machine shop was available to the students.

Table 1 - 2012 First Year Seminar in Engineering Topics and Connection to Project

Session #	Topic	Connections SL = Service Project ENG = Engineering LC = Liberal Core
1	Introduction and Succeeding in Classroom	LC
2	Catholic Social Teachings	LC
3	Life Cores	LC
4	Service Learning Project	SL
5	Ethics	SL, ENG
6	Team Building - ASME Team Module	SL, ENG
7	Introduction to Engineering Disciplines	ENG
8	Engineering Design	SL, ENG
9	Teamwork Skills and Project Management	SL, ENG
10	Problem Solving	SL, ENG
11	Engineering and Economics	SL, ENG
12	Engineering and Public Policy	ENG
13	Future Challenges (Engineering and Society)	SL, ENG
14	Service learning -Proposal Presentations	SL

	Mid-Semester Break	
15	Measurements, Units, Approximation and Estimation	ENG
16	Engineering Work Experience: Benefits	LC, ENG
17	Engineering Lab Activities - ECE, ENV, ME	ENG
18	Engineering Lab Activities - ECE, ENV, ME	ENG
19	Engineering Lab Activities - ECE, ENV, ME	ENG
20	Engineering Lab Activities - ECE, ENV, ME	ENG
	Advising Day	
21	Final Engineering Project Overview - ME	ENG
22	Final Engineering Project Overview - ECE	ENG
23	Service learning Project - Status Report	SL
24	Final Engineering Project Implementation/Service Project	ENG, SL
	Thanksgiving Break	
25	Final Engineering Project Implementation/Service Project	ENG, SL
26	Final Engineering Project Implementation/Service Project	ENG, SL
27	Service learning Installation and Assessment	ENG, SL
28	Final Engineering Project Implementation/Service Project	ENG, SL
FINALS	Service Learning Project Final Presentations	ENG, SL

The assessment methods were modified to assess the changes made to the course content and emphasis. Table 2 presents the new assessment methods, the correlation to the course outcomes, and a small description of each assessment technique. When a semester-long project is incorporated, it is critical to tie a large number of the assessment methods to the project. For example, at least three weekly journals had questions related to the service learning project and teamwork.

Table 2: Description of Assessment Methods and Correlation to Course Outcomes

Grade %	Assessment Methods	Course Outcome	Description
16%	Weekly Journals	5, 7, 9	Reflective electronic weekly entry on course learning experiences. Topics ranged from service learning activity, LIFECORE activities, ethics, time management assessment, etc. (Liberal Core requirement)
5%	Time Management & LifeCore Assessment	9	For the first five weeks of the semester, students complete a weekly time management worksheet which they correlated to the nine LifeCore dimensions.
5%	Freshman Inventory	8	Students reflect upon their experiences throughout their first semester and the resume is to be used as a final assignment for the course.
2%	Quizzes	1	Topics: Ethics and Engineering Measurements
10%	Homeworks	1,2	Problems were selected from the textbook during the first half of the semester[7]
10%	Reports	3,5,6,9	Students submit a typed report on the following topics: *(1)* Catholic Social Teachings: Case study, *(2)* Life Cores: Self-study, *(3)* Engineering and social issues.
16%	Laboratory	4	Lab activities consist of experiments in the engineering

	Reports		laboratories. Students run the experiment, record data, and write a report. *The lab activities are: (1)* Stress-strain analysis (ME), *(2)* Sand filtration (ENV), *(3)* Speed control of DC motor (ECE), and *(4)* Fluid mechanics (ME)
20%	Community Based Design Project: Progress Reports, Proposal, Reflections, and Presentations	2, 7, 8	Learning through Service is the motto that guides the activities in this section. A community based engineering project is selected and students apply the engineering design model. Report, presentations and reflections are required. Progress reports and evaluations were adapted from the EPICS program[8].
16%	Final Projects	2,4,8	Two final engineering design problems are presented. Both required a formal report. The topics are wireless communication (ECE project) and structural analysis and design (ME project).

