2006-967: STRATEGIES FOR INTEGRATING SERVICE-LEARNING INTO THE ENGINEERING CORE AT THE UNIVERSITY OF MASSACHUSETTS LOWELL AND THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

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Strategies for Integrating Service-Learning into the Engineering Core at the University of Massachusetts Lowell and the Massachusetts Institute of Technology

Abstract

While the pedagogy of Service-Learning (S-L) has been applied beneficially in a variety of disciplines, only recently have engineering departments begun to adopt the practice of integrating academically-relevant community service projects into classes and, in doing so, it is most common to offer service-oriented projects in elective classes. However, the University of Massachusetts Lowell and the Massachusetts Institute of Technology have independently begun to develop S-L programs in engineering fields that work specifically to use the pedagogy in the core curriculum of the discipline. While the two universities and educational programs are distinct, the approach to S-L has been reasonably similar, and faculty and staff from each school have used common tools and methods to assess certain aspects of the integration from student and faculty perspectives. From surveys used at both of the schools (almost 760 pre-surveys and 680 post-surveys administered in the 04-05 academic year), a key finding was that student opinion changed significantly regarding the relationship between engineering and societal problems; students developed the belief that engineers should apply their skills to solve social problems. Additionally, both institutions surveyed the engineering faculty about their attitudes toward S-L and found the majority of faculty showed considerable interest in the concept. Overall, these findings show promise for integrating S-L into core engineering curriculums.

Introduction

Service-Learning (S-L) has a rich history in education, providing students and the communities they serve with significant benefits^{i,ii,iii}. Service-Learning is the integration of academic subject matter with service to the community in credit-bearing courses, with key elements including reciprocity, reflection, coaching, and community voice in projects^{iv}. Reflective activities help students process their experience and gain insight into the service they perform, the concepts that they are reinforcing, and the connection between the two^{v,vi,vii}. When S-L is used effectively in an academic class, students typically benefit in a number of important ways, including motivation for learning, teamwork, communication, synthesis of multiple technical concepts, understanding of engineering ethical responsibilities, and civic engagement^{i,ii,iii}.

As shown in Table 1, S-L can help educators to fulfill ABET Criterion 3 standards^{viii,ix}.

Table 1: Relationship between ABET Criterion 3 and S-L Pedagogy

Criterion 3 standards	How S-L can meet these
(a) an ability to apply knowledge of mathematics, science, and engineering	Well-chosen S-L projects provide students with the opportunity to apply these knowledge sets directly to real, potentially ambiguous problems.
(b) an ability to design and conduct experiments, as well as to analyze and interpret data	S-L projects can fit this criterion exactly; for example, students might collect and then analyze data for an agency interested in local groundwater contamination or the experimentation may be part of developing a technical solution to a problem.
(c) an ability to design a system, component, or	As students working on S-L projects involve

process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	real community partners, the constraints are necessarily evident and real.
(d) an ability to function on multi-disciplinary teams	As students work directly with community partners on S-L projects, their collaboration is multi-disciplinary; the benefit can be expanded by using teams of students from different disciplines, as well.
(e) an ability to identify, formulate, and solve engineering problems	Very few community partners are able to describe their needs in technical terms; the students must convert layperson problems into engineering problems and then solutions.
(f) an understanding of professional and ethical responsibility	The interaction with community partners coupled with active reflective activities provides students with the opportunity to understand these responsibilities.
(g) an ability to communicate effectively	Interaction with community partners, negotiating team dynamics, and reflection activities provide significant opportunities to hone communication skills.
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	Interactions with community partners in a variety of contextual settings (cultural, economic, ethnic) provide significant opportunities to consider and learn how engineering solutions fit into society.
(i) a recognition of the need for, and an ability to engage in life-long learning	While students usually focus on one specific aspect of a community's needs that fits directly with the course goals, the experience of working on real needs typically exposes students to many other aspects of the problem, motivating them to learn new material and helping them recognize the need to do so continually, if they are to solve real problems.
(j) a knowledge of contemporary issues	Interaction with community partners and the complexity of project implementation helps students become acutely aware of multiple contemporary issues.
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.	S-L projects typically require students to use the full range of engineering skills that they are developing.

