AC 2010-1419: SERVICE LEARNING IN THE COLLEGE OF ENGINEERING AT VILLANOVA UNIVERSITY

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Service Learning in the College of Engineering
Villanova University

Introduction

It is important for students to participate in community service and to develop an awareness of the impact they can have on society. When people work on service projects they usually learn a great deal; however, this paper specifically discusses Service Learning defined as "a teaching and learning strategy that integrates meaningful community service with instruction and reflection to enrich the learning experience, teach civic responsibility, and strengthen communities". [(1)] Learning "civic responsibility" and "strengthening communities" are both desirable outcomes of engineering education. The emphasis of this paper is on Service Learning as it applies to engineering education and engineering students.

This paper provides a brief history of service and service learning at Villanova University. It discusses a rationale for service learning and then describes service learning in the College of Engineering. Some typical projects are described. Also discussed is how Service Learning has impacted the education of our students.

History of Service Learning at Villanova University

Significant opportunities and encouragement for student participation in volunteer activities are provided by the university. Each year a voluntary "Day of Service" is sponsored in which over 3000 students and over 500 faculty, staff, and alumni participate. These students account for one-half of the undergraduate student body of the university. About two thousand students participate in each of three other yearly service events held on campus. Approximately three-hundred undergraduate students volunteer weekly working in locations within a fifty mile radius of the university. Additionally every year approximately 900 undergraduate students go on service trips lasting usually from one to three weeks. These students travel to local, national, or international locations. Most of these trips are not focused solely on engineering although many have engineering related components and many engineers participate in these activities. Appendix A shows a summary of some of the ongoing Community Service/Service Learning projects. [(2)]

At least since 1969 the College of Engineering has had students working with community organizations to solve local problems. In 1992 the Engineering College started sponsoring one week to one month long international service trips focused solely on engineering related projects. These trips are supervised by faculty members with the help of engineering alumni. The first trip was to Wacuco, Panama. Since then, there have been engineering service trips to places such as Panama, Nicaragua, Honduras, Kenya, Peru, Thailand, Philippines, Florida and Louisiana.

Rationale for Service Learning

As stated in the University's Mission Statement, students and faculty have a responsibility to "better the human condition". [(3)] It is a goal of the university to inculcate in the students a belief

that they have a moral and ethical responsibility to try to improve the lives of all people. Further, the Mission Statement "encourages students, faculty and staff to engage in service experiences and research, both locally and globally, so they learn from others, provide public service to the community and help create a more sustainable world". [3] This can be done by studying and experiencing people and cultures and then acting to improve understanding and living conditions for everybody.

The College of Engineering considers Service Learning to be a critical aspect of the academic and personal growth of its students. These students learn about engineering and the world while serving local and international communities. [4] The college administration has always been supportive of Service Learning but in recent years the Dean and Associate Deans of the College of Engineering have taken leadership roles. They participate actively. Frequently leading groups of faculty and students on Service Learning experiences.

The National Society of Professional Engineers Code of Ethics states in the Preamble:

> Engineering has a direct and vital impact on the quality of life for all people. Accordingly, the services provided by engineers require honesty, impartiality, fairness, and equity, and must be dedicated to the protection of the public health, safety, and welfare. [5]

Service Learning provides students the opportunity to deal with the "public" and frequently gives them the experience of improving the "quality of life" of the people with whom they are interacting.

The Accreditation Board of Engineering and Technology (ABET) defines engineering as follows:

> Engineering is the profession in which a knowledge of the mathematical and natural sciences gained by study, experience, and practice is applied with judgment to develop ways to utilize, economically, the materials and forces of nature for the benefit of humankind. [6]

What better way is there for an engineering student to learn about engineering for "the benefit of humankind", than to use their engineering skills to develop ways to improve the lives of people both locally and throughout the world?

Service Learning contributes to a student's understanding of "professional and ethical responsibility" and understanding the "impact of engineering solutions in a global, economic, environmental, and societal context" which are two "Program Outcomes" prescribed by the Accreditation Board of Engineering and Technology. [7] Additionally, well arranged Service Learning projects contribute to student development in all of ABET's Criterion 3. (a) through (k) Program Outcomes. [7]

The National Academy of Engineers in their report on educating the engineer of 2020 state,

> Technical excellence is *the* essential attribute of engineering graduates, but those graduates should also possess team, communication, ethical reasoning, and societal and global contextual analysis skills as well as understand work strategies. Neglecting development in these arenas and learning disciplinary technical subjects to the exclusion of a selection of humanities, economics, political science, language, and/or interdisciplinary technical subjects is not in the best interest of producing engineers able to communicate with the public, able to engage in a global engineering marketplace, or trained to be lifelong learners. [8]

Project-oriented team-based service learning is an effective way for engineering students to learn technical material and gain an understanding of engineering in a societal context. Service Learning contributes to students developing many of the attributes recommended in this report.