4. Service Learning Projects

Service-learning challenges students to translate classroom lessons into the "real world," while providing a tangible benefit to the community. The proposed projects are selected before the start of the semester in collaboration with the Office of Service Learning and the Gannon Alliances to Improve Neighborhood Sustainability (ERIE- GAINS) coordinator. Table 3 presents the projects employed in the last three years. The selection of the project is critical. They must provide the level of complexity to keep students engaged but not overwhelm.

In 2010, the service projects were introduced early in the semester. Students were allowed to assemble their teams and select one of the four projects. A list of expected task/ roles was provided to the students. The students divided the roles and mostly worked independently without functioning as a team. A prototype, a report and one presentation were the expected deliverables. At the end of the semester, one out of nine groups produced a physical product; the other eight groups presented their concepts. In 2011, a similar structure was employed for the service projects as in 2010. The only changes were associated with the deliverables: groups were required to make a presentation on their progress on early November and to create a video using PhotoStory to summarize their activities during finals week. The level of hands-on experience varied amongst the groups.

In 2012, one community-based engineering project served as the central theme throughout the entire semester. The project selected was the *Little Free Libraries*[9]. Through the Center of Service Learning and ERIE-GAINS, eleven different community partners were identified to adopt the little free libraries. Clearly outlined deliverables were incorporated throughout the semester to guide students as they applied the engineering design process to this hands-on activity. Figure 1 presents the timeline and an overview of the activities associated with the community-based project. A set of criteria was provided to students to consider during the development of their concept. Table 4 presents the criteria employed during the initial evaluation of the designs.

Table 3: Summary of 2010-2012 projects

Year	Service Learning Project Options	Students Distribution, Students per team	Budget	Comments
2010	1- Perry Square Holiday Decorations	6 teams, 5	$50.00 per group	Only one group built the prototype. Concepts were only presented by others.
	2- Trap the Bloody Red Shrimp	1 team, 5		Conceptualization
	3 - Calculate our Energy Use	1 team, 5		Basic Measurements
	4- Next Great Environmental Design	1 team , 5		Conceptualization
2011	1- Solar Panel Installation	2 teams, 3 / 4	Budget based on requests.	Conceptualization, no installation.
	2 - C.H.O.S.E.N. Mission Project	2 teams, 3 / 4		Students disassembled, cleaned and re-assembled a sterilizer.
	3 - Gannon Goodwill Garden Fence	1 team, 4		Conceptualization.
	4 – Vermi-Composting Experiment	1 team, 3		Design and cost presented. No construction.
	5- White Roofs = Cool Campus?	3 teams, 5 / 4 / 4		Measurements were taken and costs were presented. It was concluded that white roofs are not efficient in Erie.
	6 -Furniture / Fixtures for the One Green World Cafe	4 teams, 5 / 4 / 4 / 4		One table was built using recycled rotors.
2012	Little Free Libraries[9]	11 teams: 4 groups of 6 /7 groups of 5	$250.00 per group	Eleven libraries were built by the end of the semester; four were installed (Figure 3).

Table 4: Criteria provided to students during the project introduction

Criteria	Comments
Cost	Less than $250.00
Creative Design	Unique. Is not similar to any of the models
Eco-friendly	Percentage made of recyclable materials
Mission	Relates to the neighborhood or to the mission of the community partner
Feasibility	Is it realistic to build (consider design, skills, materials)
Durability	Will it protect the books during the seasons?
Requirements	Follows constraints and recommendation by the Little free library organization on the website

