AC 2012-5524: WHAT DO STUDENTS THINK ABOUT SERVICE-LEARNING IN REQUIRED ENGINEERING COURSES?

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What do Students Think about Service-Learning in Required Engineering Courses?

Abstract

Service-learning (S-L) has been integrated into an average of 30 engineering courses every year since 2004 in five undergraduate departments. Forty-three faculty members have tried S-L, over half the engineering faculty. In 2010-2011, 1267 students (out of an enrollment of 1600) engaged in S-L projects in 33 courses contributing an estimated 49,500 hours to the community. This approach to trying to develop better engineers and more engaged citizens was motivated by the growing body of research showing widespread benefits of S-L, the meeting of academic objectives through addressing real community needs in credit-bearing courses. But what do the students who are part of this program think about S-L? In this study surveys of student views were collected and analyzed. In general, the students are significantly positive in response to S-L. For example, two-thirds agree in principle with combining service and academic coursework. On average they agree that learning and interest in subject matter as well as professional skills are all improved with S-L. Two-thirds agree that S-L has helped keep them in engineering. Forty percent of those who knew about the S-L program said it was one of the factors for their coming to the engineering school. Significant large differences were found comparing female and male responses, with females more positive toward S-L. Over 75% of students indicate that service should be an expected part of the engineering profession. The implication is that service should be an expected and integrated part of the engineering curriculum.

Background

In the fall of 2004, the University of Massachusetts Lowell, a medium-size state university, began integration of service-learning (S-L) projects into required engineering courses within five undergraduate academic departments. The goal was to have students exposed to S-L in on average one course in each of eight semesters during their engineering program with an overarching aim to graduate better engineers and more engaged citizens. Previous papers have summarized earlier results.1-16

The original motivation for attempting this service-learning program was rooted in the findings of classic studies in which service-learning was shown to be effective in a large number of cognitive and affective measures, including critical thinking and tolerance for diversity, and leads to better knowledge of course subject matter, cooperative learning, and recruitment of under-represented groups in engineering; it also leads to better retention of students, and citizenship.17

Eyler and Giles also found service-learning to impact positively: tolerance for diversity, personal development, interpersonal development, and community-to-college connections. Students reported working harder, being more curious, connecting learning to personal experience, and demonstrated deeper understanding of subject matter. They found that service-learning is more effective over four years and that the messiness inherent in helping solve real community-based problems enhances the positive effects.17

Astin et al. found with longitudinal data of 22,000 students that service-learning had significant positive effects on 11 outcome measures: academic performance (GPA, writing skills, critical thinking skills), values (commitment to activism and to promoting racial understanding), self-efficacy, leadership (leadership activities, self-rated leadership ability, interpersonal skills), choice of a service career, and plans to participate in service after college. In all measures except self-efficacy, leadership, and interpersonal skills service-learning was found to be significantly more effective than service alone \(^{18,19}\). This longitudinal study is ongoing. Astin is quoted as commenting: “The research is very impressive. Service-learning comes as close as anything I’ve ever seen to being a panacea for higher education. It has a powerful effect on students and a powerful effect on the teacher.” (Alexander Astin, Director, HERI, UCLA, remarks April 21, 2004, at Emory University).

Methodology

The basic research question here is what impact this service-learning approach has on student attitudes and their resulting performance. The “treatment” is: over the last seven years, an average of 30 engineering courses incorporated S-L to various degrees ranging from 5 to 100% of course learning objectives and grades. On average about two-thirds of the students each semester have a required course in which S-L projects are mostly required but in some cases optional. Last academic year (2010-2011) 1267 students were engaged in service-learning projects in the engineering college. The total enrollment for the college was 1600 the same year. An estimated 49,500 hours were contributed to the community. One way to illustrate the number of courses with S-L integrated into the curriculum is depicted in Figure 1. Each column represents an academic year under its department. Within each column, dots with deeper shading indicate that the S-L was required for everyone in the course that semester. Lighter shading indicates that the S-L was a choice, or elective, opted by only some of the students in the course, usually in lieu of another project. The size of each dot represents the number of courses containing S-L in that department in that semester.

Figure 2 represents an attempt to illustrate the numbers of students participating in S-L projects each semester. Here the size of the bubbles is in proportion to the numbers of students rather than the number of courses.
Figure 1. Number of S-L courses by year and place in the curriculum in five departments.
Appendix A contains a table of courses with S-L projects during the academic year 2010-2011. This table can also be used to get ideas for S-L projects in similar courses in other colleges.

The experimental design and measures include pre and post student surveys conducted annually, supplemented with surveys of faculty and community partners as well as interviews of students and faculty. Pre surveys are given during the first week of the fall semester in an introduction to engineering course taken by most all entering students. Post surveys are targeted to all engineering students at the end of the spring semester. The student survey instruments are given in Appendix B.

Results

The 2011 spring survey was taken by 428 students, 14% of whom were female and 77% white. The mean responses to the 1 – 9 Likert scale are summarized in Table 1. For 31 of the 33 total responses the mean was significantly different from neutral at the five percent level on a t-test.

The key neutral mean response was to the statement: Within service-learning courses, the service-learning projects should be required and not optional (with a choice of both service and non-service projects). To this statement, 29% disagreed (1 – 4 on the scale), 39% agreed (6 – 9 on the scale), with the remaining 32% neutral. Also shown is the difference between male and
female mean responses: notable is the fact that the female responses were significantly more positive toward S-L for 22 of the questions (two-thirds).