Service-Learning has been used in engineering education in a number of arenas. Bill Oakes^{ix} has a list of 33 universities that have S-L in engineering and describes a number of examples of S-L in his resource guidebook for engineering S-L. In 2004-05, NSF funded ten programs to introduce S-L into engineering, which add approximately eight more universities to the list. Tsangⁱ and Lima and Oakes^x describe more examples of S-L in engineering courses.

However, Service-Learning is not commonly integrated into core engineering classes; when it is used, it is most often incorporated into elective and capstone courses, such as with the EPICS program started at Purdue, now expanded to 15 universities, that involves elective interdisciplinary S-L courses that students can take from first year to senior year^{xi} and the

capstone projects explored by civil engineering students at the University of Utah^{xii}. There are many factors that may contribute to this limited use of S-L in core engineering classes, including limited faculty and curriculum time, lack of knowledge of the pedagogy and its best practices, and challenges finding appropriate projects for specialized engineering topics. Capstone and elective classes typically have a broader focus that provides more flexibility for S-L.

What is unique about this effort described in this paper is the integration of S-L into required courses in the core curriculum, so that every student is exposed to the practice, either as a required or as an optional aspect of the core class. Further, this study offers initial, inter-institutional research into benefits of S-L for engineering students specifically, a field of inquiry that is currently quite limited^{ix} even though engineering students are taught differently from those in liberal arts disciplines. S-L magnifies those differences, since many liberal arts S-L experiences are placement-based experiences, whereas most engineering classes include S-L projects.

Given the potential benefits of S-L for engineering education, introducing the practice into core required engineering classes may offer educational benefits beyond students' experiences in elective and capstone classes, and will be able to reach more students in engineering programs, if the challenges described above can be overcome. Hence, the University of Massachusetts Lowell (UML) and the Massachusetts Institute of Technology (MIT) have worked to integrate S-L into core engineering classes to determine whether doing so is feasible, beneficial to students, and appealing to faculty. By collaborating on the assessment efforts of this initiative, we are investigating whether and how service learning can benefit students at two very different universities, as well as differences in benefits between the schools.

Educational Methodology

Both UML and MIT received planning grants from NSF to expand significantly the use of S-L in their engineering programs. UML, which has a relatively long history of using S-L in engineering classes, worked to develop S-L within the entire College of Engineering; MIT, with a much newer S-L initiative, focused on using S-L in the Department of Mechanical Engineering. Tables 2 and 3 display the classes that used S-L during the 2004-2005 academic year for each of these universities; the first column displays the number of the course used at the university currently.

Table 2: UML S-L Courses, Academic Year 2004-2005

Course #	Fall / Spring	Cr	Course Title	S-L Activity	S-L Students	Course Enrollment
Common First Year Courses						
25.107	F	2	Intro. to Engineering I	Tsongas Center exhibits for K-12 illustrating principles of engineering with Rube-Goldberg devices	270	270
25.108	S	2	Intro. To Eng. II - Chem	Vinegar maker for disinfectants for remote clinics; demo	19	19
25.108	S	2	Intro. To Eng. II - ME	Pilot: teaching modules for middle school children on principles of renewable energy	8	55

Course #	Fall / Spring	Cr	Course Title	S-L Activity	S-L Students	Course Enrollment
Common First Year Courses, continued						
25.108	S	2	Intro. To Eng. II - PL	Plastic box for assistive tech projects - speech recognition voice boxes	31	31
25.108	S	2	Intro. To Eng. II - EE	Circuits for voice box assistive technology projects with Plastic Dept.	73	73
25.108	S	2	Intro. To Eng. II - CE	Traffic study, parking lot study and design, and measurement of the CMAA Mill Building	37	37
Additional Required Courses						
Plastics Engineering						
26.215	F	1	Lab	Test materials for solar lantern for Peru	24	24
26.218	S	2	Intro to Design	Design/manufacturing of housings for assistive tech. voice box project	50	50
26.418	S	3	Plastics Design	Casket liner refinement for National Cemetery Assoc.; design of solar lantern enclosures	12	12
Civil Engineering						
14.286	F	3	Probability & Statistics	Crime analysis for Lowell Police, youth organizations	45	45
14.330	S	3	Soil Mechanics	Soil analysis for Lawrence Community Works, villages in India	47	47
14.204	S	3	Strength of Materials	Structural analysis of the CMAA Mill Building	33	33
14.460	F	3	Water Resources Eng.	Open channel design for irrigation in a village in Peru	17	17
14.485	S	3	Capstone Design	Renovation design for the CMAA Building in Lowell.	11	11
Mechanical Engineering						
22.213	S	3	Kinematics	Design playground rides for kids with disabilities; local playground safety analysis; canal surface cleaning device	51	51
22.202	S	2	Design Lab II	Manufacture device to help relative/friend with disability with everyday activities	48	48
22.341	S	3	Conduction and Radiation	UML Engineering Building window replacement analysis for energy conservation	54	54
22.403	F	3	ME Lab II (Applications)	Develop method to test local playground surface hardness for safety	12	34
22.423	S	3	Capstone Design	Assistive technology motorized tricycle; low-cost leg prosthesis for Peruvian villages; solar water system for villages; hydro educational exhibit for Tsongas Industrial History Center; FIRST robot competition advisors for high school students	9	27