Service Learning experiences involve students in real-life engineering projects where teams of students meet with clients to define community needs and constraints and then work with the community to help satisfy their needs. Documentation of final recommendations and oral and written presentations to the community are usually involved. It is experiential learning.

According to the report of the National Academy of Engineering, Educating the Engineer of 2020 Adapting Engineering to the New Century, Service Learning contributes to the recruitment and retention of students [9]. In the report it is stated

> Curricular approaches that engage students in team exercises, in team design courses, and as noted above, in courses that connect engineering design and solutions to real-world problems so that the social relevance of engineering is apparent appear to be successful in retaining students. [8]

In another place in the same report the statement is made

> Based on the curricular experiments that have been conducted under the National Science Foundation (NSF) Coalitions Program, it is apparent that students who are introduced to engineering design, engineering problem solving, and the concept of engineering as a servant of society early in their undergraduate education are more likely to pursue their engineering programs to completion. The same approach apparently is also more appealing to women and underrepresented minority students who are in such short supply in engineering programs and much more likely to drop out. [8]

Types of Projects in the College of Engineering

Students, faculty, and administrators in the College of Engineering participate in a variety of Service Projects and Service Learning. Engineering students work weekly with teams of inner-city middle and high school students tutoring, teaching, or acting as advisors on technical projects. They volunteer to do energy audits of homes and businesses in the local community. They travel nationally and internationally working on Habitat For Humanity and Engineers Without Borders type projects. [2] *Table 1* is a summary of many of these projects.

The projects related to the trips are mostly associated with Civil Engineering although the College is expanding the focus to include students and faculty from all of the engineering disciplines and even from majors such as Nursing, Business, and Foreign Languages. It is important for engineering students to learn how to work with people from a variety of different disciplines and backgrounds.

Related to these trips the students and their faculty advisors work on such things as cinder block, reinforced concrete, and steel structures, gravity fed and pumped water systems, photovoltaic systems, potable water testing and treatment, small sanitation systems, micro-hydroelectric systems, playgrounds, energy audits, and micro-finance entrepreneurial projects with an engineering focus.

Sometimes students work on the construction of projects but usually more time is spent working with local communities collecting information, doing feasibility studies, evaluating existing systems and training the local partners. When back on campus students design structures and systems and help raise funds so the people in the local communities can implement the designs.

Table 1: Service Learning with Engineering Involvement

Service Learning		
Project	**Date Begun**	**Description**
Amigos de Jesus	2000	In this service learning course students work on various structural designs for a Catholic orphanage in Honduras. *Amigos de Jesus* is not only a residential orphanage for over fifty children but it also supports hundreds of impoverished children in the area.
Boosting Engineering, Science and Technology Robotics BEST	2004	The College of Engineering in conjunction with the Sophomore Service Learning Community supports the Philadelphia Hub BEST Robotics Competition in three ways: as mentors to area robotics clubs, as the host of the Kick-off, and as volunteers at the final competition.
Engineers Without Borders	2002	Engineers Without Borders - USA (EWB-USA) ***Water Supply Project, Baan Bo Mai, Thailand:*** Completed work in Thailand to establish a storage and distribution system to provide a cleaner water source for two villages and an orphanage in northern Thailand (Took over the project from the University of Maryland in 2007 and completed it in May 2008.) ***Water Supply Project, Kenya:*** The feasibility of a pumped potable water system was investigated. ***Capdau Elementary School Project, New Orleans:*** In 2006, to help those affected by Hurricane Katrina, helped a primary school rebuild and completely refurbish their outdoor playground facilities. Over the course of three trips, asphalt and concrete were removed to establish a site, hazardous debris disposed of and a new play set designed by the kids themselves was installed. ***Special Olympics Project, Villanova, PA:*** Engineering students built ramps for the award blocks to make it easier for the athletes to receive their awards. One set for the November 2006 Special Olympics and a second set for the 2007 Special Olympics were constructed.