Table 1. Spring 2011 Student Survey Mean Responses

<table>
<thead>
<tr>
<th>Question</th>
<th>n</th>
<th>Mean</th>
<th>Differ from Neutral</th>
<th>Gender</th>
<th>n</th>
<th>Mean</th>
<th>t-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Career Values</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Challenge</td>
<td>428</td>
<td>7.86</td>
<td>*</td>
<td>male</td>
<td>369</td>
<td>7.78</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>female</td>
<td>59</td>
<td>8.32</td>
<td></td>
</tr>
<tr>
<td>Helping</td>
<td>428</td>
<td>7.55</td>
<td>*</td>
<td>male</td>
<td>369</td>
<td>7.48</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>female</td>
<td>59</td>
<td>8.03</td>
<td></td>
</tr>
<tr>
<td>Income</td>
<td>427</td>
<td>7.22</td>
<td>*</td>
<td>male</td>
<td>369</td>
<td>7.20</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>female</td>
<td>58</td>
<td>7.34</td>
<td></td>
</tr>
<tr>
<td>Security</td>
<td>427</td>
<td>8.05</td>
<td>*</td>
<td>male</td>
<td>368</td>
<td>8.03</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>female</td>
<td>59</td>
<td>8.17</td>
<td></td>
</tr>
<tr>
<td>Variety</td>
<td>428</td>
<td>7.47</td>
<td>*</td>
<td>male</td>
<td>369</td>
<td>7.39</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>female</td>
<td>59</td>
<td>7.95</td>
<td></td>
</tr>
<tr>
<td>2. Service and academic coursework should be integrated.</td>
<td>427</td>
<td>6.51</td>
<td>*</td>
<td>male</td>
<td>367</td>
<td>6.37</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>female</td>
<td>60</td>
<td>7.35</td>
<td></td>
</tr>
<tr>
<td>3. Engineers should use their skills to solve social problems.</td>
<td>428</td>
<td>7.16</td>
<td>*</td>
<td>male</td>
<td>368</td>
<td>7.10</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>female</td>
<td>60</td>
<td>7.53</td>
<td></td>
</tr>
<tr>
<td>4. I learn more when courses contain hands-on activities.</td>
<td>428</td>
<td>7.63</td>
<td>*</td>
<td>male</td>
<td>368</td>
<td>7.54</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>female</td>
<td>60</td>
<td>8.13</td>
<td></td>
</tr>
<tr>
<td>5. Service in general should be an expected part of the engineering profession.</td>
<td>426</td>
<td>6.69</td>
<td>*</td>
<td>male</td>
<td>367</td>
<td>6.54</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>female</td>
<td>59</td>
<td>7.64</td>
<td></td>
</tr>
<tr>
<td>6. People who receive social services largely have only themselves to blame for needing services.</td>
<td>424</td>
<td>4.27</td>
<td>*</td>
<td>male</td>
<td>365</td>
<td>4.33</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>female</td>
<td>59</td>
<td>3.88</td>
<td></td>
</tr>
<tr>
<td>7. Most social problems are easy to solve.</td>
<td>428</td>
<td>3.65</td>
<td>*</td>
<td>male</td>
<td>368</td>
<td>3.68</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>female</td>
<td>60</td>
<td>3.52</td>
<td></td>
</tr>
<tr>
<td>8. I can have an impact on solving problems that face my local community.</td>
<td>426</td>
<td>6.54</td>
<td>*</td>
<td>male</td>
<td>368</td>
<td>6.49</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>female</td>
<td>58</td>
<td>6.81</td>
<td></td>
</tr>
<tr>
<td>9. I can have an impact on solving problems that face under-served communities internationally.</td>
<td>420</td>
<td>6.12</td>
<td>*</td>
<td>male</td>
<td>362</td>
<td>6.05</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>female</td>
<td>58</td>
<td>6.55</td>
<td></td>
</tr>
<tr>
<td>10. Working in teams is a waste of time.</td>
<td>426</td>
<td>2.57</td>
<td>*</td>
<td>male</td>
<td>366</td>
<td>2.63</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>female</td>
<td>60</td>
<td>2.15</td>
<td></td>
</tr>
<tr>
<td>Question</td>
<td>N</td>
<td>Mean</td>
<td>SD</td>
<td>Male Mean</td>
<td>Female Mean</td>
<td>Male SD</td>
<td>Female SD</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>----</td>
<td>------</td>
<td>------</td>
<td>-----------</td>
<td>------------</td>
<td>--------</td>
<td>-----------</td>
</tr>
<tr>
<td>11. It is important to me personally to influence the political structure.</td>
<td>426</td>
<td>4.60</td>
<td>0.82</td>
<td>4.63</td>
<td>4.42</td>
<td>277</td>
<td>277</td>
</tr>
<tr>
<td>12. It is important to me personally to have a career that involves helping people.</td>
<td>424</td>
<td>6.46</td>
<td>0.82</td>
<td>6.33</td>
<td>7.27</td>
<td>277</td>
<td>277</td>
</tr>
<tr>
<td>13. I am uncomfortable working with people who are different from me in such things as race, wealth, and life experiences.</td>
<td>426</td>
<td>3.04</td>
<td>0.82</td>
<td>2.99</td>
<td>3.32</td>
<td>277</td>
<td>277</td>
</tr>
<tr>
<td>14. I have a close working relationship with at least one faculty member at this institution.</td>
<td>426</td>
<td>5.16</td>
<td>0.82</td>
<td>5.03</td>
<td>5.93</td>
<td>277</td>
<td>277</td>
</tr>
<tr>
<td>15. Within service-learning courses, the service-learning projects should be required and not optional (with a choice of both service and non-service projects).</td>
<td>422</td>
<td>5.14</td>
<td>0.82</td>
<td>4.93</td>
<td>6.47</td>
<td>277</td>
<td>277</td>
</tr>
<tr>
<td>19a. The amount of effort I put into the service-learning project(s) relative to an equivalent class project without service was</td>
<td>381</td>
<td>5.70</td>
<td>0.82</td>
<td>5.57</td>
<td>6.52</td>
<td>277</td>
<td>277</td>
</tr>
<tr>
<td>19b. In the service project(s) I learned how engineers apply the concepts I learned in class to real-life problems.</td>
<td>377</td>
<td>5.91</td>
<td>0.82</td>
<td>5.71</td>
<td>7.17</td>
<td>277</td>
<td>277</td>
</tr>
<tr>
<td>19c. In the service project(s) I learned now to work with others effectively.</td>
<td>376</td>
<td>6.07</td>
<td>0.82</td>
<td>5.92</td>
<td>6.98</td>
<td>277</td>
<td>277</td>
</tr>
<tr>
<td>a. The likelihood that I would continue in engineering.</td>
<td>383</td>
<td>6.49</td>
<td>0.82</td>
<td>6.37</td>
<td>7.22</td>
<td>277</td>
<td>277</td>
</tr>
<tr>
<td>b. My belief that I can make a difference in the community using engineering skills.</td>
<td>383</td>
<td>6.51</td>
<td>0.82</td>
<td>6.38</td>
<td>7.25</td>
<td>277</td>
<td>277</td>
</tr>
<tr>
<td>c. My interest in learning the subject matter of the courses.</td>
<td>383</td>
<td>6.42</td>
<td>0.82</td>
<td>6.28</td>
<td>7.27</td>
<td>277</td>
<td>277</td>
</tr>
<tr>
<td>d. My commitment to being involved in community issues as an engineer.</td>
<td>384</td>
<td>6.34</td>
<td>0.82</td>
<td>6.21</td>
<td>7.15</td>
<td>277</td>
<td>277</td>
</tr>
</tbody>
</table>
The pre Fall 2011 survey had an “n” (sample size) of 445, of which 89% were male, 11% female, and 2.5% international students, 12% Asian, 6% black, 71% white, and 28% transfer students. The mean responses are listed in Table 2. The only mean that was not significantly different at the 5% level on a t-test was the same question as in the Spring 2011 post survey about not requiring S-L. So it appears the students both entering and finishing academic years value S-L but are very roughly evenly split about requiring it, although less than a third were actually opposed to the idea.