Course #	Fall / Spring	Cr	Course Title	S-L Activity	S-L Students	Course Enrollment
Electrical Engineering						
16.311	F	2	Electronics Lab I	Build sub-audible detector circuits for radio modem systems in the Andes	62	62
16.312	F, S	2	Electronics Lab II	Build proximity sensor for blind; study IC devices that can record and play back voice	80	80
16.399 (senior)	F, S	3	Capstone I	Assistive technology, reverse engineer product for persons with disabilities; VA Hospital computer station design	80	80
16.499	F, S	3	Capstone II	Assistive technology: e.g., voice recognition switches, proximity sensors, environmental controls; 80 clients	80	80
Non-Engineering Courses						
45.334	F, S	3	Engineering Ethics (required)	Students examine whether introducing TV to remote villages is ethical	180	180
42.406	S	3	Writing in the Community	Students help S-L project by writing narratives of experiences former Peru/assistive technology students	14	14
Totals:					1347	1434

Table 3: MIT S-L Courses, Academic Year 2004-2005

Course #	Fall/ Spring	Units*	Course Title	S-L Activity	S-L Students	Course Enrollment
2.002	S	12	Mechanics and Materials II	Teams analyzed a unique form of charcoal, being developed for use in Haiti, made from agricultural by-products to identify trade-offs between composition, manufacturing methods, and fracture toughness.	13	44
2.006	S	12	Thermo-Fluids Engineering II	Student teams designed components for a distillation system to extract essential oils from tree byproducts to encourage reforestation. Students performed the research and analysis for a paper design.	64	64
2.009	F	12	Product Engineering Processes	Teams of 16-20 students worked on a semester-long design project, creating a fully functional prototype. Four of the six teams chose S-L projects: a solar collector coupled with a steam-powered water pump; a method for creating charcoal briquettes from agricultural waste products; a low-energy refrigeration system for transporting vaccines to rural areas; and a human-powered battery charger for use with a microfilm projector developed in the class in a previous year.	51	95
Totals:					128	176

* "A typical MIT subject carries 12 units. The number of units for each subject indicates the number of hours spent each week in class and laboratory, plus the estimated time the average student spends each week in outside preparation. A normal credit load per semester is four to four-and-one-half subjects (48-54 units)^{xiii}."

For both schools, the objective was to introduce S-L in as many courses as possible, focusing on the core of the curriculum while maintaining high academic and service standards for the S-L experience. At UML, faculty were supported in this initiative with mini-grants, some TA assistance, and three faculty members in the mechanical and electrical engineering departments experienced in S-L. At MIT, which had an existing initiative to support S-L campus-wide but limited engineering experience, additional faculty support was provided by a faculty member in the mechanical engineering (M.E.) department and an M.E. graduate student well-versed in S-L. Additional funding was set aside specifically for M.E. faculty and students applying to the existing MIT S-L grants program.

Student Research Methodology

Both institutions used pre- and post-survey instruments for the S-L classes listed above and five questions were designed by the authors to be identical on attitudes toward service and civic responsibility. The exact wording of the statements on the surveys follows in Table 4. These were partially adapted from those used by Eyler and Giles^{xiv}.

Table 4: Identical Attitudinal Questions used by UML and MIT

1. Engineers should use their skills to solve social problems.
2. I feel that social problems are not my concern.
3. I feel that I can have an impact on solving problems that face my local community.
4. I feel that I can have an impact on solving problems that face under-served communities internationally.
5. I have developed a close personal relationship with at least one faculty member at this institution.