Habitat for Humanity	1989	In the Week-Long program, 20 to 30 Villanovans construct or rebuild houses for economically disadvantaged persons. Twenty groups per year travel throughout the United States. From 2004 thru 2007, Villanova sent the most students out of approximately 250 campus chapters. In the Two-day program, Villanova works with local Habitat affiliates Approximately 800 VU students sign up each year,
Learners Connect! Learning Partners	2006	Learning Partners is an online tutoring and mentoring program between Villanova undergraduates and students at the School of the Future (SOTF). Participants work together through an online course that is focused on career/college goals with SOTF learners. The program has the goal of focusing learners on the fact that college is a feasible possibility. It tries to accomplish this through presence of a college student as mentor and through the content of the mentoring relationship.
Mission Service Break Experiences	1976	The week-long service experience is primarily determined by each service site and the requests/desires needed by each service site.
Overbrook High School Program	2007	A tutoring clinic is held on site at Overbrook High School (West Philadelphia) during the school day three days per week and an afterschool academic tutoring center three afternoons per week. The participants attend to whatever subject questions the students have. Most of the time is spent helping the students with Math, Science, and English, and occasionally, with Spanish and their Senior projects.
Sophomore Service Learning Community	2006	Students live in the same residence hall, where they attend weekly seminars to discuss/study their service learning. Students must take at least one Service Learning course as well as the one credit reflection seminar. Students offer weekly service.
VESTED Academy	2005	VESTED is an exposure and enrichment program whereby students receive information and training in the fundamental principles of engineering in an interactive environment utilizing hands-on experimentation. They also receive information on college life, academic preparation, and effective study skills through outside speakers and workshops.
Villanova University/ Catholic Relief Services Partnership	2005	Collaborative education, research, advocacy and service including: • *Lectures/Events*: 7 to 10 annual university lectures and events Attendance exceeded 700 in AY 2007-2008 • *Curriculum*: piloted, with several other universities, a web-based two-week offering ; sponsored a semester long, team taught course focusing on legislative advocacy; held approximately 4 to 10 classroom guest lectures per year. • C*RS Internships*: several student internships to study social issues in locations such as Ecuador and Lebanon as well as in U.S.
Villanova Urban Storm Water Partnership	2002	The mission of the VUSP is to advance the evolving comprehensive stormwater management field and to foster the development of public and private partnerships through research on innovative stormwater, Best Management Practices, directed studies, technology transfer, and education. The VUSP performs research and public outreach in the area of stormwater management. Combining seminars, workshops, symposiums, internet broadcast and homepage, we reach many thousands. Many public and municipal watershed groups are involved.
"Water for Waslala" Community Water Supply Project	2002	Since 2002, the College of Engineering and later, the College of Nursing have partnered with the non-profit organization Water for Waslala (WfW) to assess, design and implement water supply projects for rural communities in Nicaaragua. Students in a senior design seminar class go to Waslala for a week assessment trip. Students assist local groups identifying community needs & create project plans. Students travel to rural villages to evaluate prior projects/assess new ones for water supply/distribution systems. Students return to Villanova and finalize engineering specifications for gravity-fed water supply and distribution systems. These groups then prepare and submit proposals to WfW for funding consideration.

Integration into Education

Some of the projects are integrally related to courses and others are totally independent of specific courses. Some courses that have appreciable Service Learning components are:

- EGR 2001 - Engineering: Humanistic Context
- ME 4050 - International Development
- CHE 4831 - Chemical Engineering Research I
- ME 4800,01,02 - Design Seminar in Mechanical Engineering
- ECE 3970 - Design Seminar in Electrical Engineering
- CEE 4606 - Civil and Environmental Engineering Capstone Design
- CEE 4611 - Civil Engineering Service Learning
- Many courses in the Engineering Entrepreneurship minor.

For example in EGR 2001 - Engineering: Humanistic Context, in addition to their coursework the students work in groups on semester long projects which must use engineering and/or science to satisfy some need of society. Recently one of these projects was the design of a water distribution system for a community in Kenya. Another project was the development of an Introduction to Engineering course to be presented to local middle and high school students. In ME 4050 - International Development the students have worked on the design of gravity fed water systems in Thailand and Nicaragua among other things. Students in the Civil, Mechanical, and Electrical Engineering Capstone Design courses work together on a variety of projects, most recently a solar powered pumping system for an orphanage in Honduras.