Table 2. Fall 2011 Pre Student Survey, Attitudes Towards Service-Learning

<table>
<thead>
<tr>
<th>Mean responses to Likert scale of 1 (strongly disagree) to 5 (neutral) to 9 (strongly agree)</th>
<th>Mean</th>
<th>Significantly Different from &quot;Neutral&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Service and academic coursework should be integrated</td>
<td>6.46</td>
<td>*</td>
</tr>
<tr>
<td>3. Engineers should use their skills to solve social problems.</td>
<td>7.00</td>
<td>*</td>
</tr>
<tr>
<td>4. I learn more when courses contain hands-on activities.</td>
<td>7.82</td>
<td>*</td>
</tr>
<tr>
<td>5. Service in general should be an expected part of the engineering profession.</td>
<td>6.83</td>
<td>*</td>
</tr>
<tr>
<td>6. People who receive social services largely have only themselves to blame for needing services.</td>
<td>4.00</td>
<td>*</td>
</tr>
<tr>
<td>7. Most Social problems are not my concern.</td>
<td>3.69</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>8. I can have an impact on solving problems that face my local community.</td>
<td>6.93</td>
<td>*</td>
</tr>
<tr>
<td>9. I can have an impact on solving problems that face under-served communities internationally.</td>
<td>6.53</td>
<td>*</td>
</tr>
<tr>
<td>10. Working in teams is a waste of time.</td>
<td>2.11</td>
<td>*</td>
</tr>
<tr>
<td>11. It is important to me personally to influence the political structure.</td>
<td>4.73</td>
<td>*</td>
</tr>
<tr>
<td>12. It is important to me personally to have a career that involves helping people.</td>
<td>6.71</td>
<td>*</td>
</tr>
<tr>
<td>13. I am uncomfortable working with people who are different from me in such things as race, wealth, and life experiences.</td>
<td>2.59</td>
<td>*</td>
</tr>
<tr>
<td>14. I have a close working relationship with at least one faculty member at this institution.</td>
<td>3.28</td>
<td>*</td>
</tr>
<tr>
<td>15. If service-learning is integrated into a course, the service-learning projects should be required and not optional (with a choice of both service and non-service projects).</td>
<td>5.16</td>
<td>*</td>
</tr>
</tbody>
</table>

Efforts have been made to track students by ID number through the program and compare one survey to another by the same student. Since students are not required to give their ID number (nor answer the survey at all, for that matter), getting enough of a sample has been challenging. For example, thirty-eight students had surveys in both the Fall of 2007 and the Spring of 2011 with ID numbers. The results of comparing the difference in each response with a paired t-test resulted in just a few of the 14 questions, which are given in Table 3.

Table 3. Significant mean differences in responses between Fall 2007 and Spring 2011 for the same student (paired t-test at the 5% level)

<table>
<thead>
<tr>
<th>Mean responses to Likert scale of 1 (strongly disagree) to 5 (neutral) to 9 (strongly agree)</th>
<th>n</th>
<th>Difference post S11 - pre F07</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Service-Learning and academic coursework should be integrated</td>
<td>38</td>
<td>0.528</td>
</tr>
<tr>
<td>7. Most social problems are easy to solve.</td>
<td>38</td>
<td>-1.00</td>
</tr>
<tr>
<td>10. Working in teams is a waste of time</td>
<td>38</td>
<td>-0.853</td>
</tr>
<tr>
<td>11. It is important to me to influence the political structure</td>
<td>38</td>
<td>-1.12</td>
</tr>
<tr>
<td>14. I have a close working relationship with at least one faculty member at this institution.</td>
<td>38</td>
<td>2.17</td>
</tr>
</tbody>
</table>

A shorter term comparison between pre and post surveys from the same students was made with the Fall 2010 and Spring 2011 surveys. The significant mean differences (5% level in a paired t-test) are shown in Table 4.
Table 4. Difference between Spring 2011 Post and Fall 2010 Pre Paired Samples

<table>
<thead>
<tr>
<th>Mean responses to Likert scale of 1 (strongly disagree) to 5 (neutral) to 9 (strongly agree)</th>
<th>n</th>
<th>Difference post S11 - pre F10</th>
<th>Significant Difference Post-Pre</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Engineers should use their skills to solve social problems.</td>
<td>51</td>
<td>0.667</td>
<td>*</td>
</tr>
<tr>
<td>5. Service in general should be an expected part of the engineering profession.</td>
<td>51</td>
<td>0.588</td>
<td>*</td>
</tr>
<tr>
<td>8. I can have an impact on solving problems that face my local community.</td>
<td>51</td>
<td>-0.549</td>
<td>*</td>
</tr>
<tr>
<td>10. Working in teams is a waste of time.</td>
<td>51</td>
<td>0.569</td>
<td>*</td>
</tr>
<tr>
<td>14. I have a close working relationship with at least one faculty member at this institution.</td>
<td>51</td>
<td>1.784</td>
<td>*</td>
</tr>
</tbody>
</table>

Some of the comments from this sample of students who had volunteered for a S-L project in the second semester of introduction to engineering are perhaps more telling than numerical results.
- The amount of service learning ought to be increased.
- I was surprised at how this turned out. I was very excited to see the [high school] students’ reaction to our experiment [S-L project].
- This was a lot of more fun than I expected, I learned through teaching and I would gladly like to do this again. Thank you so much for the opportunity…

Several students complained that the S-L projects in the first year were all given in the final two weeks of the semester at a time of great stress for everyone. This comment has been a common one from students of courses where the S-L projects are given at the end of the semester. One suggested best practice is to integrate the projects earlier into the semester.