Students were asked to rank their agreement with the statements on a scale of 1 to 9, with 1 signifying strong disagreement, 5 neutrality, and 9 strong agreement. Analysis was conducted on the 801 pre-surveys and 713 post surveys that were available; approximately 18% of the surveys were from MIT. Logistical challenges were the primary reason that the number of post-surveys is lower than the number of pre-surveys. Females comprise fifteen percent of the responses. The questionnaires were analyzed without pairing pre- and post- responses because, due to the voluntary nature of all questions in the survey, few student IDs were obtained. Hence, it is possible that the pre- and post- populations are not identical. In addition, it is possible that a small number of UML students completed the survey multiple times, if they took more than one service learning class in a given semester. Despite the challenges associated with surveys being voluntary, a representative sample was obtained. In order to maintain academic rigor, it was not possible to use control groups for this study.

Student Outcomes

Student responses were analyzed with a 5% significance level using both a one-tailed t-test and a Pearson Chi-Square test. Results of the analysis showed mean increases on all questions between pre- and post-surveys. Question two seeks a decreased response to indicate social orientation, so this result means that the response did not match our hypothesis, that students exposed to the S-L experience would change their attitudes to be more socially oriented; the

results for the four other questions did align to our hypothesis. The two tests yielded differences in which changes were significant, as shown in Table 5. For the Chi-Square, the only statistically significant changes were on the first question and fifth question; for the t-test, the fourth and fifth questions showed significant changes with the first question approaching significance.

Separate comparisons by school and gender were performed using a Chi-Squared analysis. The only difference between schools on the “pre” and “post” changes was that for MIT respondents, there was no significant difference on the first question. When results were separated by gender, overall, only males showed a significant difference on the first question, while the difference was significant for both males and females on the last question. A separate tabulation by year showed that first and second year students had significant, positive changes on the last question.

Tests of differences between schools with pooling of the pre- and post-surveys yielded significant differences on all five questions with MIT students showing more positive agreement on all except the second question, which was significantly more negative. Pooling of pre- and post-surveys and comparing by gender showed significant differences on all but the first question; on average, females feel more responsible and empowered to make a difference personally for societal change.

Table 5: Statistical Outcomes for Student Responses

Items in bold are significant

Abridged Question	Pre Mean	Post Mean	Pearson Chi-Square value, degrees of freedom, and significance			one-tailed t-test value, degrees of freedom, and significance		
			χ^2	df	p	t	df	p
1. engineers should solve social problems.	6.49	6.65	21.993	8	0.005	-1.580	1391.175	0.057
2. social problems are not my concern.	3.37	3.42	6.258	8	0.618	-0.420	1452	0.338
3. I can have an impact on solving local problems	6.32	6.38	6.605	8	0.580	-0.639	1447	0.262
4. I can have an impact on problems internationally.	5.81	6.01	13.089	8	0.109	-1.994	1444	0.023
5. relationship with at least one faculty member	4.75	5.35	38.775	8	0.000	-4.433	1437	0.000

Tabulations by course allowed comparisons for all three MIT courses and only three UML courses (as the questionnaires were targeted across the academic year for UML). MIT’s 2.006 course showed significant changes from “pre” to “post” on all five questions, while UML’s 25.107 showed significant changes on the last question and 26.215 on the first question.

Thus, the opinion of students that engineers should use their skills to solve social problems showed an increase in the service-learning courses. Beliefs of individual empowerment to solve social problems did not appear to significantly increase across the board, however. Service-

learning projects appear to have increased the feeling of having a personal link with faculty. Given the range of ways that S-L was integrated into these classes, and the short time period over which the analysis was completed, it is to be expected that dramatic transformations would not appear in this initial assessment. However, the initial positive changes promote the value of S-L for engineering students. Both schools appear committed to continue the effort of integrating S-L into core courses, and to continue to assess this transformation.

Previous research has shown that additional outcomes for MIT's 2.009 service learning class include significant changes in career aspirations, with a preference toward engineering-oriented ones following the class; more interest in service-oriented activities by minority students; and women having a greater increase in their confidence than men in using certain engineering skills^{iv}. The results of other items on the UML student surveys, such as gender and ethnicity differences in the reasons for studying engineering, are discussed in another paper in this conference: women and minorities appeal more likely to choose engineering with the goal of helping others, rather than oneself.