Many Service Learning Projects are not directly connected to specific courses. These projects are usually sponsored by various departments or organizations in the College of Engineering. For example the Villanova student chapter of Engineers Without Borders co-sponsors many of these projects. To become involved in these projects the students must apply. Some of the projects are more selective than others because more students apply for the trips than can be accommodated. The applications are used to help with the selections. Active members of Engineers Without Borders, upper class students and students with needed skill sets or knowledge are given preference.

At the start of most projects the students meet bi-weekly or more frequently, for a month or two, usually with an advisor, to get background information related to their clients and the project. Students research and discuss topics such as culture, history, geopolitical considerations, poverty, government, societal constraints, economics, etc. The students also receive instruction related to the technical aspects of the project, which they may not have seen in class, such as Surveying, water testing, water treatment, pumps, photovoltaics, power generation, energy audits, micro-hydroelectric systems, robotics, etc. They also work independently on project management, finances, planning, and design. When the project is not directly related to a course, a variety of faculty members are involved in these meetings, each presenting their own topic of interest or expertise.

Students are encouraged to develop “local solutions to local problems”. They need to work closely with community members to understand the technical expertise available in the

community as well as to understand economic and cultural considerations. That is the only way that the system that is designed and built will be truly sustainable. Throughout the project, the students and faculty spend time discussing what they are doing and finally what they have accomplished and experienced.

Examples of Service Learning Projects in the College of Engineering

Potable Water Distribution Systems:
Twenty to twenty-five students travel to Waslala, Nicaragua each year during Spring Break. Half of the students are nurses and half are engineers. The all the students meet frequently for the two months prior to the trip to learn as much as they can about the people and conditions in Waslala, Nicaragua. The nursing students and the engineers also meet separately. The nurses plan their community health workshops. The engineers learn or review topics related to pipe flow, open channel flow, concrete tank construction, foundations, simple suspension bridges, surveying and flow measurement, water quality testing, water related community health, project planning, and community assessment procedures. Also the students procure any equipment or supplies that will be needed for the trip.

When the students arrive in Waslala they break up into three or four groups including both engineering and nursing students and faculty. The smaller groups travel to communities who have requested water systems. The nurses give community health workshops and meet with community members to discuss water related health problems while the engineers collect information to help determine the feasibility of a water system for that community. The engineers also meet with the community as a whole to discuss the community's expectations and suggestions for a water system, community organization, and what is necessary for the construction and maintenance of a water system. Also included is talk about preservation of the habitat around the source, sustainability and reforestation.

These groups also travel to communities that have water systems that were previously designed by Villanova students and faculty and built by the local community members. One of the purposes of these visits is to inspect the systems and make suggestions about how to improve them. Another purpose is to assess whether the water system has improved the community's health and quality of life. Each evening the groups meet to discuss their experiences of the day and to go over the data they have collected.

After returning to school, the students continue to meet to determine the feasibility of the specific systems and to design the systems that are feasible. The final reports include Detail Drawings of the piping systems, storage tanks, catchment tanks, tap stands, stream and ravine crossings, and source protection. Also included are a Bills of Materials and cost estimates. The reports are then presented by the students to an organization called Water for Waslala which is made up of young Villanova alumni who raise money to fund these water projects.

Micro-Hydroelectric Power Systems:
Groups of business and engineering students are working on the design of Micro-hydroelectric power systems for communities in the Philippines and in Nicaragua. First they determined that photovoltaic cells are too expensive and fossil fuel generators are not sustainable for these

communities. Next the students learned as much as they could about their clients and researched micro-hydroelectric power generation. At the same time the business students raised funds for the project and investigated the potential for related micro-economic development programs.

The communities were visited to determine their specific needs, desires, and constraints. Streamflow data was collected along with the corresponding elevations and distances. The students met with local manufacturers, craftsmen, and suppliers to assess their capabilities and determine who could manufacture or supply the turbines and other mechanical and electrical parts. This also helped with cost estimates.

While at school, the students contacted and received help from local engineers working in related fields and solicited parts from U.S. manufacturers. After preliminary designs were completed, groups of students revisited the communities to discuss the plans. They also revisited the manufacturers they chose to do the work so they could discuss the manufacture of the parts.