There are some encouraging results in this analysis, but the sample size is too small for any length of reasonable time to see changes in basic attitudes. This pedagogical approach is very diffuse over the entire four years of the curriculum, and some departments have in fact few S-L projects. The question about the working relationship with a faculty member is important because this factor has been shown to be a very important one in retention. Efforts are continuing to capture more before and after surveys from the same students.

**Summary and Discussion**

What do students think about S-L in required engineering courses? **Recruitment:** Over the past six years twenty to twenty-five percent of entering students indicate that S-L was one of the factors that influenced their coming to this particular university, but in later surveys a question was added about whether the students knew about the SLICE program. In the most recent pre...
survey (n=455, Fall 2011), 43% of those who knew about the S-L program indicated it was one of the factors for enrolling. **Retention:** Two-thirds of the students consistently indicate a positive impact of S-L on their continuing in engineering. In the latest post survey of all levels of students (n= 428, Spring 2011) in response to the statement that S-L increased the likelihood of their dropping out of engineering 52% indicated “strongly disagree” (1 on a Likert scale of 1 to 9).

**Subject matter learning:** Two-thirds agree in principle with combining service and academic coursework. On average they agree that learning and interest in subject matter as well as professional skills are all improved with S-L. Students are evenly divided as to whether the S-L projects should be mandatory in courses. In virtually every other response to 33 questions in all, the average responses were significantly (5%) on the positive side of the effects of S-L and have been over the years. **Gender:** In the past several years, females have responded significantly more positively to 20 or more of the 33 survey questions than males, many times being one or two whole points higher on average on the 9 point Likert scale. On more than one occasion a female has written that S-L is the only thing that has kept her in engineering. Females in the college make up 18% of the graduating class, while they represent only about 10-12% of the entering students, indicating a higher retention rate. (Note that there are no admissions or outreach programs to incentivize women at this institution.)

A final observation: 75% of the students in the Spring 2011 survey indicated agreement with the statement that service should be an expected part of the engineering profession (20% strongly agreed, 9 on the Likert scale; only 10% disagreed at any level). If that premise is true, then service should be an expected part of the engineering curriculum, i.e., S-L embedded into required core courses.

In summary, the advantages of this approach are that S-L is available to essentially all the students in the college for a significant number of semesters, that no extra courses need to be taken to get the benefits of S-L, that core subject matter is reinforced with the S-L projects (besides teamwork and communication), that the students are exposed to a variety of projects and community partners, that a large number of faculty benefit, and that a high number of community projects can be undertaken. S-L has become more than a pedagogy: civic engagement is viewed by three-fourths of the students as an interwoven part of the profession.

**Acknowledgements**

The authors acknowledge gratefully the support of this program by the University of Massachusetts Lowell and by the volunteer efforts of many students, faculty, administrators, and community partners as well as the financial support of the National Science Foundation (Grants EEC-0431925, EEC-0530632, ARRA - EEC-0935185 and DUE-0920574). Thanks to all the faculty members in engineering and other colleges who have tried service-learning in their courses as part of this program. In particular, the efforts of Jacob Lauer and Jeffrey Chung in statistical analysis of the Spring 2011 survey are appreciated. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.
References

Appendix A. Table of courses with S-L projects during the academic year 2010-2011.

### SLICE - Courses Offered - Intercollegiate Courses

<table>
<thead>
<tr>
<th>Course #</th>
<th>Sem</th>
<th>Credits</th>
<th>Course Name</th>
<th>Professor(s)</th>
<th>Project Description</th>
<th>S-L Project%</th>
<th># S-L students</th>
<th># total students</th>
</tr>
</thead>
<tbody>
<tr>
<td>25.107</td>
<td>F’10</td>
<td>2</td>
<td>Intro. to Engineering I</td>
<td>Stephen Johnston, Dave Willis</td>
<td>Engineering kits for classrooms - including 8 Lowell Public Middle Schools (contact Claire Abrams)</td>
<td>10%</td>
<td>487</td>
<td>487</td>
</tr>
<tr>
<td>25.108</td>
<td>S’11</td>
<td>2</td>
<td>Intro. to Engineering II - ME</td>
<td>Sammy Shina</td>
<td>Lab experiments in solar energy for Grit Lowell Tech HS (GLTHS)</td>
<td>29%</td>
<td>19</td>
<td>160</td>
</tr>
<tr>
<td>25.108</td>
<td>S’11</td>
<td>2</td>
<td>Intro. to Engineering II - Plastics</td>
<td>Carol Barry</td>
<td>Safety analysis of plastic sippy cups for Acme Family Child Care</td>
<td>20%</td>
<td>27</td>
<td>27</td>
</tr>
<tr>
<td>25.200</td>
<td>F’10</td>
<td>1</td>
<td>Community-Based Engineering Design Project I</td>
<td>John Duffy</td>
<td>Adobe forming device design, construction, test.</td>
<td>100%</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>25.400</td>
<td>F’10</td>
<td>1</td>
<td>Community-Based Engineering Design Project III</td>
<td>Byungki Kim</td>
<td>Design of a convertible WC</td>
<td>100%</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>25.401</td>
<td>S’11</td>
<td>3</td>
<td>Interdisciplinary Engineering Capstone Design</td>
<td>John Duffy</td>
<td>Research and recommended procedures for low-cost medical screening tests for remote health clinics</td>
<td>100%</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

### SLICE - Courses Offered - Chemical Engineering Courses

<table>
<thead>
<tr>
<th>Course #</th>
<th>Sem</th>
<th>Credits</th>
<th>Course Name</th>
<th>Professor(s)</th>
<th>Project Description</th>
<th>S-L Project%</th>
<th># S-L students</th>
<th># total students</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.310</td>
<td>S’11</td>
<td>3</td>
<td>Separation Processes with Mass Transfer</td>
<td>Zhiyong Gu</td>
<td>Analysis and recommendations for separation processes of essential oils for the Mesoamerican Development Institute (MDI)</td>
<td>20%</td>
<td>42</td>
<td>42</td>
</tr>
<tr>
<td>10.409</td>
<td>F’10</td>
<td>3</td>
<td>Engineering Economics</td>
<td>Gil Brown</td>
<td>Initial analysis and recommendations for various energy technologies for the Lawrence History Center (LHC)</td>
<td>10%</td>
<td>23</td>
<td>23</td>
</tr>
</tbody>
</table>