Faculty Research Methodology

A key aspect of a S-L program is faculty involvement; hence, both UML and MIT surveyed their faculty to understand faculty interest in and concerns about S-L^{xvi}. According to Driscoll, surveys like these are reasonably rare, but critical for the expansion of S-L programs^{xvii}. Given the distinct nature of the universities, different methods were used to conduct the surveys.

At UML, a faculty meeting was held, at which 47 faculty (72% of the college of engineering) attended. Following a presentation about the benefits of S-L and best practices for the pedagogy in engineering education, faculty were given a written survey about their beliefs in terms of the benefits of S-L, their concerns about using the pedagogy, and their interest in it. At MIT, faculty were interviewed individually using a structured interview format. Of the 75 faculty in the mechanical engineering department at the time of the interviews, 54 agreed to be interviewed (72%). These faculty were representative of the department in terms of gender, tenure status, and area of study. The survey contained questions about their knowledge of, attitudes about, and interest in S-L. Following the interview, a pamphlet about MIT's S-L program was distributed.

Faculty Outcomes

While the two surveys' distinct methodology and questions limited the number of analyses that could be performed, we found a variety of interesting comparable findings in terms of faculty concerns, beliefs about barriers, and interest in using S-L. MIT faculty were asked about their openness to using S-L in classes that they teach, on a scale of 1-10. With the caveat that sufficient support was provided, 80% of responded positively. UML faculty were asked to respond to whether, in principle, S-L would be beneficial to the students in the courses they teach: 66% responded positively.

Both UML and MIT faculty were asked about the benefits of S-L and their concerns about the pedagogy, though the types of questions varied. However, comparing the responses offers insights into their concerns and beliefs. Of the MIT faculty, 41% were significantly concerned about the impact of S-L on academic rigor; 24% of UML faculty surveyed had similar concerns. 45% of UML disagree that it is possible to integrate service-learning into existing courses

without adding to the overall workload of students; 52% of MIT faculty expressed concern that the curriculum was too tight to include S-L. These barriers to implementation are interesting to explore and provide important insights not only into faculty knowledge and beliefs about S-L but information for administrators on how to address and improve S-L execution.

Forty-five percent of UML faculty reported that time was the top barrier to integrating service-learning into courses they teach; 33% of MIT faculty reported time constraints for revising course curriculum as one of their concerns about S-L. Other key concerns for UML faculty were lack of information about how to implement S-L successfully, lack of financial support, and concerns about liability. The other top concern for MIT faculty was the difficulty in finding an appropriate project.

One interesting outcome from these studies is that neither set of faculty cited tenure incentives as a top concern about using S-L. While it is likely that changes to tenure criteria to include S-L usage would increase untenured faculty interest in the pedagogy, this finding suggests that departments can begin to encourage and support the practice without taking the considerable step of modifying tenure standards. However, the differences in respondents' attitudes to their concerns about S-L suggest that S-L coordinators and department administrators interested in encouraging S-L should consider performing surveys of their faculty to identify the top barriers at their particular school.

Conclusions and Future Work

In the 2005-2006 academic year, both UML and MIT are continuing to develop S-L in engineering classes; many classes listed above are running again this academic year, and new offerings are being developed. At UML, new classes include Design of Machine Elements (with a wide variety of student-selected projects), Convective Processes (a water pumping system for a village in Peru), Design Theory (design of experiments for molding plastic scrapers for the community), Design Lab I (assistive technology devices design), Transportation Engineering (optimizing the traffic signals of selected intersections/arterials in the City of Lowell), and Statics (water tower design for another village in Peru). At MIT, students in 2.000 How and Why Machines Work, an introductory mechanical engineering class, will develop educational kits on nanotechnology for local high schools and in 2.72 Elements of Machine Design, students will work on assistive technology and international development projects. Given that, overall, both sets of faculty were open to using the pedagogy of S-L in their classes, the opportunities for this S-L expansion seem quite promising. And these results suggest that overall engineering faculty interest in service and S-L may be reasonably common. However, the barriers to adopting the pedagogy can differ, so that institutional cultures and norms, as well as faculty concerns, should be considered in the process of developing a S-L program.

The assessment work being performed will continue and expand, in the hopes of further understanding the effects of using S-L in engineering classes. It is the hope of the authors that other universities doing similar work will collaborate on assessment efforts, so that even greater pools of data can be analyzed. For this purpose, our questionnaires are included in the Appendix.

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Appendix

Reformatted questionnaires used in the study are given below. A scantron version of the UML questionnaire was also used. MIT used slightly different surveys for each class; a representative sample, the 2.002 post survey, is shown. Both paper and web-based surveys were used, depending on class logistics. The 2.002 pre survey can be found at <http://web.mit.edu/drwallac/Public/2.002/index.html>

UML Student ID (ISIS No.) _____

Today's Date: _____ Course Number: _____

Questions for students ("post")

This survey is a follow-up to the one you took at the beginning of the semester or year. 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. The ISIS ID number is very important for research purposes. Thanks from the SLICE project, UML College of Engineering.

i. Did you participate in a service-learning project in this course? ☐ Yes ☐ No

A. Gender: ☐ Male ☐ Female

B. Are you an international student: ☐ Yes ☐ No

C. Ethnicity: ☐ Asian ☐ Black ☐ Caucasian ☐ Hispanic
☐ Native American ☐ Other: _____

D. Have you voted in a previous election? ☐ Yes ☐ No

E. How far do you live right now from campus? _____ miles (If you live on campus, put zero.)

F. Age: _____

G. Have you ever been involved in community service activities before? Check all that apply:
☐ No ☐ Yes, during high school ☐ Yes, during college

H. How many hours per week do you work at a paid job? _____

I. How many credit-hours of courses are you taking this semester? _____

J. Please rank your five (and only five) most important career values (1 = highest):

___ Challenge: Learning new skills or information, self-development

___ Creativity: Doing things in a new way or inventing things

___ Helping: Doing things for others, building a better world

___ Income: Making a high salary

___ Independence: Being our own boss, deciding how and when to do your work

___ Outdoors: Working outside, in different types of weather

___ Physical: Being physically active at work, or being physically inactive

___ Prestige: Doing work that is seen as important, and for which people respect you

___ Public: Providing information to, and interacting with the public

___ Security: Having stable employment and income, not worrying about lay-offs

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

___ Team: Being cooperative, getting to know co-workers

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

[1= Strongly Disagree, 5=Neutral, 9=Strongly Agree]

a. The amount of effort I put into the service-learning project was greater than what I would have put in for an equivalent project not involving service.	1	2	3	4	5	6	7	8	9
b. In the service project, I learned how to apply concepts learned in class to real problems.	1	2	3	4	5	6	7	8	9
c. In the service project, I learned how to work with others effectively.	1	2	3	4	5	6	7	8	9
1. Service and academic coursework should be integrated.	1	2	3	4	5	6	7	8	9
2. Engineers should use their skills to solve social problems.	1	2	3	4	5	6	7	8	9
3. I feel that social problems are not my concern.	1	2	3	4	5	6	7	8	9
4. People who receive social services largely have only themselves to blame for needing services.	1	2	3	4	5	6	7	8	9
5. Social problems are more difficult to solve than I used to think.	1	2	3	4	5	6	7	8	9
6. The problems of unemployment and poverty are largely the fault of society rather than of individuals.	1	2	3	4	5	6	7	8	9
7. I feel that I can have an impact on solving problems that face my local community.	1	2	3	4	5	6	7	8	9
8. I feel that I can have an impact on solving problems that face under-served communities internationally.	1	2	3	4	5	6	7	8	9
9. It is important to me personally to influence the political structure.	1	2	3	4	5	6	7	8	9
10. It is important to me personally to have a career that involves helping people.	1	2	3	4	5	6	7	8	9
11. I feel 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
12. I have developed a close personal relationship with at least one faculty member at this institution.	1	2	3	4	5	6	7	8	9

**2.002 MIT Post-Survey
Spring 2005**

The mechanical engineering department has received an NSF grant to study teaching methods used at MIT. We would appreciate your contribution to this study by completing the survey below. This information will have no impact on your grades and will not be available to the course instructors. Your participation in this survey is voluntary and you may elect not to answer any question you choose. All responses will remain confidential and anonymity of any reported results is assured. Your name is used only to connect pre-post survey responses. Thank you for your participation!

1. Your MIT ID: _____

2. Gender: ☐ Male ☐ Female

3. Your ethnicity: _____

4. Are you an international student: ☐ Yes ☐ No

5. What 2.002 lab section are you in:

☐ Monday ☐ Tuesday morning ☐ Tuesday afternoon ☐ Thursday

6. How happy are you with your choice of academic major?

1-----2-----3-----4-----5-----6-----7-----8-----9
Very Very
unhappy happy

7. Rank the career choices below from most to least desirable after graduation, where '1' is your most desirable career choice:

- ☐ Management Consulting
- ☐ Product Development Firm
- ☐ Manufacturing Company
- ☐ Medicine
- ☐ Research and Development
- ☐ Graduate School
- ☐ Other _____

8. Currently, what is your overall attitude toward MIT?

1-----2-----3-----4-----5-----6-----7-----8-----9
Extremely Extremely
negative positive

Please rate yourself on the following abilities, and check one box for each question:

9. Compared to the average 2.002 student, I feel my	<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="text-align: center;"> <p>Much Below Average</p> <p>←</p> </div> <div style="text-align: center;"> <p>Neutral</p> </div> <div style="text-align: center;"> <p>Much Above Average</p> <p>→</p> </div> </div>									Your comments are very helpful to us. Please use blank sheet at the back for more space.	
	1	2	3	4	5	6	7	8	9		Comments
a. problem solving ability is											
b. ability to think creatively is											
c. ability to design testing methods to quantify basic mechanical properties is											

Please check one box for each statement:	<div style="display: flex; justify-content: space-between;"> <div>Strongly Disagree</div> <div>Neutral</div> <div>Strongly Agree</div> </div> <div style="display: flex; justify-content: space-between; margin-top: 5px;"> ← → </div>									Please use blank sheet at the back for more space. Comments
	1	2	3	4	5	6	7	8	9	
10. Engineers should use their skills to solve social problems.										
11. I feel that social problems are not my concern.										
12. I feel that I can have an impact on solving problems that face my local community.										
13. I feel that I can have an impact on solving problems that face under-served communities internationally.										
14. I have developed a meaningful relationship with at least one faculty member at MIT.										

15. How interested are you in doing community service?

1-----2-----3-----4-----5-----6-----7-----8-----9
 Not at all Very
 interested interested

16. Choose the response that best describes your community service activities since coming to MIT.

- ☐ Community service has not been one of my priority choices
☐ I am interested in community service activities, but have not had time while at MIT
☐ I am involved in community service (Estimate the number of hours per month: _____)

17. If applicable, how meaningful have you found your past community service activities to be?

1-----2-----3-----4-----5-----6-----7-----8-----9
 Not at all Very
 meaningful meaningful N/A

18. What was the project lab you worked on in 2.002, that you presented today: _____

19. Compared to the other lab sessions in 2.002, how interesting did you find this project lab?

1-----2-----3-----4-----5-----6-----7-----8-----9
 Not at all Very
 interesting interesting

20. Compared to the other lab sessions in 2.002, how much did you learn from this project lab?

1-----2-----3-----4-----5-----6-----7-----8-----9
 Nothing A tremendous
 amount

21. Compared to the other lab sessions in 2.002, how satisfying did you find this project lab?

1-----2-----3-----4-----5-----6-----7-----8-----9
 Not at all Very
 satisfying satisfying

22. Has this class altered the way you think about your educational and/or career options?

1-----2-----3-----4-----5-----6-----7-----8-----9
 Not at all A tremendous

28. Check one box for each question. Please rate the following statements:	<div style="display: flex; justify-content: space-between; align-items: center;"> <div>Strongly Disagree ←</div> <div>Neutral</div> <div>→ Strongly Agree</div> </div>									Please use blank sheet at the back for more space. Comments
	1	2	3	4	5	6	7	8	9	
a. the lab project I worked on in this class helped a community in need.										
b. the lab project helped me better understand community needs and how I could help										

29. Check one box for each question. For the project lab, how helpful did you find the following resources:	<div style="display: flex; justify-content: space-between; align-items: center;"> <div>Not at all Helpful ←</div> <div>Neutral</div> <div>→ Very Helpful</div> </div>									Please use blank sheet at the back for more space. Comments
	1	2	3	4	5	6	7	8	9	
a. Introductory presentation in lab about the project										
b. the TAs										
c. the lab instructor										
d. Pierce										
e. For the charcoal project only, Amy &/or Jessica										
f. Prof. Park's lectures										

30. Is there anything else you would like us to know about service learning in 2.002 and/or at MIT generally?

Thank you, we really appreciate your completing this survey.