Competent manufacturers located as close as possible to the communities were selected to increase the probability of sustainability and for economic development. The hope is that some community members and the manufacturers will develop enough expertise that they can help nearby communities develop similar systems.

Amigos de Jesus Orphanage Project in Poses Verdes, Honduras:
Since 2000, Civil Engineering students enrolled in Senior Capstone Design in Structural Engineering have worked on various structural designs at Amigos de Jesus, an orphanage in Poses Verdes, Honduras. Students in the classes have traveled to Honduras with the professors to work on the construction of various structural designs.

So far a volunteer center, chapel, and two school buildings have been designed and built and two more school buildings are under construction including a computer laboratory building. The students are creating a center for learning on the site of the orphanage. This eight building school complex designed by our Civil Engineering students will not only be used by the boys at the orphanage, but also by children from the surrounding area, who may otherwise never have access to any formal education. [10]

Boosting Engineering, Science and Technology-Robotics (BEST):
BEST is a non-profit, volunteer organization whose mission is to inspire students to pursue careers in engineering, science and technology through participation in a sports-like, science and engineering based, robotics competition. The College of Engineering in conjunction with the Sophomore Service Learning Community supports the Philadelphia Hub BEST Robotics Competition in three ways: as mentors to area robotics clubs, as the host of the Kick-off, and as volunteers at the final competition. The BEST competition is a six week process that begins with a Kick-off to introduce the competing teams to the new game and ends with competition day. Villanova hosts the Kick-off which brings over 300 area robotics students, parents, teachers and supporters to campus. Villanova recruits and trains a group of twenty graduate and undergraduate students as mentors to the robotics students. The robotics students are members of clubs and classes throughout the Philadelphia School District and participate in various competitions during the academic year. Mentors spend three hours a week at an assigned school.

In total five schools were visited during the six week competition period for BEST Robotics. In addition, in 2006, almost two dozen Robotics educators, from the School District of Philadelphia (SDP), gathered at Villanova University's Center for Engineering Education and Research (CEER) to take part in an AT&T sponsored three-day computer-aided design workshop. This program was repeated in 2007 when 26 teachers visited Villanova for a three day robotics educator's workshop. [2]

Impact on Students

When students return from service trips they are asked to express their opinions on certain topics related to the trip and themselves. These surveys help quantify student opinions of how Service Learning has impacted them and their education. The answers to selected questions are summarized in *Tables 2 and 3*. Students and advisors also answer open-ended questions which are more difficult to quantify. These surveys as well as anecdotal evidence will be discussed related to the effects of Service Learning on engineering students.

Table 2: Student Survey Regarding Service Trips

The following questions were asked of students after returning from service trips.		
Questions	**Three Engineering Trips**	**University trips**
	n=45	n=629
(1 very little ----------5 very much)	**Rating**	
1) Extent to which this activity contributed to your understanding of the responsibility to care and be concerned for others	4.8	4.8
2) Extent to which this activity contributed to your understanding of how to apply your unique gifts within society/community	4.5	4.5
3) Extent the Activity contributed to integration with your academics	4.7	3.7
(1 Strongly Disagree ----------5 Strongly Agree)		
4) The activity was well planned and organized	4.8	4.8
5) The regular meetings and/or gatherings of this activity were effective	4.7	4.8

Social Awareness and Responsibility:
When students work with members of a community, it increases their awareness of societal constraints [11] and social responsibility. This statement is supported by the students' responses in our survey to question #1 in *Table 2* which asks how Service Learning affected their social awareness. The response to this question was 4.8/5.0 with *1 representing very little and 5 very much.* Through these experiences students become more aware of an engineer's responsibility to society and how to use their engineering skills. Their response of 4.5/5.0 to question #2 in Table #2 supports this. They learn how to interact with clients and respond to clients' wishes. They learn how to explain technical issues in non-technical terms and how to clearly and unambiguously document design plans. Our students had a "learning experience" when they found that a set of design plans which they felt were clear and unambiguous, were inappropriately "scaled-up" by a community for a different project.

International awareness and experience:
When these projects are international in nature the students become more aware of differences in cultures. They realize that culture and life experiences affect how people think. They give the students a global perspective on engineering and present engineering in a societal context. Students become more confident that they can work with people of different cultures who speak different languages. Students are frequently surprised when they can communicate technical information to community members who speak a different language. A number of our students and faculty have returned from trips with a new interest in learning a foreign language. Some of our students have come back from trips and earned minors in Spanish. A number of students have become fluent in Spanish, primarily so they could return to the communities that they visited for extended periods of time. Currently the Dean of the College of Engineering is planning Summer Spanish Language Workshops for faculty in the college who are interested.

Motivation and Learning:
The increased motivation and enthusiasm the students have to master their academic subjects is evident. This is supported by the student response to the engineering trips shown in *Table 2* questions #3 and #5 which discuss how well the project activities integrated with their academics. The responses to both questions were 4.7/5.0. Students involved with these service projects voluntarily attend classes and meetings that are not parts of their courses. They approach faculty with technical questions unrelated to their courses. They sometimes approach faculty to give seminars on topics that are not covered in the curriculum. This results in the students developing technical expertise they would not otherwise have. For example Civil Engineering students attend seminars on sizing solar panels and electrical power management. Mechanical Engineers learn how to survey and use stream flow measurement devices and how to test for water quality. Electrical Engineering students learn about fluid flow. We also find students teaching and discussing with other students technical topics related to their projects.

That these projects contribute to the intellectual and personal development of students is supported by the results of the two questions in the student survey shown in *Table 3*. 100% of the students answering the survey felt that the project on which they were working, either "Effectively" or "Very Effectively" contributed to their personal and intellectual development.

Table 3: Service Trip Survey Regarding Student Development

Student Survey Regarding Personal and Intellectual Development					
Questions n=45	**Very Ineffective**				**Very Effective**
Value of Activity as it contributed to your personal development	0 %	0 %	0 %	15.6 %	84.4 %
Value of Activity as it contributed to your intellectual development	0 %	0 %	0 %	26.7 %	73.3 %

Faculty-Student Interactions:
As a result of these projects the relationship between faculty members and students changes. Faculty members see how enthusiastic and hard working the students are. Students see faculty members as real people who do not automatically know the answers to real problems. Students are frequently surprised to find that faculty members enjoy working and talking with them. For

example a faculty member on one of the international trips to Central America came back with the story of walking on narrow rocky trails in a remote part of Nicaragua when one of the students asked him to explain a technical concept. Prior to this the student did not understand the concept and was hesitant to "waste" his teacher's time in class by asking questions. This topic was then discussed in detail for the rest of the hike with both the student and the teacher learning something.

Conclusions

Service Learning projects enhance the intellectual and personal development of students and faculty. Attitudes about service to society and poverty and diversity are developed and good habits formed. The image that students and faculty members have of themselves and of their relationship to a global society is changed. Students universally state that they benefitted more from the experience than the communities with whom they worked. Introspection is fostered. Concepts in science and engineering are better understood. Interpersonal skills are developed. Enthusiasm for engineering is enhanced. In the College of Engineering at Villanova University, the student demand for Service Learning opportunities has necessitated the constant expansion of these programs. The "expansion of Service Learning" is now included in the Strategic Plans of the Engineering College and the University. [12]

References

1. **Corporation for National and Community Service.** What is Service Learning? *Learn and Serve America's National Service-Learning Clearinghouse.* [Online] [Cited: November 18, 2009.] http://www.servicelearning.org/what-service-learning.
2. **Office of Planning and Institutional Research.** *A volume of Community Engangement, Community Service and Service Learning.* Villanova : Villanova University, 2009.
3. **Villanova University.** Mission Statement. *Office of the President.* [Online] 2009. http://www1.villanova.edu/villanova/president/about_university/mission.html.
4. **College of Engineering - Villanova University.** Opportunities for Service Learning. *College of Engineering - Villanova University.* [Online] 2009. http://www.villanova.edu/engineering/service/.
5. **National Society of Professional Engineers.** NSPE Code of Ethics for Engineers. *NSPE Ethics.* [Online] 2009. http://www.nspe.org/Ethics/CodeofEthics/index.html.
6. **Oakes, W. and Lima, M.** *Service-Learning in Your Community.* St. Louis : Great Lakes Press, Inc., 2006.
7. **Engineering Accreditation Commission.** *Criteria for Accrediting Engineering Programs 2009-2010.* Baltimore : ABET, Inc., 2009.
8. **National Academy of Engineering.** *Educating the Engineer of 2020 - Adapting Engineering to the New Century.* Washington : The National Academies Press, 2005.
9. —. *Changing the Conversation:Message for Improving Public Understanding of engineering.* Washington : The National Academies Press, 2008.
10. **Civil and Environmental Engineering Department.** Civil and Environmental Engineering Opportunities for Service Learning. *Villanova University.* [Online] 2009. http://www.villanova.edu/engineering/departments/civil/service/.
11. **Wyatt, T. and Brown, J.** Design Thinking for Social Innovation. *Stanford Social Innovation Review.* Winter 2010.
12. **Strategic Planning Committee - Villanova University.** *The Villanova University Strategic Plan.* Villanova, PA : Villanova University, 2010.

13. **Chemical Engineering Department.** Chemical Engineering Opportunities for Service Learning. *Villanova University.* [Online] 2009. http://www.villanova.edu/engineering/departments/chemical/servicelearning.htm.
14. **Coyle, E, Jamieson, L., and Oakes, W.** EPICS: Engineering Projects in Community Service. *International Journal of Engineering Education.* 2005, Vol. 21, No. 1.

Appendix A

Community Engagement and Community Service		
Project	**Date Begun**	**Description**
Advent Giving Tree	1986	Villanova joins with the St. Thomas of Villanova Parish and four inner city parishes. The STV parish team buys gifts of warm clothing for 320 the elderly and children. Members of the Parish wrap and deliver these gifts. Villanova students help deliver the gifts.
Annual Athletic Department Community Service Trip	2001	Athletics administrators, coaches, and staff annually volunteer to perform various community service projects including: painting cafeterias, serving meals, replacing kneelers, repairing stone work, and assisting in pouring of new concrete slabs.
Balloon Day	1973	Balloon Day is a Campus Ministry sponsored event. It is a time for the Villanova Community to come together each Spring (April) to celebrate a day of giving back to those who are less fortunate. We welcome several hundred children from Philadelphia area schools and persons with disabilities to come to campus for a carnival day. Invitees include all the children and others we work with on our service projects as well as faculty, staff, high school counselors and other groups.
Best Buddies	1998	The mission of Best Buddies is to enhance the lives of people with intellectual disabilities by providing opportunities for *one-to-one* friendships and integrated employment. At Villanova, interaction is through monthly outings (several times each semester there are gatherings at the Villanova campus), plus phone calls and e-mails.
Bigs and Littles	1978	VU student partners ("Bigs") are required to be in touch with their "Littles" (6 – 12 year old children) once a week, personally or by phone. University vans provide weekly transportation. There are two or three outings (e.g. trips to ballpark, Valley Forge) a semester. Buses are hired for these occasions.
Bone Marrow Donor	1992	Villanova partners with the Fox Chase Temple Bone Marrow Transplant Program. Under the leadership of the football program 500 to 1000 Villanova students, faculty, staff and friends are tested annually and eligible candidates are added to the bone marrow donor list.
College Recruitment Weekend	2007	The weekend is designed to give underrepresented and first generation high school seniors and juniors an opportunity to experience a taste of college life while also preparing them for the challenges of getting into and staying in college. This "exposure" program aims to make college a real option for these students. The program runs over a weekend, allowing students to stay in the residence halls and meet first year students. In addition, the program includes an SAT prep session in Math and Verbal, as well as workshops on the college application, the college essay, and the college interview.
Community Outreach of Villanova	1983	Afternoon and evening trips are offered Monday through Friday to community centers, afterschool programs, soup kitchens and shelters; namely, LaSalle Academy, North Light Community Center, Northern Home for Children, Sts. Agatha & James Soup Kitchen (UCHC site), St. Barnabas Mission, and St. Francis Inn.
Congresso	2007	In this week long program open to Philadelphia High School students, students come to campus for educational workshops that improve personal, social, and intellectual skills.
Goizueta Foundation Educational Enrichment	2008	The Goizueta Foundation Fund for Educational Student Enrichment allows students to engage their passions and work toward becoming civic and moral citizens of the world.

Habitat for Humanity	1989	In the Week-Long program, 20 to 30 Villanovans construct or rebuild houses for economically disadvantaged persons. Each group has one to two adult advisors and two student leaders. Twenty groups per year travel throughout the United States. From 2004 thru 2007, Villanova sent the most students out of approximately 250 campus chapters. In the Two-day program, Villanova works with local Habitat affiliates Approximately 800 VU students sign up each year,
Laurel	2007	Villanova students work with Laurel House, a center for victims of domestic violence. We also provide furniture, clothes, and small appliances for residents moving to houses or apartments.
Mission Service Break Experiences	1976	The week-long service experience is primarily determined by each service site and the requests/desires needed by each service site. Typical projects include construction, tutoring, health promotion, orphanage outreach, and HIV/AIDS work.
New Directions	2006	Villanova students are paired one-on-one with high school students from the inner-city. Through meetings, tutoring, visits to places of interest it is hoped that a bonding of friendship will develop,
NOVAL: North Light Villanova Alliance	2004	NOVAL is a partnership between Villanova and the North Light Community Center (Manayunk area of Philadelphia). VU participants in NOVAL perform direct service such as tutoring youth, field trips, health education, community family dinner, Day of Service North Light. Participants also provide "back office" functions such as assistance with strategic planning, printing, mail merge, HR manual, outside lighting plan, brochure design, and interior design.
Once and Dones	2004	"Once and Dones" are weekend service opportunities that do not require a semester-long commitment from volunteers. Once and Dones serve a variety of populations and perform a range of activities, including environmental groups, walks/runs for charity, and animal shelters.
One Day University	2007	The Center hosts and co-coordinates an outside organization's event which seeks to bring more than 200 area residents to a day of collegiate lectures.
Packages to Soldiers in Iraq	2007	Donations for soldiers in Iraq, such as, pens, paper, toiletries, soccer balls, snacks, food, t-shirts, cosmetics, are collected.
PIVOTS: Villanova Science and Magic Camp	2005	PIVOTS is a two week long Science, Theatre and Magic Camp for 14 to 20 teenagers, which "blurs the distinction between creativity in STEM and creativity in the arts." Villanova has worked with Philadelphia middle and high schools in underserved communities to find students who could not afford summer camp and would benefit from a scholarship to PIVOTS.
President's Climate Commitment	2007	The President's Office has made a commitment to perform a greenhouse gas inventory, to determine the University's carbon-footprint, and to develop a plan to offset these emissions and become "climate-neutral" at some point in the future.
Public Interest Auction	1998	The Public Interest Fellowship Program (PIFP) at the Villanova University School of Law provides financial support to students who commit their summers to public service legal work. PIFP fundraises for its student fellowships through a variety of creative endeavors. The ultimate highlight of the fundraising efforts, however, is the PIFP Auction, held each spring at Villanova, which raises money by selling items solicited by students (and faculty) throughout the school year.
Rays of Sunshine	1983	About 175 students participate each semester. Students typically are on site one, or sometimes, two days per week. Students work in small groups of 25 to 30 students and provide a range of on-site service, including tutoring students and mentoring youth. Other Ray of Sunshine projects include serving nursing home residents, children with disabilities, and women with mental health and intellectual disabilities problems.
Ruibal Challenge	2003	Freshmen Villanova students offer 3 hours of service (once a week) to children. VU students bring "a talent" to inner city grammar school students at several parish schools – the talent could be in dance, art, sports, or other fields. They also serve as

		tutors/mentors in small groups.
Saint Martin de Porres Tutoring	2007	Students from the Saint Martin de Porres scholarship program are paired with students at Strawberry Mansion High School in Philadelphia and provide tutoring support several times throughout the semester
Saint Thomas of Villanova Day of Service	2006	On this day, more than 3,500 Villanova students, faculty, staff and alums perform service at over 50 nonprofit organizations, parishes, schools, and other human service organizations.
Saint Vincent de Paul Annual Collection	1994	An estimated 20,000 pounds of clothing, furniture, food, and other household items are collected from students going home at the end of the year. Staff and faculty help to sort items before they are donated.
Special Olympics Fall Festival	1973	The 2007 Fall Festival welcomed over 1,000 athletes and 400 coaches from 44 counties to participate in statewide competition in six sports. Last year's Fall Festival drew over 2,500 volunteers from the Villanova student body and the surrounding community to serve as officials, athlete escorts, and award presenters, as well as to provide administrative and support services. The Fall Festival is hosted and organized by Villanova University students and is the largest annual student-run Special Olympics event in the world.
Undergraduate Nursing Senate	1983	The Undergraduate Nursing Senate (UNS) is a nursing student organization that primarily does service for the local and regional communities although it has benefited the international community as well.