### SLICE - Courses Offered - Civil Engineering Courses

<table>
<thead>
<tr>
<th>Course #</th>
<th>Sem</th>
<th>Credits</th>
<th>Course Name</th>
<th>Professor(s)</th>
<th>Project Description</th>
<th>S-L Project%</th>
<th># S-L students</th>
<th># total students</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.301</td>
<td>F’10</td>
<td>3</td>
<td>Fluid Mechanics</td>
<td>Kenneth Lee</td>
<td>Groups of 4 worked with HS science teachers of their choice to develop &amp; build hardware to demo fluids concepts in the HS classes; UML students did initial classroom demos.</td>
<td>10%</td>
<td>53</td>
<td>53</td>
</tr>
<tr>
<td>14.410</td>
<td>S’11</td>
<td>3</td>
<td>Engineering Economics</td>
<td>Gil Brown</td>
<td>Analysis and recommendations for cost effective HVAC technologies for the Lawrence History Center (LHC)</td>
<td>5%</td>
<td>36</td>
<td>36</td>
</tr>
<tr>
<td>18.510</td>
<td>S’11</td>
<td>3</td>
<td>Water Resource System Assessment</td>
<td>William Moeller</td>
<td>Presentation and reports on water resource system assessment and the effect of the Integrated Open Canopy. Presentation transmitted to three different campuses in Honduras via internet and translated by Raul Raudoles (MDI)</td>
<td>33%</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

### SLICE - Courses Offered - Electrical Engineering Courses

<table>
<thead>
<tr>
<th>Course #</th>
<th>Sem</th>
<th>Credits</th>
<th>Course Name</th>
<th>Professor(s)</th>
<th>Project Description</th>
<th>S-L Project%</th>
<th># S-L students</th>
<th># total students</th>
</tr>
</thead>
<tbody>
<tr>
<td>16.100</td>
<td>F’10</td>
<td>1</td>
<td>Intro to Electrical and Computer Engineering</td>
<td>Xingswei Wang</td>
<td>Assistive Technology soldering project to create room check timers for Holy Family Hospital, Methuen, MA</td>
<td>30%</td>
<td>148</td>
<td>148</td>
</tr>
<tr>
<td>16.399</td>
<td>F’10</td>
<td>3</td>
<td>Capstone I (Proposal)</td>
<td>Donn Clark</td>
<td>Develop a business plan to fund the design and development of a product which would be considered an &quot;Assistive Technology&quot; device. Students work with a specific client and identify Capstone Assistive Technology project to be accomplished in 16.499.</td>
<td>100%</td>
<td>56</td>
<td>56</td>
</tr>
<tr>
<td>16.399</td>
<td>S’11</td>
<td>3</td>
<td>Capstone I (Proposal)</td>
<td>Donn Clark</td>
<td>Develop a business plan to fund the design and development of a product which would be considered an &quot;Assistive Technology&quot; device. Students work with a specific client and identify Capstone Assistive Technology project to be accomplished in 16.499.</td>
<td>100%</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td>16.499</td>
<td>F’10</td>
<td>3</td>
<td>Capstone II (Proposal)</td>
<td>Alan Rux, Donn Clark, Senait Hailesleslalic, Chuck Maffeo, Jay Fu</td>
<td>Students are required to design, test and deliver a device that would enhance the quality of life for a disadvantaged person. Students are required to have direct contact with their client throughout the project.</td>
<td>100%</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td>16.499</td>
<td>S’11</td>
<td>3</td>
<td>Capstone II (Proposal)</td>
<td>Alan Rux, Donn Clark, Senait Hailesleslalic, Chuck Maffeo, Jay Fu</td>
<td>Students are required to design, test and deliver a device that would enhance the quality of life for a disadvantaged person. Students are required to have direct contact with their client throughout the project.</td>
<td>100%</td>
<td>61</td>
<td>61</td>
</tr>
</tbody>
</table>
### SLICE - Courses Offered - Mechanical Engineering Courses