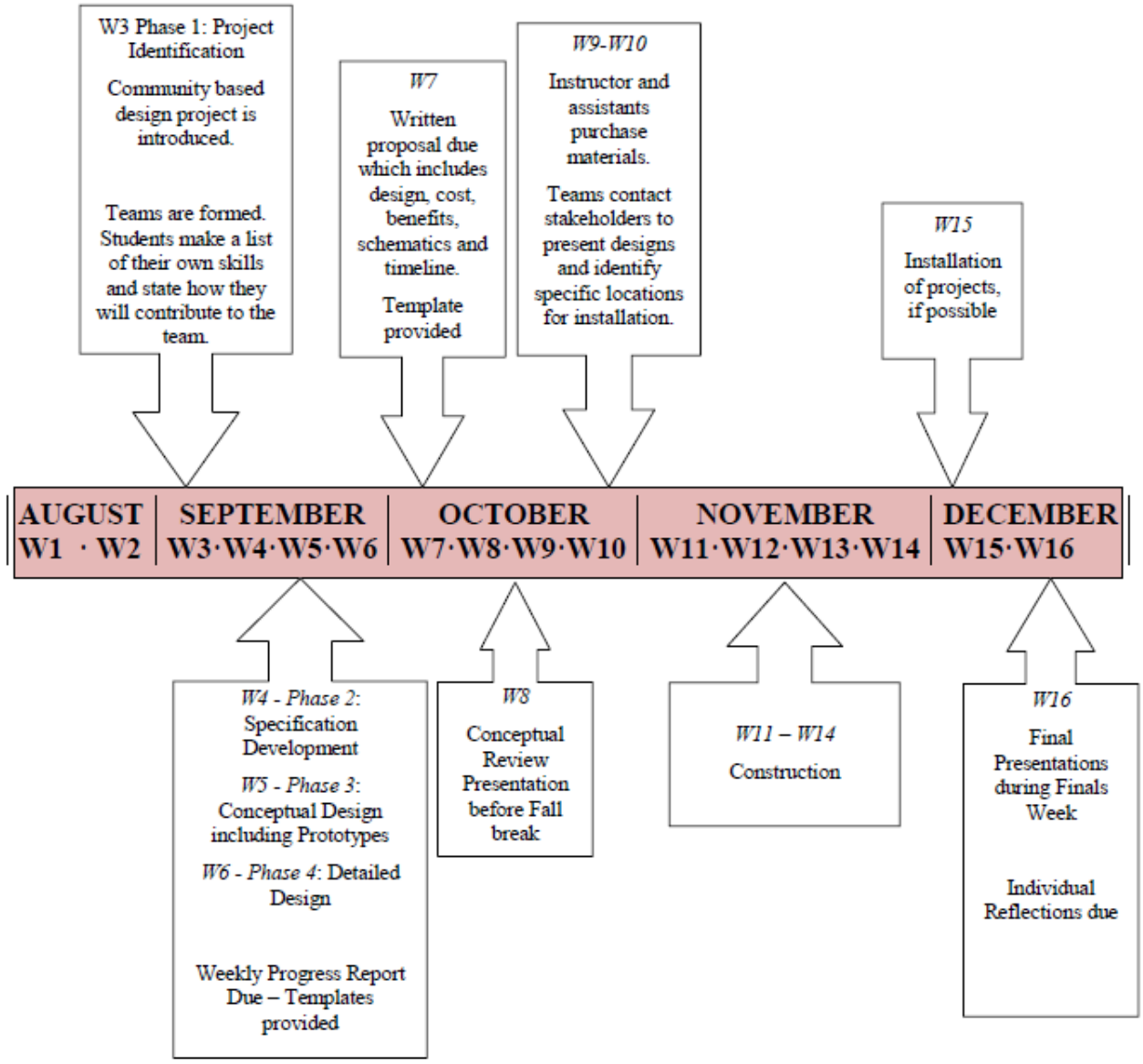

Figure 1 - Deliverables and activities related to community-based service learning project

As presented in the timeline (Figure 1), prototypes were constructed to verify the conceptual design. Figure 2 presents three out of the nine prototypes submitted. From day one, the students were aware that building each library was an expected outcome of the course. At the end of the semester, the eleven little free libraries (one per team) were constructed and four were installed. Figure 3 presents pictures of the installed products. This sample illustrates the different designs that arouse from this exercise. Media attended the installation of the first library and news articles were published promoting the work done by the engineering students[10-11]. The recognition the students received empowered them as they saw the success of their semester long community-based engineering design project.

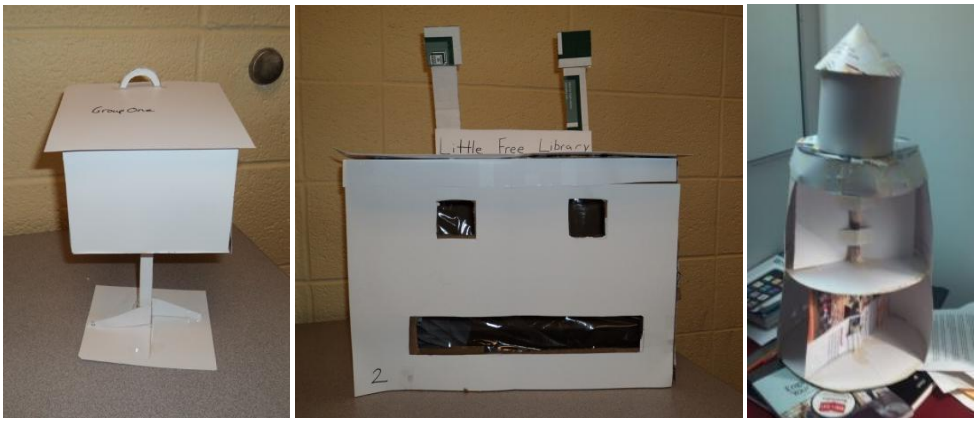

Figure 2- Prototypes of three out of the four Little Free Libraries installed

Figure 3 - The four Little Free Libraries installed: (a) Newspaper Box Little Free Library, (b) Robot Little Free Library, (c) Lighthouse Little Free Library, and (d) House Little Free Library.

5. Preliminary Assessment

The restructure of the First Year Seminar was designed to achieve a cohesive course that engages students in the design process through service learning and introduces them to the university. Course exit surveys for the last three years, 2010-2012, were compiled and compared (note that this survey is general and is used in every single course in the university). Appendix A presents the data. From the students' responses regarding the *course outcomes*, it is observed that the modifications to the course did not result in any statistically significant changes from the students' perception related to the overall course outcomes.

As presented on Table 2, a larger number of deliverables were required from the students in 2012 as compared to previous years. The university-wide course exit survey collects general data regarding the assessment techniques and the overall course evaluation (refer to Appendix A for the data). No significant changes are observed in the students' perception of the assessment techniques. On the other hand, in the comments section of the course exit survey, students stated that the required work on this first-year seminar was higher as compared to other first year experiences. There are over twenty first year seminars at the university; each one with a different focus.

In order to capture more information regarding the impact of the community-based engineering service learning project (which the university-wide course exit survey does not address), an additional survey was developed. The preliminary results are presented on Table 5. The students' answers regarding their overall satisfaction and the awareness of the engineering design process correlate to their answers to the attainment of course outcomes. The questions categorized as "Service" indicate that the students "mid-agree" that through the seminar they were able to understand the impact of engineering in the community, and that service is relevant. Two questions address the engagement/retention goal: students expressed a desire to graduate from engineering / science program. The last category was "Skills": student "mid-agree" that their creativity was challenged and that they improved their communication skills. The questions presented here can be adapted in any course implementing service learning. It is important to develop or implement an instrument to assess the value of the service learning activities which the majority of university-wide surveys do not address[2].

Table 5 – Fall of 2012 Survey Results: *Engineering Environment and Students' Attitudes towards Service Learning*. Mean responses to Likert scale of 1 (Strongly agree) to 4 (neutral) to 7 (Strongly disagree), $N = 54$.