<table>
<thead>
<tr>
<th>Course #</th>
<th>Sem</th>
<th>Credits</th>
<th>Course Name</th>
<th>Professor(s)</th>
<th>Project Description</th>
<th>S-L. Project %</th>
<th>F-S-L. students</th>
<th>F total students</th>
</tr>
</thead>
<tbody>
<tr>
<td>22.201</td>
<td>F’10</td>
<td>2</td>
<td>Design Lab I</td>
<td>Byangki Kim, Bob Parkin</td>
<td>Design device to help relative/friend with disability with everyday activities (1/3 class); design of dye indicator pill maker for clean water in Peru (1/3 class); design of robust bumper system power wheelchairs for Hogan Regional Center (1/3 class)</td>
<td>10%</td>
<td>114</td>
<td>114</td>
</tr>
<tr>
<td>22.213</td>
<td>F’10</td>
<td>3</td>
<td>Dynamics</td>
<td>John Duffy</td>
<td>Analyze playground safety for student selected parks and schools; Choose different playgrounds locally by team, analyze the risks for safety; send report to responsible parties and technical report to instructor.</td>
<td>20%</td>
<td>27</td>
<td>27</td>
</tr>
<tr>
<td>22.296</td>
<td>S’11</td>
<td>3</td>
<td>Mechanical Behavior of Materials</td>
<td>Emileine Reynolds</td>
<td>Research &amp; present emerging topics for the American Textile History Museum (ATHM)</td>
<td>15%</td>
<td>41</td>
<td>41</td>
</tr>
<tr>
<td>22.300</td>
<td>S’11</td>
<td>1</td>
<td>Mechanical Engineering Project II</td>
<td>Robert Parkin</td>
<td>Solar Decathlon plumbing analysis &amp; design for the National Renewable Energy Labs (NREL)</td>
<td>100%</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>22.341</td>
<td>S’11</td>
<td>3</td>
<td>Conduction and Radiation</td>
<td>Hongseon Sun</td>
<td>Analysis of north campus windows for UMans Lowell Facilities dept.</td>
<td>10%</td>
<td>85</td>
<td>85</td>
</tr>
<tr>
<td>22.342</td>
<td>F’10</td>
<td>3</td>
<td>Convective Processes</td>
<td>Hongseon Sun</td>
<td>Boundary layer analysis of heat flow over fins of coffee driers for MDI</td>
<td>30%</td>
<td>68</td>
<td>68</td>
</tr>
<tr>
<td>22.381</td>
<td>S’11</td>
<td>3</td>
<td>Fluid Mechanics</td>
<td>David Willis</td>
<td>Developing accessible educational materials for the Lowell Telecommunications Corporation (LTC) Public Access Station. These short clips illustrate how to build fluids based toys and projects and will be used as gap-fill material on the public access station.</td>
<td>20%</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td>22.400</td>
<td>S’11</td>
<td>1</td>
<td>Mechanical Engineering Project III</td>
<td>Robert Parkin</td>
<td>Design of a parabolic concentrator for possible adoption in Solar Decathlon and private homes beyond</td>
<td>100%</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>22.423</td>
<td>S’11</td>
<td>3</td>
<td>Capstone Design</td>
<td>John Duffy (9), Byangki Kim (3), Steve Johnston (3)</td>
<td>Design of solar abode house for Peru, test abode mixes for strength; test and upgrade motorcycle balance for remote clinics; design low-cost prostheses, arrange manufacture of prostheses for a young mother in Peru; design a thermosyphon, coveralls solar hot water system for Peru. Embedded iPod controls for a crutch handle.</td>
<td>100%</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>22.425</td>
<td>F’10</td>
<td>3</td>
<td>Design of Machine Elements</td>
<td>Chris Niczeczy</td>
<td>Static &amp; Fatigue Failure Analysis: photovoltaic limb for Village Empowerment (4); water tower for Village Empowerment (4); specialized beds for Hogan Regional Center (two groups 3 + 4)</td>
<td>25%</td>
<td>15</td>
<td>56</td>
</tr>
<tr>
<td>22.504</td>
<td>S’11</td>
<td>3</td>
<td>Energy Engineering Workshop</td>
<td>John Duffy</td>
<td>For remote villages in Peru; measured solar data analysis for accuracy and to determine optimal orientations of collectors; solar thermosyphon solar hot water system design; solar ammonia cooling system; solar stills, solar crop dryers; solar experiments for grade 6-12 students; low-cost sun tube lighting; solar space heating system expansion of solar house at Lowell Technical High School; active solar thermal system design for restaurant in Lowell for city; PV system design for UML building using GIS satellite images;</td>
<td>100%</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>22.521</td>
<td>F’10</td>
<td>3</td>
<td>Solar Fundamentals</td>
<td>John Duffy</td>
<td>Daylighting design of Solar Decathlon house; daylighting design of solar abode house for Peru; lab PV standalone test stand design and construction for remote locations; PV deep well design for water pumping for livestock at IO nation; PV design for One-Laptop-per-Child computers in remote schools in Peru; solar abode house design with water thermal storage; solar systems for grade 6-12 students in remote villages; PV system design for restaurant in Lowell for the city; PV output curve testing system design; daylighting for Lowell Technical High School solar house/classroom. Solar drip irrigation design; implementation of pilot projects, long-term testing, CFD models of passive solar abode housing in Peru.</td>
<td>20%</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td>22.527</td>
<td>S’11</td>
<td>3</td>
<td>Solar Systems Engineering</td>
<td>John Duffy</td>
<td>Solar drip irrigation design; implementation of pilot projects, long-term testing, CFD models of passive solar abode housing in Peru.</td>
<td>20%</td>
<td>31</td>
<td>31</td>
</tr>
<tr>
<td>24.532</td>
<td>F’10</td>
<td>3</td>
<td>Selected Topics: Energy Science</td>
<td>John Duffy</td>
<td>Solar drip irrigation design; implementation of pilot projects, long-term testing, CFD models of passive solar abode housing in Peru.</td>
<td>100%</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>22.581</td>
<td>S’11</td>
<td>3</td>
<td>Advanced Fluid Mechanics</td>
<td>David Willis</td>
<td>Developing accessible educational materials for LTC Public Access Station. These short clips illustrate how to build fluids based toys and projects and will be used as gap-fill material on the public access station. (Higher expectations than undergrads.)</td>
<td>20%</td>
<td>21</td>
<td>21</td>
</tr>
</tbody>
</table>

### SLICE - Courses Offered - Plastic Engineering Courses

<table>
<thead>
<tr>
<th>Course #</th>
<th>Sem</th>
<th>Credits</th>
<th>Course Name</th>
<th>Professor(s)</th>
<th>Project Description</th>
<th>S-L. Project %</th>
<th>F-S-L. students</th>
<th>F total students</th>
</tr>
</thead>
<tbody>
<tr>
<td>26.215</td>
<td>F’10</td>
<td>1</td>
<td>Plastics Process Lab I</td>
<td>Carol Barry</td>
<td>Plastic bottles, water &amp; pollutants testing for Ace Family Child Care</td>
<td>20%</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td>26.218</td>
<td>S’11</td>
<td>2</td>
<td>Introduction to Design</td>
<td>David Kazmer</td>
<td>Design and prototyping of Ability Switch housings for Assistive Tech agencies including Bridgewell</td>
<td>20%</td>
<td>33</td>
<td>33</td>
</tr>
<tr>
<td>26.348</td>
<td>S’11</td>
<td>3</td>
<td>Heat Transfer</td>
<td>&quot;Jim&quot; Jan Chan Huang</td>
<td>Analysis and recommendations for the evaluation tools for the Green Restaurant Program for the Green Building Commission (GBC) Lowell, MA</td>
<td>14%</td>
<td>32</td>
<td>32</td>
</tr>
</tbody>
</table>

### SLICE - Courses Offered - Non Engineering Courses

<table>
<thead>
<tr>
<th>Course #</th>
<th>Sem</th>
<th>Credits</th>
<th>Course Name</th>
<th>Professor(s)</th>
<th>Project Description</th>
<th>S-L. Project %</th>
<th>F-S-L. students</th>
<th>F total students</th>
</tr>
</thead>
<tbody>
<tr>
<td>59.536</td>
<td>S’11</td>
<td>3</td>
<td>Vehicle Empowerment; Overcoming Global Poverty</td>
<td>John Duffy + others</td>
<td>Development plans for micro business in remote areas; solar abode houses, motorcycle ambulances, photovoltaic water purification bottles; solar cookers</td>
<td>20%</td>
<td>11</td>
<td>11</td>
</tr>
</tbody>
</table>
Appendix B. Survey Instruments for Students.

Student Pre Survey about Service-Learning  

Fall 2011

Please fill in this survey registration area. This information is used for research purposes only, and has no bearing on your academic or program status. Your responses will form an important part of a research project on service-learning and will enable us to improve the courses you will be taking. Responses are kept confidential.

SURVEY REGISTRATION AREA

Student ID (ISIS No.): ________________________

1. What is your gender?  
   ___ Male  
   ___ Female

2. Are you an international student?  
   ___ Yes  
   ___ No

3. What is your race? (check all that apply)  
   ___ American Indian or Alaska Native  
   ___ Asian  
   ___ Black or African American  
   ___ Native Hawaiian or Other Pacific Islander  
   ___ White  
   ___ Other: ________________________________

4. What is your ethnicity?  
   ___ Hispanic/Latino  
   ___ Non Hispanic/Non-Latino

5. How many miles do you live from campus? (if you live on campus, put zero: 0) __________.

6. What is your age? __________

7. How many hours per week do you work at a paid job? __________

8. How many credit hours are you taking this semester? __________

9. What is your current academic status?  
   ___ Freshmen  
   ___ Sophomore

10. I am a transfer student.  
    ___ Yes  
    ___ No
11. What is your major? (check all that apply)

- Biomedical Engineering
- Engineering Technology
- Chemical Engineering
- Mechanical Engineering
- Civil Engineering
- Plastics Engineering
- Computer Engineering
- Undeclared Engineering
- Electrical Engineering
- Other
- Energy Engineering

12. Prior to UML have you ever been involved in community service activities? Check all that apply.

- No
- Yes, during high school
- Yes, during college
- Yes, outside of school

13. If eligible, did you vote in the November 2010 public election?

- Yes
- No
- Not eligible then

We define “service-learning” as a learning approach in which students achieve academic objectives in a credit-bearing course by meeting real community needs.

14. Estimate the total number of service–learning projects you have participated in your entire academic career. __________

SURVEY RESPONSE AREA:

INSTRUCTIONS: Your responses will form an important part of a research project on service-learning. You may elect not to answer any question you choose. All responses will remain confidential and anonymity in any reported results is assured. The instructor of this course will not view the individual questionnaire responses. Filling out this questionnaire is completely voluntary, and you will not be penalized in any manner if you decide not to participate. Thanks from the SLICE project, UML College of Engineering.
1. Please rate the importance of each of these career values. Please choose the answer that makes sense to YOU; not what you think others would say. [1=Not important, 5=Neutral, 9=Very important]:

**Challenge:** Learning new skills or information, doing things in a new way
1 2 3 4 5 6 7 8 9

**Helping:** Doing things for others, building a better world
1 2 3 4 5 6 7 8 9

**Income:** Making a high salary.
1 2 3 4 5 6 7 8 9

**Security:** Having stable employment and income, not worrying about lay-offs.
1 2 3 4 5 6 7 8 9

**Variety:** Doing many different activities, not doing the same things all the time.
1 2 3 4 5 6 7 8 9

Please respond based on your honest reaction to each item. Please choose the answer that makes sense to YOU; not what you think others would say. [1=Strongly disagree, 5=Neutral, 9=Strongly agree]

2. Service and academic coursework should be integrated.
1 2 3 4 5 6 7 8 9

3. Engineers should use their skills to solve social problems.
1 2 3 4 5 6 7 8 9

4. I learn more when courses contain hands-on activities.
1 2 3 4 5 6 7 8 9

5. Service in general should be an expected part of the engineering profession
1 2 3 4 5 6 7 8 9

6. People who receive social services largely have only themselves to blame for needing services.
1 2 3 4 5 6 7 8 9

7. Most social problems are easy to solve.
1 2 3 4 5 6 7 8 9

8. I can have an impact on solving problems that face my local community.
1 2 3 4 5 6 7 8 9
9. I can have an impact on solving problems that face under-served communities internationally.

10. Working in teams is a waste of time.

11. It is important to me personally to influence the political structure.

12. It is important to me personally to have a career that involves helping people.

13. I am uncomfortable working with people who are different from me in such things as race, wealth, and life experiences.

14. I have a close working relationship with at least one faculty member at this institution.

15. Within service-learning courses, the service-learning projects should be required and not optional (with a choice of both service and non-service projects).

16. Did you know that service-learning was integrated into the College curriculum? __Yes __No

17. If you did know, was being able to take classes with service-learning one of the reasons you chose UMass Lowell? __Yes __No

Student Post Survey about Service-Learning Spring 2011

Please fill in this survey registration area. This information is used for research purposes only, and has no
bearing on your academic or program status. Your responses will form an important part of a research project on service-learning. Responses are kept confidential.

**SURVEY REGISTRATION AREA**

**Student ID (ISIS No.): ______________________________**

1. What is your gender?  
   __Male  
   __Female

2. Are you an international student?  
   __Yes  
   __No

3. What is your race? (check all that apply)  
   __American Indian or Alaska Native  
   __Asian  
   __Black or African American  
   __Native Hawaiian or Other Pacific Islander  
   __White  
   __Other: ________________________________

4. What is your ethnicity?  
   __Hispanic/Latino  
   __Non Hispanic/Non-Latino

5. How many miles do you live from campus? (if you live on campus, put zero: 0) __________.

6. What is your age? __________

7. How many hours per week do you work at a paid job? __________

8. How many credit hours are you taking this semester? __________

9. What is your current academic status?  
   __Freshmen  
   __Sophomore  
   __Junior  
   __Senior  
   __Graduate  
   __Yes  
   __No

10. I am a transfer student.
11. What is your major? (check all that apply)

- Biomedical Engineering
- Chemical Engineering
- Civil Engineering
- Computer Engineering
- Electrical Engineering
- Energy Engineering
- Engineering Technology
- Mechanical Engineering
- Plastics Engineering
- Undeclared Engineering
- Other

12. Prior to UML have you ever been involved in community service activities? Check all that apply.

- No
- Yes, during high school
- Yes, during college
- Yes, outside of school

13. If eligible, did you vote in the November 2010 public election?

- Yes
- No
- Not eligible then

We define “service-learning” as a learning approach in which students achieve academic objectives in a credit-bearing course by meeting real community needs.