Overall, the seminar and its experiences…	**Category**	**Likert Scale**	**Mean**	**Standard Deviation**
… have been satisfying	Overall	Agree	3.09	1.7295
… have increased my appreciation for the aspects of engineering design	Eng	Mid-Agree	2.80	1.7844
… have increased my awareness of the interdisciplinary interactions of engineering	Eng	Mid-Agree	2.61	1.6068
… have provided opportunities to assess my abilities and interest in my chosen major and career	Retention	Mid-Agree	2.73	1.8219

… have increased my desire to be a graduate of an engineering and / or science program	Retention	Mid-Agree	2.70	2.0889
… have allowed me to understand the impact of engineering solutions in a societal context	Service	Mid-Agree	2.50	1.6107
… have redefined engineering as a helping profession	Service	Mid-Agree	2.70	1.7385
… have improved my ability to communicate effectively	Skills	Mid-Agree	2.89	1.8292
… have challenged my creativity	Skills	Mid-Agree	2.89	1.8395
… have improved my attitude towards community service	Service	Mid-Agree	2.83	1.7988

6. Lessons Learned and Conclusions

Research indicates that students' engagement in hands-on team-based engineering problem-solving activities reinforces the classroom experiences and increases retention. Relevant service-learning activities prepare students for lifelong community participation. These concepts guided the redesign of the First-Year seminar in Engineering. The conceptualization of an idea has a significant merit in the engineering field, but the realization and implementation of the idea carries a larger merit. First years students in engineering benefit from a complete design cycle which challenges their creativity and builds their professional competencies. Once the service learning design project was incorporated into the first year experience, it was imperative to find the means to complete a design cycle, with a tangible product, at the end of the course. This was achieved for the first time in fall of 2012.

As new initiatives are implemented, every aspect must to be assessed to improve future experiences. The following list provides a guide for any faculty wishing to adapt this model to some degree.

- *Selection of the project is critical*. The scope of the project must possess the adequate level of complexity to challenge students and at the same time be feasible for a semester long course.
- *Clearly present the project and its community impact.* Students buy-in will make the semester long project more enjoyable and successful. Make the students care.
- *Keep good communications with stakeholders*. When working with community partners, many aspects are outside the faculty and the students' control. For example, some agencies might require approvals at different levels before a decision can be made. This can delay answers to questions in a timely fashion. If possible, involve the Service Learning Office and make the communications with stakeholder their responsibility. This will allow students to collaborate with personnel within the institution and avoid disappointments that can arise from unresponsive stakeholders.
- *Be aware of students' different skill sets*. First-year students possess a very different set of skills when they enter the engineering programs. Some students might have taken an introduction to engineering course in high school; others might be familiar with drawing

packages. On the other hand, there will be students with no experiences or skill sets related to engineering.

- *Ensure machine shop support for the freshmen.* Based on the different skills sets and the students' access to tools, it is important to coordinate machine shop support for those groups that need it.
- *Standardize the materials without eliminating the possibility of creative designs*. In 2012, students were allowed to select anything their heart desired as long as they were under budget. This resulted in over seven trips to Lowes and Home Depot. A recommendation is to create an online account that students can use to select their materials and save them in the shopping cart. Faculty or assistants can then review and order the materials. Orders will be managed more effectively.
- *Connect several assessment methods to the project.* As presented in Table 2 and Section 3, the project should have an enough weight in the overall course grade to ensure students' initial investment.
- *A maintenance program must be instituted.* Projects that deliver a product to the community should estipulate who is responsible of any future maintenance. At this point, the Service Learning Office is developing a system to maintain the Little Free Libraries stocked with books as well as to periodically check their physical conditions.
- *Obtain monetary commitment*. Money should not be the reason why a project is not implemented when the cost is reasonable especially after students have devoted a large amount of time to the development of an idea.
- *Non-engineering students can be participants in the seminar*. The projects and lectures should be general enough such as to engage non-engineering students.
- *Enroll upperclassmen to serve as managers*. The time required to oversee service-learning projects can overwhelm faculty introducing them for the first time especially in a course with a large enrollment. Upperclassmen can benefit from the interaction with freshmen. They can learn leadership and management skills form this experience. From the freshmen perspective, they can connect in a friendlier level with the upperclassmen. A mentoring relationship can develop which can have retention effects.
- *Obtain university and community coverage of the project*. The recognition that students receive for their work and their community engagement are a powerful tool to increase students' satisfaction and desire to continue involved in service learning projects.

7. References

1. C. W. Swan, J. J. Duffy, K. Paterson, A. R. Bielefeldt, and O. Pierrakos. (2011). The EFELTS Project – Engineering Faculty Engagement in Learning through Service. [PDF] in *American Society for Engineering Education Annual Conference and Exposition Proceedings*. (Paper 2011-1324), NSF Grantees Poster Session, June 26-29, Vancouver, British Columbia, Canada.

2. A. R. Bielefeldt, Paterson, K. G., and C. W. Swan. (2010). Measuring the Value-Added from Service Learning in Project-Based Education, *Int. J. Engng Ed.,* Vol. 26, No. 3, pp. 535–546.

3. K. Paterson, C. Swan, and K. L. Guzak. (2012). Impacts of Service on Engineering Students [CD] in *Proceedings of the 2012 American Society of Engineering Education Annual Conference*, June 10-13, San Antonio, TX.

4. Gannon University Undergraduate Catalog 2012-2013 http://www.gannon.edu/Academic-Offerings/Academic-Catalogs/

5. Sundaram, R. (2011). Work In Progress: Integration of Topic Modules and Organization of Session Flow for the First-Year Seminar Course in Engineering to Motivate and Sustain Student Learning. *41st ASEE/IEEE Frontiers in Education Conference*. October 12-15, Rapid City, SD.

6. Sundaram, R. (2012). Work in Progress: Redesigned First-Year Seminar Course in Engineering – Delivery, Learning Outcomes Assessment, and Lessons Learned. *42nd ASEE/IEEE Frontiers in Education Conference*, October 3-6, Seattle, Washington.

7. Oakes, W.C., Leone, L.L., and Gunn, C.J (2012). *Engineering your Future: A Brief Introduction to Engineer*ing. Oxford University Press, Fourth edition.

8. EPICS Purdue. [Online] Available: https://engineering.purdue.edu/EPICS

9. Little Free Libraries. (n.d.) *Little Free Libraries* [Online] Available: http://www.littlefreelibrary.org/

10. Gannon University. News Archive 12/11/2012, *XXX Brings Little Free Library Concept to Erie* [Online] Available: http://www.gannon.edu/NewsDetail.aspx?id=8589939047

11. Myers, Valerie. (2012). Gannon University to place first 'Little Free Library'. *Erie Times-News*. [Online] Available: http://www.goerie.com/article/20121206/NEWS02/312059912/Gannon-University-to-place-first-'Little-Free-Library'

Appendix A

Fall 2010-2012 Course Exit Survey Results

Course Outcomes. Mean responses to Likert scale of 5(Strongly Agree) to 3(Neutral) to 1(Strongly Disagree).

Outcomes	*Fall 2010_01 (19/22)*		*Fall 2010_02 (18/21)*		*Fall 2011_01 (23/24)*		*Fall 2011_02 (24/27)*		*Fall 2012 (51/58)*	
	Mean(5)	**sd**	Mean(5)	**sd**	Mean(5)	**sd**	Mean(5)	**sd**	Mean(5)	**sd**
1 Comprehend basic topics in mathematics, science, and problem solving tools common to the engineering fields	**3.7**	**0.34**	**4.1**	**0.38**	**4.0**	**0.43**	**3.9**	**0.38**	**4.0**	**0.33**
2 Comprehend the engineering design process and problem solving techniques	**3.4**	**0.45**	**3.9**	**0.50**	**3.9**	**0.49**	**4.0**	**0.34**	**3.9**	**0.32**
3 Comprehend how economic, environmental concerns, health and safety, communication, social concerns impact engineering	**3.6**	**0.38**	**3.8**	**0.43**	**4.3**	**0.39**	**4.2**	**0.35**	**4.0**	**0.35**
4 Demonstrate the ability to conduct experiments and analyze data	**3.3**	**0.43**	**4.0**	**0.44**	**4.0**	**0.30**	**4.1**	**0.34**	**3.9**	**0.38**
5 Demonstrate the ability to analyze one of the following LIFECORE dimensions including related activities and presentations: Intellectual, Life Planning, Cultural, or Political	**3.6**	**0.37**	**3.7**	**0.49**	**4.0**	**0.44**	**3.9**	**0.39**	**3.8**	**0.41**
6 Demonstrate the ability to relate the following two elements of Catholic social teaching to their own lives: (a) the affirmation of the fundamental rights and responsibilities of every person, (b) the protection of the dignity of work and the rights of workers	**3.7**	**0.40**	**3.8**	**0.49**	**4.0**	**0.38**	**3.7**	**0.36**	**3.7**	**0.39**
7 Demonstrate the ability to analyze what they learned from their engineering service learning experience	**3.1**	**0.39**	**4.0**	**0.42**	**4.1**	**0.36**	**4.0**	**0.33**	**3.8**	**0.34**
8 Demonstrate effective electronic communication and collaboration skills, including the ethical use of computing software and Internet technologies	**3.6**	**0.41**	**4.2**	**0.42**	**4.0**	**0.43**	**4.0**	**0.37**	**3.7**	**0.42**
9 Demonstrate the ability to evaluate personal study habits and develop goals to improve those habits	**3.3**	**0.36**	**4.1**	**0.45**	**3.9**	**0.47**	**3.9**	**0.41**	**4.0**	**0.36**
Total Class Response:	**3.5**	**0.39**	**4.0**	**0.45**	**4.0**	**0.41**	**3.9**	**0.36**	**3.9**	**0.36**

Assessment Techniques. Students indicate the fairness of each method of assessing their performance. Mean responses to Likert scale of 1 (Unfair) to 3 (neutral) to 5 (Fair).

	Questions	*Fall 2010_01 (19/22)* Mean(5)	sd	*Fall 2010_02 (18/21)* Mean(5)	sd	*Fall 2011_01 (23/24)* Mean(5)	sd	*Fall 2011_02 (24/27)* Mean(5)	sd	*Fall 2012 (51/58)* Mean(5)	sd
1	Examinations/ Quizzes	3.1	0.53	4.2	0.46	4.1	0.59	4.2	0.44	4.3	0.46
2	Homework assignments	3.3	0.40	4.1	0.54	4.4	0.40	4.4	0.39	3.5	0.60
3	Projects/Papers	2.8	0.43	3.7	0.55	4.2	0.46	4.3	0.42	3.6	0.63
4	Oral presentations	3.7	0.41	4.4	0.37	4.4	0.45	4.4	0.40	4.1	0.47
5	Classroom discussion	3.7	0.57	4.0	0.39	4.4	0.42	4.3	0.48	4.2	0.52
6	Attendance policy	4.3	0.54	4.8	0.24	4.5	0.36	4.6	0.33	4.6	0.36
	Total Class Response:	3.5	0.48	4.2	0.42	4.3	0.45	4.4	0.41	4.1	0.51

Overall Evaluation of the course. Mean responses to Likert scale of 1 (Poor) to 3 (neutral) to 5 (Excellent).

	Questions	*Fall 2010_01 (19/22)* Mean(5)	sd	*Fall 2010_02 (18/21)* Mean(5)	sd	*Fall 2011_01 (23/24)* Mean(5)	sd	*Fall 2011_02 (24/27)* Mean(5)	sd	*Fall 2012 (51/58)* Mean(5)	sd
1	How would you rate the overall quality of the course?	2.7	0.45	3.5	0.44	4.0	0.45	3.7	0.54	3.6	0.44
2	How would you rate the faculty's overall performance in this course?	3.4	0.42	4.4	0.38	4.2	0.44	4.0	0.44	3.9	0.44
3	How would you rate your overall learning experience in this course?	2.6	0.54	3.1	0.58	3.9	0.48	3.5	0.51	3.4	0.57
	Total Class Response:	2.9	0.47	3.7	0.47	4.0	0.46	3.7	0.50	3.6	0.48