14. Estimate the total number of service–learning projects you have participated in your entire academic career. __________

SURVEY RESPONSE AREA:

INSTRUCTIONS: Your responses will form an important part of a research project on service-learning. You may elect not to answer any question you choose. All responses will remain confidential and anonymity in any reported results is assured. The instructor of this course will not view the individual questionnaire responses. Filling out this questionnaire is completely voluntary, and you will not be penalized in any manner if you decide not to participate. Thanks from the SLICE project, UML College of Engineering.

1. Please rate the importance of each of these career values. Please choose the answer that makes sense to YOU; not what you think others would say.

   [1=Not important, 5=Neutral, 9=Very important]:

   Challenge: Learning new skills or information, doing things in a new way
Helping: Doing things for others, building a better world

1 2 3 4 5 6 7 8 9

Income: Making a high salary.

1 2 3 4 5 6 7 8 9


1 2 3 4 5 6 7 8 9

Variety: Doing many different activities, not doing the same things all the time.

1 2 3 4 5 6 7 8 9

Please respond based on your honest reaction to each item. Please choose the answer that makes sense to YOU; not what you think others would say.

[1=Strongly disagree, 5=Neutral, 9=Strongly agree]

2. Service and academic coursework should be integrated.

1 2 3 4 5 6 7 8 9

3. Engineers should use their skills to solve social problems.

1 2 3 4 5 6 7 8 9

4. I learn more when courses contain hands-on activities.

1 2 3 4 5 6 7 8 9

5. Service in general should be an expected part of the engineering profession

1 2 3 4 5 6 7 8 9

6. People who receive social services largely have only themselves to blame for needing services.

1 2 3 4 5 6 7 8 9

7. Most social problems are easy to solve.

1 2 3 4 5 6 7 8 9

8. I can have an impact on solving problems that face my local community.

1 2 3 4 5 6 7 8 9

9. I can have an impact on solving problems that face under-served communities internationally.

1 2 3 4 5 6 7 8 9
10. Working in teams is a waste of time.
   1 2 3 4 5 6 7 8 9

11. It is important to me personally to influence the political structure.
   1 2 3 4 5 6 7 8 9

12. It is important to me personally to have career that involves helping people.
   1 2 3 4 5 6 7 8 9

13. I am uncomfortable working with people who are different from me in such things as race, wealth, and life experiences.
   1 2 3 4 5 6 7 8 9

14. I have a close working relationship with at least one faculty member at this institution.
   1 2 3 4 5 6 7 8 9

15. Within service-learning courses, the service-learning projects should be required and not optional (with a choice of both service and non-service projects).
   1 2 3 4 5 6 7 8 9

The next section is about your experience with service-learning. ("Service learning" is a learning approach in which students achieve academic objectives in a credit-bearing course by meeting real community needs.)

16. Was being able to take classes with service-learning one of the reasons you chose UMass Lowell?
   ___Yes ___No ___No, but if I knew about SLICE, it would have been a factor

17. Please indicate the number of classes in each semester in which you participated in a class project that addressed a real community issue or problem through service-learning.

FALL 2010
   a. Total number of classes with service-learning projects that you have taken 1 2 3 4
   b. Number of the classes in which service-learning was required. 1 2 3 4
   c. Number of the classes in which service-learning was optional. 1 2 3

SPRING 2011
   a. Total number of classes with service-learning projects that you have taken 1 2 3 4
   b. Number of the classes in which service-learning was required. 1 2 3 4
   c. Number of the classes in which service-learning was optional. 1 2 3
18. Approximately how many hours total did you spend working on all your S-L projects in each semester? [Please indicate the number of hours].

   Fall 2010:________   Spring 2011:________

19. On average, across service-learning projects,

   [1=Much less; 5=Same; 9= Much more]
   a. The amount of effort I put into the service-learning project(s) relative to an equivalent class project without service was:
      1 2 3 4 5 6 7 8 9

   [1=Strongly disagree; 5=Neutral; 9= Strongly agree]
   b. In the service project(s) I learned how engineers apply the concepts I learned in class to real-life problems.
      1 2 3 4 5 6 7 8 9
   c. In the service project(s) I learned how to work with others effectively.
      1 2 3 4 5 6 7 8 9

20. To what extent have your service-learning project(s) this year had impact on the following:

   [1=Strongly negative; 5=Neutral; 9= Strongly positive]
   a. The likelihood that I would continue in engineering.
      1 2 3 4 5 6 7 8 9
   b. My belief that I can make a difference in the community using engineering skills.
      1 2 3 4 5 6 7 8 9
   c. My interest in learning the subject matter of the courses.
      1 2 3 4 5 6 7 8 9
   d. My commitment to being involved in community issues as an engineer.
      1 2 3 4 5 6 7 8 9
   e. My ability to address complex, open-ended problems (typical of community projects)
      1 2 3 4 5 6 7 8 9
   f. My ability to write and speak credibly as an engineer.
      1 2 3 4 5 6 7 8 9
   g. My understanding of the value of teamwork in addressing community issues.
      1 2 3 4 5 6 7 8 9
h. My ability to plan and carry out a project for the community.
   1  2  3  4  5  6  7  8  9

i. My school pride.
   1  2  3  4  5  6  7  8  9

j. The likelihood that I would drop out of engineering.
   1  2  3  4  5  6  7  8  9

k. My view of the engineering profession in a positive way.
   1  2  3  4  5  6  7  8  9

21. Did your service-learning project(s) lead you to further action (for example, volunteering) with the community agency or organization you worked with, or the topic/issue you worked on?
   __ Yes  __ No

22. What formal mechanisms did you use in your service-learning class to assess what you learned through your service-learning project? (Check all that apply)
   __ Discussion  __ Written assignments other than a report
   __ Making a presentation  __ None
   __ Keeping a journal/log  __ Other
   __ Written reports

23. Comments and suggestions: