

CoE 2010 Initiative: A Report of the Overarching Assessment

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Executive Summary

At the University of Wisconsin-Madison, the College of Engineering (CoE) has created an initiative to transform undergraduate education through vision and goals created by the 2010 Task Force. Faculty and staff identified the following goals:

- build disciplinary excellence with multidisciplinary perspective
- nurture critical thinking,
- develop multicultural competence,
- cultivate collaboration and leadership skills, and
- promote an ethic of service to the profession and the community.

At the request of the Task Force, the Engineering Learning Center (ELC) conducted an overall assessment to evaluate the relative impacts of the courses within the initiative. The short-term goal of this assessment was to capture the change in attitude and perception related to the CoE 2010 goals among undergraduate students and faculty. The long term goal is to use this data to establish a baseline from which future changes in perceptions and attitudes and progress on the 2010 initiative can be measured. This report describes the assessment plan and participants, examines the data collected during the overall assessment, and presents preliminary conclusions and recommendations.

The eleven projects were assessed in three ways: electronic surveys for students and faculty, a faculty focus group, and the number of hits as well as faculty comments related to the electronic newsletter about teaching and learning. The questions on both the student and faculty surveys were designed to examine perceptions and attitudes related to the CoE 2010 Goals.

From a total of 3203 students, we invited a random sample of 1291 to take the survey and received 205 responses, yielding a response rate of approximately 16%. Of the 223 faculty members invited to take the survey, 70 responded yielding a response rate of approximately 31%.

An analysis of the demographics showed an overrepresentation of freshman/sophomore survey respondents and an underrepresentation of senior survey respondents. Future assessments should be designed to allow or encourage an increased number of upperclassmen students to participate.

Findings

Student and faculty perspectives for each of the five overall goals follow below as key findings. More specific findings, explanations, and quotations are within the report.

Disciplinary excellence with multidisciplinary perspective

Student Perspective

- 63% of all survey respondents have considered taking a course outside of their discipline.
- 53% have considered adding a second major or certificate.
- 47% of respondents who took EPD 690 (now INTEREGR 102), 38% of respondents who took INTEREGR 101 and 28% of students who took EPD 155 cited this course as a contributor to their abilities to communicate to others about their engineering discipline.

Faculty perspectives

- 78% have integrated material from other disciplines into their courses
- 61% indicated that the reason they did this was that the material from other disciplines was needed to solve problems presented in class.

Critical thinking

Student Perspective

- Students were asked, “For this course, I was asked to explore problems with more than one solution.” On a scale from 1 (strongly disagree) to 5 (strongly agree), the average student survey rating was a 3.9.
- Students were asked, “For this course, I was asked to determine the validity or usefulness of information or methods.” On a scale from 1 (strongly disagree) to 5 (strongly agree), the average student survey rating was a 3.9.

Faculty perspective

- Of all survey respondents, 88% have integrated material that requires students to think critically.
- Regarding the reason that they integrated critical thinking skills, 33% indicated that future courses and engineering practice were two reasons. “Students need to be able to think critically for future courses and as an engineer.”
- When asked how they knew that students were better able to think critically, the most common response (21%) was “Homework problems/questions required critical thinking.”

Multicultural competence

Student perspective

- 31% of respondents indicated that they planned to study abroad.
- Students were asked, “This course improved my awareness of cultural issues related to engineering.” On a scale from 1 (strongly disagree) to 5 (strongly agree), the average student survey rating was a 3.1.

Faculty perspective

- Of all survey respondents, 52% have integrated cultural issues related to engineering
- Faculty were asked, “The curriculum and instruction of this course helps to improve students’ awareness of cultural issues related to engineering.” On a scale from 1 (strongly disagree) to 5 (strongly agree), the average rating was a 3.6.

Collaboration and leadership skills

Student perspective

- 62% planned to pursue some type of leadership position.
- Students were asked, “This course helped improve my ability to work as a team.” On a scale from 1 (strongly disagree) to 5 (strongly agree), the average student survey rating was a 3.5.
- Students were asked, “This course helped improve my leadership skills.” The average student survey rating was a 3.2.

Faculty perspective

- 64% integrated material into their courses that enhanced students’ collaboration skills.
- 45% have integrated material into their course(s) that enhanced students’ leadership skills.

Ethic of service to the profession and the community

Student perspective

- 45% indicated that they have become a more contributing member of the groups and/or organizations to which they belong, OR have joined a new group or organization Since the beginning of this academic year,
- 57% had performed volunteer service in the community this academic year, or had planned to do so in the future

Faculty perspective

- 18% have integrated material that included or motivated volunteer service in the community as a part of the course(s)
- Faculty were asked, “For this course, I thought about or discussed the value of volunteer service in the community.” On a scale from 1 (strongly disagree) to 5 (strongly agree), the average student survey rating was a 2.5.

Recommendations

In addition to the data collected during this assessment, the process leading to the collection and analysis has led to some recommendations for future work.

- Continue to gather data from multiple methods: the student survey, the faculty survey, focus group, and hits to websites including the electronic newsletter.
- Use pre and post surveys or other assessment tools for more accurate results rather than asking survey respondents to rate their perceived change.
- Encourage faculty to administer the survey or assessment tool as part of a course evaluation.
- Examine syllabi for course characteristics, such as learning goals, instructional strategies, activities, and course format, to identify commonalities, if any, among courses that have the highest average levels of change.
- Encourage faculty to expand syllabi (course descriptions) to include CoE 2010 learning outcomes.
- Recognize faculty and courses that build the skills, attitudes, and knowledge aligned with the CoE 2010 goals; see Table IV Courses included in Survey Analysis.
- Revise upper-level design courses to be inter-disciplinary.
- Focus limited resources on first- and second-year courses.
- Invite undergraduate and graduate students through advisory groups to brainstorm strategies to incorporate these recommendations and improve teaching and learning experiences.

By reviewing and acting on the assessment results, the Task Force will be able to determine which learning experiences are more effective, and how we can replicate their success across the College of Engineering.

Introduction

At the University of Wisconsin-Madison, the College of Engineering (CoE) has created an initiative to transform undergraduate education through vision and goals created by the 2010 Task Force. Faculty and staff identified the following goals:

- build disciplinary excellence with multidisciplinary perspective
- nurture critical thinking,
- develop multicultural competence,
- cultivate collaboration and leadership skills, and
- promote an ethic of service to the profession and the community.

As part of the initiative, the CoE funded eleven pilot projects totaling approximately \$500,000 in May, 2007. Although each project was responsible for conducting its own individual assessment, the 2010 Task Force and the Engineering Learning Center (ELC) conducted an overarching assessment to evaluate the relative impacts of the courses within the initiative. The short-term goal of this assessment was to capture the change in attitude and perception related to the CoE 2010 goals among undergraduate students and faculty. The long term goal is to use these data to establish a baseline from which future changes in perceptions and attitudes and progress on the 2010 initiative can be measured. The assessment included (1) two electronic surveys, one for students and one for faculty, (2) a focus group for selected faculty members, and (3) a paper survey for a second group of selected faculty members. This report describes the assessment plan and participants, examines the data collected during the overarching assessment, and presents preliminary conclusions and recommendations.

Assessment Plan and Administration

The eleven projects under the CoE 2010 Initiative (see Table I below) were assessed in three different ways. First, five of the eleven projects were assessed through two electronic surveys, one for undergraduate engineering students and one for engineering faculty teaching an undergraduate course during the 2007-2008 academic year. These projects included: (1) Engineering Risk, Uncertainty, and Decision Analysis Certificate, (2) Energy and Sustainability Certificate, (3) Engineering Problem Solving with Computers, (4) Integration of EPD 397 with Multidisciplinary Engineering Courses, and (5) Introduction to Society's Grand Challenges.

To develop the survey, we used WebSurvey@UW, a tool developed through the Division of Information Technology (DoIT) at UW-Madison (see Appendix I and II). The survey went through several revisions with input from the CoE Task Force and the UW Survey Center. In mid-April, we piloted the student survey with seven members of the ASEE Graduate Student Chapter at UW-Madison, and the faculty survey with five members of the 2010 task force. From the pilot surveys, we made two changes on both surveys by (1) re-wording a few phrases that were ambiguous, and (2) changing the format by eliminating the progress bar; because the design of our survey allowed only one question on most pages, the progress bar made the survey appear longer than it really was.

Table I: Description of Projects under CoE 2010 Initiative

<i>Project Title</i>	<i>Project Goal</i>	<i>Associated Courses</i>
Certificate in Engineering Risk, Uncertainty, and Decision Analysis	To develop a new certificate program focusing on providing engineers and other students an in-depth exposure to modern methods for the analysis of reliability, risk, and uncertainty.	ISyE 574: Risk Analysis: Nuclear Power Plant CEE 494: CEE Decision Making
Energy and Sustainability Course for Energy Certificate Program	To develop a high-level course focusing on energy generation with a focus suitable for preparing engineering seniors to make quantitative comparisons between current and alternative processes.	CBE 562 (Special Topics): Energy & Sustainability
Engineering and Biology: Technological Symbiosis	To create a cross-college, introductory course designed to explore and highlight the ways in which biology and engineering can be successfully integrated.	
Engineering for Energy Sustainability	To initiate the development of a suite of cross-cutting courses that span the engineering curriculum, addressing energy sustainability, and with firm roots in the 'real world' design and engineering practices associated with participating disciplines, leading to a 'Certificate in Engineering for Energy Sustainability.'	
Engineering Problem Solving with Computers	To create three hybrid courses that share common curriculum related to specific software tools but that use examples and exercises taken from specific engineering fields, to demonstrate the problem-solving or data-collection aspects of using the software.	NEEP 271:Engr Problem Solving I CBE 562: Intro Chemical Process Modeling CEE 291: Prob. Solving Using Comp
Fostering of Student Participation in Study Abroad (Engineering Courses Abroad)	To make three junior-level engineering courses available to all UW-Madison students studying abroad, to enable these students flexibility in satisfying curricular requirements while overseas, and provide a model for replication.	
Integration of EPD 397 with Two Multidisciplinary Engineering Courses	To develop a stepped, 2-semester, collaborative approach to teaching technical communications in multidisciplinary, service-oriented design courses.	EPD 397: Tech. Comm. CEE 649: Sustainable Energy Building Design ME 349: Engr Design Projects
International Genetically Engineered Machine (iGEM) Competition	To establish an interdisciplinary iGEM team and promote education and research in biological engineering.	
Intro to Society's Engr Grand Challenges: A Modular Curriculum	To create a modular, introductory, cross-disciplinary course building on NAE's Grand Challenges project.	EPD 690: Intro to Society's Engineering Grand Challenges. Now INTEREGR 102
Teaching and Learning Insights	To develop an electronic newsletter and corresponding archives on the web that would distribute concise answers to instructors' questions about diversity, advising, and teaching.	
Zhejiang University Summer Program	To develop a new 8-credit, 8-week summer study-abroad program (following the successful model of the Toulouse Summer Program) at Zhejiang University in Hangzhou, China.	

Because we were only interested in the perceptions and attitudes of students who had taken an undergraduate engineering course, we included a question in the beginning of the student survey which directed participants to the end of the survey if they had not taken a course in the CoE. Correspondingly, we were only interested in the responses from faculty who had taught an undergraduate engineering course, and thus included a similar question at the beginning of the faculty survey. The surveys were first administered during the last week of class, and a reminder was sent out during finals week. To relay the importance of the survey, the email invitation was sent via the Office of the Dean of Engineering (See Appendix III).

The second assessment approach was to conduct a focus group for those five projects which did not offer a course during the 2007-2008 academic year. Faculty was invited to discuss similar questions about their projects that had been included in the electronic survey (see Appendix IV). These projects included (1) Engineering and Biology: Technological Symbiosis, (2) Engineering for Energy Sustainability, (3) Fostering of Student Participation in Study Abroad, (4) Zhejiang University Summer Program, and (5) International Genetically Engineered Machine (iGEM). The focus group was held in mid-May, and was attended by one or two members from each project except the International Genetically Engineered Machine (iGEM), which had no representation. The focus group was facilitated by the ELC. Results from the focus group are tied into the conclusions and recommendations.

The final assessment approach applied to a specific project, the design and dissemination of an electronic newsletter titled "Teaching and Learning Insights (TLI)." TLI was distributed once a month by the Engineering Learning Center, in collaboration with the COE Climate and Diversity Committee. It communicated strategies and supporting research related to teaching and learning in college classrooms to all faculty, instructional staff, and students. The number of 'hits' to the site indicated quantitatively that individuals accessed the newsletter. Between October and December 2007, 416 unique visitors viewed TLI, and between January and August 2008, 1,888 unique visitors viewed TLI. Over twenty faculty interviews, profiles, and experiences incorporated representatives from all departments. Numerous unsolicited comments provided positive suggestions and support. Work is on-going to continue the newsletter as a tool to share effective teaching and learning experiences.

The next sections analyze the results of the student and faculty surveys, according to each of the CoE 2010 Goals.

Results

Response Rate

During the 2007-2008 academic year, 3203 students had enrolled in an undergraduate engineering course. We invited a random sample of 1291 students to take the survey and received 205 responses, yielding a response rate of approximately 16%. We believe the low response rate may be explained by the fact that the survey was administered at the end of the year. As this is the time of year when students are most busy, it is reasonable to expect that we would have received more responses had the survey been administered at a different time of the year. Of the 223 faculty members invited to take the survey, 70 responded yielding a response rate of approximately 31%. In comparison to the student survey, a higher response rate may be

explained by the fact that faculty had a more vested interest in having their opinion heard by the CoE Task Force.

Demographics

The table below shows the distribution of all students eligible to take the survey during the 2007-2008 academic year, compared with the survey respondents.

Table II: Comparison of Survey Respondents and CoE Undergraduate Students

	<i>Student Survey Respondents</i>	<i>Undergraduate Engineering Students Fall 07-08</i>
Gender		
Female	20%	18%
Male	80%	82%
Race/Ethnicity		
American Indian/Alaskan Native	1%	1%
Asian	6%	6%
Black/African American	2%	2%
Hispanic/Latino	3%	2%
International student	6%	7%
Not Specified	2%	3%
White	81%	79%
Year in School		
Freshman	22%	20%
Sophomore	51%	20%
Junior	26%	23%
Senior	1%	35%
Other	0%	2%
Cumulative GPA		
3.5 - 4.0	40%	34%
3.0 - 3.4	37%	34%
2.5 - 2.9	16%	21%
2.0 - 2.4	8%	7%
< 2.0	0%	4%
Engineering Major		
Biological Systems Engineering	1%	0%
Biomedical Engineering	15%	10%
Chemical Engineering	12%	10%
Civil Engineering	14%	12%
Computer Engineering	6%	6%
Electrical Engineering	3%	9%
Engineering Mechanics	2%	5%
Engineering Physics	3%	1%
Geological Engineering	1%	0%
Industrial Engineering	2%	6%
Materials Science and Engineering	2%	2%
Mechanical Engineering	19%	22%
No Major Code	19%	13%
Nuclear Engineering	3%	3%

The demographic characteristics of all undergraduate engineering students appear to be similar to survey respondents in all areas except for “Year in School.” In this area, students survey respondents were much more likely to be sophomores and much less likely to be seniors when compared to all engineering undergraduate students. Although data were not weighted for this analysis, if more significant differences were found in the future, using weights would ensure more accurate analyses. Additionally, future assessments should be designed to allow or encourage an increased number of upperclassmen students to participate.

An examination of faculty demographic characteristics yields similar conclusions. Table III below compares the demographics of survey respondents to all engineering faculty who taught an undergraduate engineering course during the 2007-2008 academic year. Again, data were not weighted for this analysis.

Table III: Comparison of Survey Respondents and CoE Faculty

<i>Characteristic</i>	<i>Faculty Survey Respondents</i>	<i>"Undergraduate" Engineering Faculty 2007-2008</i>
Gender		
Female	20%	14%
Male	80%	86%
Department		
Biomedical Engineering	6%	6%
Biological Systems Engineering	0%	2%
Chemical Engineering	8%	11%
Civil and Environmental Engineering	8%	13%
Electrical and Computer Engineering	24%	23%
Engineering Professional Development	8%	1%
Engineering Physics	11%	11%
Industrial Engineering	8%	8%
Materials Science and Engineering	5%	7%
Mechanical Engineering	23%	18%
Years of Service		
0 - 4	21%	21%
5 - 9	27%	25%
10 - 14	9%	10%
15 - 19	20%	18%
20 - 24	14%	12%
25 - 29	6%	6%
30 - 34	3%	9%

Analysis Methods

To analyze the student and faculty surveys, our original intent was to create four groups: a student experiment group, a student control group, a faculty experiment group and a faculty control group. Students and faculty who took or taught a 2010 course would have been in the experiment groups. However, upon analyzing the student data, we discovered that only eighteen students and five faculty members fell into the experiment groups, and we decided that these

groups would be too small to make meaningful comparisons. Therefore, for the faculty survey we chose to analyze the data as a whole, rather than try to make comparison between groups. For the student survey, we also chose to analyze the data by course, rather than by experiment vs. control group. For this report we only look at the data for courses with at least 10 survey respondents. Although a total of 61 different courses were represented in the survey data, many courses had fewer than 10 respondents. After eliminating these courses from the analysis, we were left with 10 courses (see Table IV). Since the pilot, EPD690 has become INTEREGR102.

Table IV: Courses Included in Survey Analysis

<i>Course</i>	<i>Title</i>	<i>Number of Respondents</i>
ECE 252	Introduction to Computer Engineering	21
EMA 201	Statics	69
EMA 202	Dynamics	21
EPD 155	Basic Communication	36
EPD 690	Special Topics: Engineering Professional Development	15
INTEREGR 101	Contemporary Issues in the Engineering Profession	21
INTEREGR 160	Introduction to Engineering Design	66
ME 231	Introductory Engineering Graphics	20
ME 240	Dynamics	14
MSE 350	Introduction to Material Science	17

Although we did not receive enough survey responses to analyze the effects of all undergraduate courses in the CoE, the methods and data will be used to refine the assessment process and create a baseline for future assessments. We next present the student and faculty perspectives based on the survey data. Questions in the survey were written to correspond with the CoE 2010 Goals. Appendix IV contains Construct Analyses for each survey.

Disciplinary Excellence

Student Perspective

To assess the effects of courses on students in the CoE in terms of disciplinary excellence, we asked students to rate their ability to communicate to others about their engineering discipline first at the time of the survey (May 2008), and second at the beginning of the academic year. This question was designed as a proxy to measure students' knowledge and understanding in their discipline, with the assumption that being able to communicate about a topic is a good way to test true understanding of it. Students' classified their ability to communicate into one of four "levels": Excellent, Good, Fair or Needs Improvement.

Because we wanted to determine the change in ability during the academic year, we looked at the number of levels, if any, that a student increased to during the year. Table V shows the weighted average change for each course. For example, the weighted average for EPD 690 was determined from the equation, $(0 * .26) + (1 * .59) + (2 * .19) + (3 * .07) = 1.01$

Table V: “How would you rate your ability to communicate to others about your engineering discipline?”

<i>Course</i>	<i>Level of Change</i>				<i>Weighted Average</i>
	0	1	2	3	
EPD 690	26%*	53%	13%	7%	1.01
EPD 155	33%	42%	22%	3%	0.95
EMA 202	37%	48%	10%	5%	0.83
MSE 350	35%	53%	12%	0%	0.77
INTEREGR 101	33%	57%	10%	0%	0.77
ME 231	40%	50%	10%	0%	0.70
EMA 201	48%	35%	17%	0%	0.69
ECE 252	52%	29%	19%	0%	0.67
ME 240	50%	36%	14%	0%	0.64
INTEREGR 160	55%	30%	15%	0%	0.60
All Courses	52%	34%	13%	1%	0.63

*26% of survey respondents who took EPD 690 perceived 0 levels of change in their ability to communicate about their engineering discipline.

The bottom row of Table V shows the average levels of change for all survey respondents across all 61 courses. From these data we can see that students perceived an average increase of .63 levels in their ability to communicate to others about their engineering disciplines. Therefore, students in EPD 690 perceived additional average increase of .38 levels, students in EPD 155 perceived an additional average increase of .32 levels, and so forth. This information will be used to examine what course characteristics, such as learning goals, instructional strategies, learning activities, course format, and/or student demographics are common among courses that have the highest average levels of change, as well as provide a baseline for future assessments.

Next, we asked students to cite any engineering courses they took this year that contributed to the change in their ability to communicate to others about their engineering discipline. Table VI shows the percentages of survey respondents citing the given course as a contributor. For example, from the table we see that 47% of survey respondents who took EPD 690 felt that it contributed to their increased ability to communicate about their engineering discipline. Again, note that since the pilot year and the assessment, EPD 690 Special Topics has become INTEREGR 102 Introduction to Society’s Engineering Grand Challenges. However, the report uses EPD 690 to refer to INTEREGR 102.

Table VI: “If your ability to communicate has changed, please cite any engineering courses you took this academic year that contributed to this change.”

<i>Course</i>	<i>Percentage</i>
EPD 690	47%*
INTEREGR 101	38%
EPD 155	28%
INT 160	26%
EMA 202	24%
ECE 252	24%
ME 231	15%
ME 240	14%
EMA 201	13%
MSE 350	12%

*47% of survey respondents who took EPD 690 felt that it contributed to their increased ability to communicate about their engineering discipline.

In addition to citing a course, many students explained why they felt this course or courses contributed to their change. In general, student responses indicated that those courses that provided an overview of one or more engineering disciplines and connected the field of engineering to other engineering or non-engineering disciplines are likely to have increased student’s ability to communicate more effectively about engineering overall. For example, one student said:

“Simply learning more about engineering helps in being able to communicate about it, so CBE 250, 211, and 320 all helped in my ability to communicate.”

Another student found that working on a team project helped increase his or her ability to communicate:

“InterEgr 160, because it offers me the way to really put myself in the real team with the real project, and indeed with a real client, and hence, it has increased my ability to communicate with others in the team effectively.”

Faculty Perspective

The faculty perspective was not assessed according to disciplinary excellence, as it is difficult to determine a change in disciplinary excellence over one semester.

Multidisciplinary Perspective

Student Perspective

To assess the effects of courses on students in terms of multidisciplinary perspective, we first asked students to rate their ability to understand various engineering disciplines first at the time of the survey (May 2008), and second at the beginning of the academic year. Students again

classified their ability to communicate into one of four “levels”: Excellent, Good, Fair or Needs Improvement.

Table VII shows the weighted average change for each course, utilizing the same calculations explained above. Looking at the bottom row, we see that students perceived an average increase of 0.4 levels in their ability to understand various engineering disciplines. Therefore, students in EPD 690 perceived additional average increase of 0.34 levels, students in INTEREGR 101 perceived an additional average increase of 0.32 levels, and so forth.

Table VII: “How would you rate your ability to understand various engineering disciplines?”

Course	Level of Change				Weighted Average
	0	1	2	3	
EPD 690	46%*	40%	7%	7%	0.74
INTEREGR 101	38%	52%	10%	0%	0.72
MSE 350	41%	53%	6%	0%	0.65
EPD 155	58%	31%	11%	0%	0.53
ME 231	55%	40%	5%	0%	0.50
ECE 252	67%	19%	14%	0%	0.47
INTEREGR 160	62%	30%	8%	0%	0.46
ME 240	57%	43%	0%	0%	0.43
EMA 201	65%	29%	6%	0%	0.41
EMA 202	76%	24%	0%	0%	0.24
All Courses	66%	28%	6%	0%	0.40

*46% of survey respondents who took EPD 690 perceived 0 levels of change in their ability to communicate about their engineering discipline.

Next, we asked students to cite any engineering courses they took this year that contributed to the change in their ability to understand various engineering disciplines. Table VIII shows the percentage of survey respondents citing each course as a contributor.

Table VIII: “If your ability to understand various engineering disciplines has changed, please cite any engineering courses you took this academic year that contributed to this change.”

Course	Percentage
INTEREGR 101	62%*
EPD 690	33%
MSE 350	29%
INTEREGR 160	24%
ECE 252	14%
EMA 202	14%
EPD 155	11%
EMA 201	4%

*62% of survey respondents who took INTEREGR 101 felt that it contributed to their increased ability to communicate about their engineering discipline.

Some students also commented in addition to citing a course. In general, these survey respondents recognize the value of gaining a broad knowledge of various engineering disciplines to inform their study and career goals. For example, one student stated:

“ME 361, ME 331, and ME 340 helped me realize that although I may be studying only one engineering discipline, in order to be a successful engineer, I must be aware of what other types of engineers are learning, thinking, and doing.”

Finally, we asked students if they have, since the beginning of the academic year, (1) considered taking a course(s) outside of their discipline not required by their major, and (2) considered adding a second major or certificate. For these questions we looked at responses from students in all 61 courses, and found that 63% of all survey respondents have considered taking a course outside of their discipline, while 53% have considered adding a second major or certificate¹. Students then cited specific courses as motivating them to enroll in a course or courses in another discipline.

Table IX: “Please cite any engineering courses you took this academic year that motivated you to take courses outside of your discipline and not required by your major.”

Course	Percentage
EPD 155	28%*
ECE 252	24%
INTEREGR 101	14%
INTEREGR 160	8%
EPD 690	7%
EMA 201	3%

*28% of survey respondents who took EPD 155 felt that it motivated them to take courses outside of their discipline.

Table IX above lists the percentages of survey respondents citing the given course as a contributor. Some students not only listed the course, but explained how the course was a motivator. For example,

“ME 361 and ME 331; they helped me realize it is not about getting a degree to become an engineer, it is about becoming an engineer while getting a degree.”

Table X below shows the percentages of survey respondents citing the given course as a motivator. There are a variety of responses ranging from international engineering, environmental studies, technical communications, business, and other science and math disciplines including chemistry, biology, biochemistry, and physics. Many students have identified that they had a preexisting interest in another area and the exposure to the broad engineering disciplines helped them see the value of adding another major or certificate.

¹ See Appendix V for percentages by individual course.

Table X: "What 2nd major or certificate are you interested in? Please cite any engineering courses you took this academic year that motivated you to add a second major or certificate."

<i>Course</i>	<i>Percentage</i>
INTEREGR 160	15%*
EPD 155	11%
EPD 690	7%

*15% of survey respondents who took INTEREGR 160 felt that it motivated them to add a second major or certificate.

Faculty Perspective

To assess the effects of courses on faculty in terms of multidisciplinary perspective, we first asked faculty if they had integrated material from other disciplines. We found that of all survey respondents, 78% have integrated such material. We then asked faculty, "What was your reasoning for integrating material from other disciplines?" To analyze the responses for this question, we manually coded the responses, and determined a number of themes. Table XI summarizes the percentage of faculty responses falling under the given theme.

Table XI: "What was your reasoning for integrating material from other disciplines?"

<i>Theme</i>	<i>Percentage</i>
Reasons for Integrating	
Material from other disciplines is needed to solve problems presented in class.	61%
Integrating material from other disciplines into the curriculum helps to broaden students' knowledge base.	23%
Students will need multi-disciplinary skills/knowledge for future courses and as an engineer.	11%
Integrating material from other disciplines into the curriculum breaks down barriers between disciplines.	7%
Integrating material from other disciplines into the curriculum adds interest to the course.	7%

We can see that the majority of respondents believe that material from other disciplines is needed to solve problems presented in the course. For example, one faculty member stated,

"The tools we developed in the course apply across a wide range of disciplines in science and medicine as well as everyday consumer items"

Other faculty members feel that students need the skills and exposures that can be garnered from courses which integrate multidisciplinary materials. For example,

"Students need to apply the skills/tools that they learn in Thermodynamics to a variety of problems in order to (1) see that they are useful, (2) gain confidence with using the basic

tools in a variety of settings, and (3) learn about interesting topics that are not directly related to thermodynamics but keep the students awake in class.”

Critical Thinking

Student Perspective

To assess the effects of courses on students in terms of critical thinking, we asked students, two questions (1) “For this course, I was asked to explore problems with more than one solution” and (2) “For this course, I was asked to determine the validity or usefulness of information or methods.” Students responded to these questions based on a scale from 1 (strongly disagree) to 5 (strongly agree). The average student survey ratings for both these questions were 3.9. These results, along with several others are summarized in Table XXIII.

Faculty Perspective

To assess the effects of courses on faculty in terms of critical thinking, we first asked faculty if they had integrated material that requires students to think critically. We found that of all survey respondents, 88% have integrated such material. We then asked faculty, “What was your reasoning for integrating material that requires students to think critically?” and “How did you know that students were better able to think critically?” This second question was designed to determine the assessment methods of faculty and the extent of their utilization. To analyze the responses for this question, we manually coded the responses, and determined a number of themes. Table XII summarizes the percentage of faculty responses falling under the given theme.

Table XII: "What was your reasoning for integrating material that requires students to think critically? How did you know that students were better able to think critically?"

<i>Theme</i>	<i>Percent</i>
<i>Reasons for Integrating</i>	
Students need to be able to think critically for future courses and as an engineer	33%
Material that requires students to think critically is inherent in the course material.	29%
Encouraging students to think critically is a goal of my course.	8%
Material that requires students to think critically adds interest to the course.	1%
<i>Assessment Methods</i>	
Homework problems/questions required critical thinking.	21%
Students need to use critical thinking to successfully complete their final paper, project or exam.	20%
I use in class discussion to gauge students' ability to think critically.	12%
I use formal/informal interviews with students to assess their ability to think critically.	4%
I ask students questions during class that required them to think critically.	1%

From the table we see that an approximately equal percentage of faculty feel that (1) critical thinking skills are necessary for engineers and (2) material that encourages/requires critical thinking is inherent in their course. For example,

“It is absolutely necessary that a student think critically about a solution. It is the difference between a bad engineer and a good engineer. A good engineer can look at a problem and identify what is important, model the important aspects of the problem, and then finally examine the solution to see if it makes sense and help make design decisions.”

Additionally, faculty appear to be most likely to use homework assignments to gauge students’ critical thinking skills.

“...Textbooks often have errors in them, and the students need to realize that they need to be ready for this...they have to stop thinking that the textbook is infallible and be ready to evaluate things said, or homework problem solutions from their own accumulated knowledge, or by checking with others.”

Multicultural Competence

Student Perspective

To help assess the effects of courses on students in terms of multicultural competence, we asked students if they planned to study abroad. For this question, we looked at responses from students in all 61 courses. Overall, only 31% of respondents indicated that they planned to study abroad.² Table XIII lists the percentages of survey respondents citing the given course as a motivator.

Table XIII: “What factors influence you to study abroad? Please cite any engineering courses you took this academic year that influence you to study abroad.”

<i>Course</i>	<i>Percentage</i>
EPD 690	13%*
INTERGER 160	12%
INTEREGR 101	5%
EMA 201	3%
EPD 155	3%

*13% of survey respondents in EPD 690 felt that the course influenced them to study abroad.

In general, we found that respondents are not likely to be motivated to study abroad based on their experience in a course or courses. Instead, students listed reasons such as being marketable to employers and experiencing other cultures. For example, one student stated:

² See Appendix V for percentages by individual course.

“...I know an international understanding is important to employers. Also, I feel it would be a great experience to learn about different ways of life.”

Another student stated:

“I like adventure and experiencing new things. I also think that there is a lot to be learned from spending time abroad. It gives a different perspective and allows new thoughts to flow freely.”

Based on the relatively low percentage of respondents who cited a course as motivating them to study abroad and the additional qualitative responses from students, we can conclude that many who responded to the survey may have already had a predisposition about studying abroad.

Faculty Perspective

To assess the effects of courses on faculty in terms of multicultural competence, we first asked faculty if they had integrated material that discusses cultural issues related to engineering. We found that of all survey respondents, 52% have integrated such material. We then asked faculty, “What was your reasoning for integrating material that discusses cultural issues related to engineering?” and “How did you know that students were better able to understand these issues?” This second question was designed to determine the assessment methods of faculty and the extent of their utilization. Responses for this question were analyzed as described above. Table XIV summarizes the percentage of faculty responses falling under the given theme.

Table XIV: “What was your reasoning for integrating material that discusses cultural issues related to engineering? How did you know that students were better able to understand these issues?”

<i>Theme</i>	<i>Percentage</i>
Reasons for Integrating	
An awareness of cultural issues related to engineering is a goal of my course.	15%
Material that discusses cultural issues related to engineering is inherent in the course material.	13%
Students need to be aware of cultural issues for future courses and as an engineer.	7%
Discussion of cultural issues related to engineering is an ABET requirement	1%
Students are interested in discussing cultural issues	1%
Assessment Methods	
I use in-class discussion to gauge students' understanding of cultural issues related to engineering.	11%
Homework problems/questions required an understanding of cultural issues related to engineering.	7%
Students need to understand cultural issues related to engineering to successfully complete their final paper, project or exam.	5%
I use pre and post surveys to assess their understanding of cultural issues related to engineering.	1%

From the table we see that faculty members are most likely to integrate material that discusses cultural issues because it is a goal of their course. For example,

“I think it is very important to identify for the students how the choices made in the energy industry impact the surrounding world.”

Faculty members, in general, appear to assess students’ multicultural competence less often; however the most common assessment method was the use of in-class discussions. Another faculty member stated,

“We had a visit from an ECE professor who talked to us about energy-related problems in the world and the range of topics students might pursue in terms of sustainable energy.”

Collaboration Skills

Student Perspective

To assess the effect courses have on students’ collaboration skills, we asked students if they had become a more contributing member of a student organization, or if they had joined a new organization since the beginning of the academic year. Again we looked at responses from students in all courses, and found that 45% of respondents have become more involved in a student organization³.

Next, we asked students to cite specific courses they felt motivated them to become more involved. Table XV lists the percentages of students citing a given course as a motivator.

Table XV: “Please cite any engineering courses you took this academic year that motivated you to become more active in your group or organization.”

<i>Course</i>	<i>Percentage</i>
INTEREGR 160	12%*
EPD 155	11%
EPD 690	7%
MSE 350	6%
ME 231	5%
INTEREGR 101	5%
EMA 201	1%

*12% of survey respondents in INTEREGR 160 felt that the course motivated them to become more active in their group or organization.

Faculty Perspective

To assess the effects of courses on faculty in terms of collaboration skills, we first asked faculty if they had integrated material that enhances students’ collaboration skills. We found that of all

³ See Appendix V for percentages by individual course.

survey respondents, 64% have integrated such material. We then asked faculty, “What was your reasoning for integrating material enhances collaboration skills?” and “How did you know that students were better able to collaborate with each other?” Responses for this question were analyzed as described above. Table XVI summarizes the percentage of faculty responses falling under the given theme.

Table XVI: "What was your reasoning for integrating material that enhances students' collaboration skills? How did you know that students were better able to collaborate with each other?"

<i>Theme</i>	<i>Percentage</i>
Reasons for Integrating	
Students need collaboration skills for future courses and as an engineer.	23%
Material that enhances students' collaboration skills is inherent in the course material.	15%
Enhancing students' collaboration skills is a goal of my course.	15%
I use formal/informal interviews with students to assess their ability to collaborate with others.	3%
Assessment Methods	
Homework problems/questions required the ability to collaborate with others.	12%
Students need to collaborate with others to successfully complete their final paper, project or exam.	8%
Students conduct self-assessments of their ability to collaborate.	5%
I use a survey to determine students' ability to collaborate.	1%

We can see that the majority of respondents believe that students need collaboration skills as an engineer. For example, one faculty member stated:

“In other words, absent some education about the science of teamwork we should perhaps expect that many team experiences for students will be bad. And we hear that all of the time.”

Additionally, faculty appears to be most likely to use homework assignments to determine gauge students’ ability to collaborate.

“In EPD 690 the students worked in teams to design a presentation and a poster. We conducted self-assessments (reflection) and peer assessment of team member performance as indicators of the students' abilities to collaborate. In CEE 629 the students worked in small groups to interpret and critique primary literature, and observed their discussions/activities.

Leadership Skills

Student Perspective

To assess the effect courses have on students' leadership skills, we asked students if they planned to pursue a leadership position. Again we looked at responses from students in all courses, and found that 62% of respondents plan to pursue a leadership position⁴. We also asked students to cite specific courses they felt motivated them to pursue a leadership position. Table XVII lists the percentages of students citing a given course as a motivator.

Table XVII: "Please cite any engineering courses you took this academic year that motivate you to pursue this leadership position."

<i>Course</i>	<i>Percentage</i>
EPD 690	27%*
INT 160	20%
INT 101	19%
EPD 155	6%

*27% of survey respondents in EPD 690 felt that the course motivated them to pursue a leadership position.

Faculty Perspective

To assess the effects of courses on faculty in terms of leadership, we first asked faculty if they had integrated material that enhances students' leadership skills. We found that of all survey respondents, 45% have integrated such material. We then asked faculty, "What was your reasoning for integrating material enhances leadership skills?" and "How did you know that students were better able to be an effective leader?" Responses for this question were analyzed as described above. Table XXIII summarizes the percentage of faculty responses falling under the given theme.

Table XVIII: "What was your reasoning for integrating material that enhances students' leadership skills? How did you know that students were better able to be an effective leader?"

<i>Theme</i>	<i>Percentage</i>
Reasons for Integrating	
Material that enhances students' leadership skills is inherent in the course material.	13%
Students need leadership skills for future courses and as an engineer.	12%
The ability to work as a leader stems from being able collaborate with others.	11%
Enhancing students' leadership skills is a goal of my course.	8%
Assessment Methods	
Students need to demonstrate leadership skills to successfully complete their final paper, project or exam.	4%
I use in class discussion to gauge students' leadership skills.	1%

⁴ See Appendix V for percentages by individual course.

Faculty members are most likely to integrate material that enhances leadership skills because it is inherent in the coursework, and it is needed to lead as a future engineer. For example,

“Many ISyE students after graduation evolve into leadership positions in their careers. Completing a successful semester long project with an outside organization required communication and leadership skills as well as good technical skills. The success of their projects increased not only their leadership skills, but also their self confidence to be able to go out and ‘make things better’ in a real world environment.”

Faculty members, appear to assess leadership skills less often; however these skills were most commonly assessed during a final paper, project or exam. Another faculty member stated,

“Students need to work together and somehow need to take leadership to integrate their thoughts. It is clear that students who can communicate and coordinate the efforts create the best product.”

Ethic of Service to Profession and Community

Student Perspective

To assess the effects of courses in the CoE in terms of multidisciplinary perspective, we first asked students to rate their likelihood of performing volunteer service in the community, first at the time of the survey (May 2008), and second at the beginning of the academic year. Students again classified their ability to communicate into one of four “levels”: Excellent, Good, Fair or Needs Improvement. Table XIX shows the weighted average change for each course, utilizing the same calculations explained above. Looking at the bottom row, we see that students perceived an average increase of .19 levels in their likelihood to perform volunteer service. Therefore, students in MSE 350 and EPD 690 perceived an additional average increase of .28 levels, and so forth.

Table XIX: “How would you rate your likelihood to perform volunteer service in the community?”

Course	Level of Change				Weighted Average
	0	1	2	3	
MSE 350	59%*	35%	6%	0%	0.47
EPD 690	53%	47%	0%	0%	0.47
ME 231	80%	15%	5%	0%	0.25
EMA 201	77%	22%	1%	0%	0.24
EPD 155	81%	19%	0%	0%	0.19
INTEREGR 160	86%	12%	2%	0%	0.16
ECE 252	86%	14%	0%	0%	0.14
EMA 202	86%	14%	0%	0%	0.14
INTEREGR 101	86%	14%	0%	0%	0.14
ME 240	86%	14%	0%	0%	0.14
All Courses	81%	19%	0%	0%	0.19

*59% of survey respondents who took MSE 350 perceived 0 levels of change in their likelihood to perform service in the community.

Next, we asked students to cite any engineering courses they took this year that contributed to the change in their likelihood to perform volunteer service. Table XX shows the percentage of survey respondents citing each course as a contributor.

Table XX: "If your likelihood to perform volunteer service in the community has changed, please cite any engineering courses you took this academic year that contributed to this change."

<i>Course</i>	<i>Percentage</i>
EPD 690	20%*
ME 361	20%
EPD 155	6%
INTEREGR 160	3%

*20% of survey respondents in EPD 690 felt that the course motivated them to perform volunteer service in the community.

Finally, we asked students if they had performed volunteer service in the community, or if they planned to in the future. Again we looked at responses from students in all courses, and found that 57% of respondents had performed volunteer service, or planned to in the future⁵. We then asked students if they used engineering skills during their volunteer service, and in which course(s) those skills were learned. Table XXI lists the percentages of students citing a given course and a given skill.

Table XXI: "During your volunteer service in the community, did you use skills learned in your engineering course work? Which courses? Which skills?"

<i>Course or Skill</i>	<i>Percentage</i>
EPD 690	13%*
INT 160	6%
MSE 350	6%
EPD 155	6%
Leadership Skills	3%
Collaboration Skills	2%
Communication Skills	1%
Problem Solving Skills	1%

*13% of survey respondents in EPD 690 felt that they used skills learned in the course during their volunteer service in the community.

Faculty Perspective

To assess the effects of courses on faculty in terms of ethic of service, we first asked faculty if they had integrated material that motivated students to perform volunteer service in the community. We found that of all survey respondents, 45% have integrated such material. We then asked faculty, "What was your reasoning for integrating material that motivated students to perform volunteer service in the community?" and "How did you know that students had gained

⁵ See Appendix V for percentages by individual course.

a better ethic of service?" Responses for this question were analyzed as described above. Table XXII summarizes the percentage of faculty responses falling under the given theme.

Table XXII: "What was your reasoning for integrating material that included or motivated students to perform volunteer service in the community? How did you know that students had gained a better ethic of service to the community?"

<i>Theme</i>	<i>Percentage</i>
Reasons for Integrating	
Motivating students to perform volunteer service in the community is a goal of my course.	9%
Material that motivates students to perform volunteer service in the community is inherent in the course material.	3%
Students are interested in performing volunteer service in the community.	1%
Motivating students to perform volunteer service in the community is an ABET requirement.	1%
Assessment Methods	
I know student have a better ethic of service to the community when they continue their involvement.	1%
I use a survey to determine students' ethic of service to the community.	1%

From the table we see that faculty members are most likely to integrate material that motivates students to perform volunteer service in the community because it is a goal of their course. For example,

"Because engineers have skills that will make a difference, I strongly encourage various volunteer or service learning activities (and encourage students to consider courses such as EPICS). Other material aimed at having students understand how disability or age affects individuals (and how engineering solutions can help) hopefully motivate volunteer/service activities."

Few faculty members reported assessment techniques for vaulting students' ethic of service to community. This may be because it is difficult to assess, but also perhaps because it was the last question in the survey, and some respondents did not answer questions towards the end of the survey.

Integrated Questions

In both the student and faculty surveys, respondents were asked to respond to a series of questions about each class they took or taught during the 2007-2008 academic year. Questions on the student and faculty surveys in this section were designed to be similar in order to make comparison. Table XXIII summarizes and evaluates the responses between different courses, as well as between students and faculty perceptions. On a scale from 1 to 5 (strongly disagree to strongly agree), students and faculty rated their agreement to several statements.

Table XXIII: Comparison of Student and Faculty Responses

<i>Course</i>	<i>Overall</i>	<i>ECE 252</i>	<i>EPD 155</i>	<i>EPD 690</i>	<i>INTEREGR 160</i>	<i>ME 240</i>
Critical Thinking						
S* - For this course, I was asked to explore problems with more than one solution.	3.9	4.2	3.8	4.7	4.5	3.2
F - For this course, I asked students to explore problems with more than one solution.	4.5	5.0	5.0	5.0	5.0	4.0
S - For this course, I was asked to determine the validity or usefulness of information or methods.	3.9	3.7	4.3	4.1	4.1	3.8
F - For this course, I asked students to determine the validity or usefulness of information or methods.	4.4	5.0	5.0	4.0	5.0	3.5
Multidisciplinary Perspective						
S - This course integrated topics from various disciplines.	3.8	3.1	4.1	4.5	4.3	3.9
F - For this course, I integrated topics from various disciplines.	4.1	4.0	5.0	5.0	5.0	2.5
Collaboration						
S - This course helped to improve my ability to work as a team.	3.5	3.2	3.4	4.5	4.3	3.1
F - The curriculum and instruction of this course helps to improve students' ability to work as a team.	4.0	5.0	3.5	5.0	5.0	2.5
Leadership						
S - This course helped to improve my leadership skills.	3.2	2.8	3.2	4.3	3.9	2.7
F - The curriculum and instruction of this course helps to improve students' leadership skills.	3.5	4.0	3.5	3.0	4.7	1.0
Multicultural Competence						
S - This course helped to improve my awareness of cultural issues related to engineering.	3.1	3.4	3.9	4.5	3.8	2.1
F - The curriculum and instruction of this course helps to improve students' awareness of cultural issues related to engineering.	3.6	4.0	5.0	5.0	4.7	2.0
Ethic of Service						
F - For this course, I thought about or discussed the value of volunteer service in the community.	2.5	2.0	3.5	2.0	3.3	2.0
Overall						
Student Average	3.6	3.4	3.8	4.4	4.1	3.1
Faculty Average	3.8	4.1	4.4	4.1	4.7	2.7
Number of Students	205	21	36	20	66	14
Number of Faculty	75	1	2	1	3	2

*S and F indicate questions for students and faculty respectively.

The courses evaluated in Table XXIII were chosen because there were at least 10 student responses, and at least 1 faculty response. Appendix VI summarizes the ratings for all other courses with at least 1 student and 1 faculty response.

Finally, Table XXIV and XXV summarize selected questions from the Student Survey and Faculty Survey respectively. They represent the intentions and values of all survey respondents for each survey, and thus lead to interesting comparisons. For example, students are approximately equally likely to take a course outside of their discipline as they are to pursue a leadership position, and faculty are most likely to incorporate material into their curriculum that requires critical thinking. These questions are also useful in establishing baseline data for future assessments.

Table XXIV: Summary of Selected Questions from the Student Perspective

<i>Question</i>	<i>Percentage (Yes)</i>
Since the beginning of this academic year, have you considered taking a course(s) <i>outside of your discipline</i> not required by your major?	63%*
Do you plan to pursue any type of <i>leadership</i> position?	62%
Have you performed <i>volunteer service in the community</i> this academic year, or do you plan to in the future?	57%
Since the beginning of this academic year, have you considered adding a <i>second major or certificate</i> ?	53%
Since the beginning of this academic year, have you become a more <i>contributing member of the groups and/or organizations</i> to which you belong, OR have you joined a new group or organization?	45%
Do you plan to participate in a <i>study abroad</i> program?	31%

*63% of all survey respondents have considered taking a course outside of their discipline.

Table XXV: Summary of Selected Questions from the Faculty Perspective

<i>Question</i>	<i>Percentage (Y)</i>
Have you integrated material this academic year that requires students to <i>think critically</i> into your course(s)?	88%*
Have you integrated material this academic year from <i>other disciplines</i> (engineering or non-engineering) into your course(s)?	78%
Have you integrated material this academic year that enhances students' <i>collaboration skills</i> into your course(s)?	64%
Have you integrated material this academic year that discusses <i>cultural issues</i> related to engineering into your course(s)?	52%
Have you integrated material this academic year that enhances students' <i>leadership skills</i> into your course(s)?	45%
Have you integrated material this academic year that included or motivated <i>volunteer service in the community</i> as a part of the course(s)?	18%

*88% of survey respondents have integrated material that requires students to think critically into their courses.

Faculty Focus Group

As discussed above, some courses within the CoE 2010 Initiative were not offered during the 2007-2008 academic year. Representatives from these courses were invited to attend a focus group, during which they described their experiences faced during the 2007-2008 academic year. The following comments surfaced and are listed in no particular order.

- Administratively and logistically, it is difficult for faculty to list courses in the INTEREGR department, or to have them cross-listed between different departments.
- We need to find ways to compensate faculty members for guest teaching, modular courses. Faculty members are reluctant to make uncompensated commitments, which affect the sustainability of multidisciplinary courses.
- Lack of flexibility and collaboration among departments prevents students from taking extra courses or studying abroad. Students are too busy with their required courses, and do not see any incentive to explore other courses.
- Students prefer courses that are directly and explicitly applicable to some other course or activity.
- The CoE 2010 Initiative gives us enough resources to get us off the ground. However, we now have to break some of the “legacy barriers” which exist in varying degree within and between departments, i.e. department-specific thinking, disciplinary silos.
- An Integrated Engineering Department could be successful, where students work with advisors to develop their own major, and set of courses. This would surely give students a broader multidisciplinary perspective; however, it may be that employers will not know how to interpret or judge those majors.
- Students need to be graded more on skills and proficiency. Some proficiencies are generic to all engineers. Students could demonstrate proficiency through a portfolio or similar type of assessment.
- Focus on building existing relationships in the community. For example, the China project discovered that many local companies have international contacts.
- Graduate students are an untapped resource for developing/administering a course. To accomplish 2010 Goals, faculty could cross-list courses and recruit students from other departments to help integrate material from other disciplines. Further, the DELTA Program is a good resource for graduate students who are equipped to help create or assess a course.
- Working with younger faculty members is easier because they are more flexible, but they also have tenure pressure. It would be good if the tenure process could support more participation in these types of projects. Assistant professors may be interested, but don't have time to invest.
- Different departments place varying amounts of emphasis on teaching within the annual reviews. In some departments, trying something new is taking a big risk. A stigma may be attached to multi-disciplinary projects, projects which are “out-of-the-box.”
- We need more cross-disciplinary classes. Students explore different disciplines in some courses during the first year, for example, INTEREGR 160. There should be a design class which brings students back together at the end of their academic careers, perhaps as part of an honors program.

Conclusions

The 2008 overarching assessment of the CoE 2010 Initiative has laid significant groundwork in designing a process and collecting preliminary data to evaluate the effects of the Initiative on students and faculty. Although our original intent was to construct control and experiment groups for survey respondents, a low response rate required us to instead look at the data by course, and in the CoE overall. However, the shift in focus has allowed us to examine which CoE courses outside of the 2010 Initiative influence a change in students' perception of their attitudes, skills and abilities under one or more of the 2010 roundtable goals, and we can use this and future assessments to determine which courses (in and outside of the initiative) are contributing to the goals of the 2010 Initiative. For example, we now know that courses such as EPD 690 (now INTEREGR 102), EPD 155, INTEREGR 101 and INTEREGR 160 tend to help create the type of engineering student desired by the COE as outlined by the 2010 Initiative.

Our next step will be to examine the common characteristics among courses which students indicated as contributing to changes in their attitudes, skills and abilities. We have only started this process by examining the course descriptions available on-line. These preliminary data shows that courses such as EPD 155 and ITEREGR 160 explicitly describe the use of skills that align with the 2010 goals. However, some courses which students found to be contributors to the 2010 goals, such as ME 240 and MSE 350 have course descriptions which only describe the "text-book content" and not the use of any of the skills under the 2010 goals. Future assessments should explore reasons why or why not faculty engage in activities or instructional strategies which touch upon these goals.

Recommendations

In addition to the data collected during this assessment, the process leading to the collection and analysis has led to some recommendations for similar future work.

- Rather than asking survey respondents to rate their perceived change, use pre and post surveys or other assessment tools for more accurate results.
- Encourage faculty to administer the survey or assessment tool as part of a course evaluation.
- Continue to gather data from multiple methods: the student survey, the faculty survey, focus group, and hits to websites including the electronic newsletter.
- Examine what course characteristics, such as learning goals, instructional strategies, activities, course format, and/or student demographics are common among courses that have the highest average levels of change.
- Recognize faculty and courses that build the skills, attitudes, and knowledge aligned with the CoE 2010 goals.

The views and ideas garnered from the Focus Group can be used in conjunction with the Survey Data to inform the development of future assessments. Data from multiple methods will help the 2010 Task Force consider ways to support these course activities and instructional strategies which lead to the goals under the 2010 Initiative. By reviewing course design and objectives, discussing curricula with faculty, and using the current and future assessment of student and faculty perceptions around 2010 goals, the Task Force will be able to determine which courses

are more effective, and how we can replicate the success of these courses across the College of Engineering as a whole.

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Appendix I: Student Survey Questions

(Q1A) Please enter your student ID number:

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(Q2A) Did you take at least one course within the college of engineering this year?

- Yes
- No

(Q3A) Please list the courses you took within the *College of Engineering* this academic year.

1.
2.
3.
4.
5.
6.
7.
8.
9.

(Q4A) Please check the appropriate boxes.

	Excellent	Good	Fair	Poor	Don't Know/ Not Applicable
How would you rate your ability to communicate to others about your engineering discipline <i>currently</i> ?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
How would you rate your ability to communicate to others about your engineering discipline at the <i>beginning of this academic year</i> ?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

(Q5A) If your ability to communicate about your engineering discipline has changed, please cite any engineering courses you took *this academic year* that contributed to this change.

(Short Answer Response)

--

(Q6A) Please check the appropriate boxes.

	Excellent	Good	Fair	Poor	Don't Know/ Not Applicable
How would you rate your ability to understand various engineering disciplines <i>currently</i> ?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
How would you rate your ability to understand various engineering disciplines at the <i>beginning of this academic year</i> ?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

(Q7A) If your ability to understand various engineering disciplines has changed, please cite any engineering courses you took *this academic year* that contributed to this change.

(Short Answer Response)

(Q8A) Since the beginning of *this academic year*, have you considered taking a course(s) outside of your discipline not required by your major?

- Yes
- No

(Q9A) (If “yes” to Q8A) Please cite any engineering courses you took *this academic year* that motivated you to take courses outside of your discipline which were required by your major.

(Short Answer Response)

(Q10A) Since the beginning of *this academic year*, have you considered adding a second major or certificate?

- Yes
- No

(Q11A) (If “yes” to Q10A) What 2nd major or certificate are you interested in? Please cite any engineering courses you took *this academic year* that motivated you to add a second major or certificate.

(Short Answer Response)

(Q12A) Think about your experiences in ____ (each course listed in Q3A). Please rate your agreement with the following statements.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Not Applicable
For this course, I was asked to explore problems with more than one solution.						
For this course, I was asked to determine the validity or usefulness of information or methods.						
This course integrated topics from various engineering or non-engineering disciplines.						
This course helped to improve my ability to work as a team.						
This course helped to improve my leadership skills.						
This course helped to improve my awareness of cultural issues related to engineering.						

(Q13A) Do you plan to participate in a study abroad program?

- Yes
- No

(Q14A) (If “yes” to Q13A) What factors influence you to study abroad? Please cite any engineering courses you took *this academic year* that influence you to study abroad.

(Short Answer Response)

(Q15A) (If “no” to Q13A) What constraints prevent you from studying abroad? Please cite any engineering courses you took *this academic year* that dissuaded you to not study abroad.

(Short Answer Response)

(Q16A) Since the beginning of *this academic year*, have you become a more contributing member of the groups and/or organizations to which you belong, OR have you joined a new group or organization?

- Yes
- No

(Q17A) (If “yes” to Q16A) Please cite any engineering courses you took *this academic year* that motivated you to become more active in your group or organization.

(Short Answer Response)

(Q18A) Do you plan to pursue any type of leadership position?

- Yes
- No

(Q19A) (If “yes” to Q18A) Please cite any engineering courses you took *this academic year* that motivated you to pursue this leadership position.

(Short Answer Response)

(Q20A) Please check the appropriate boxes.

	Very Likely	Somewhat Likely	Not Very Likely	Not Likely At All
How would you rate your likelihood to perform volunteer service in the community <i>currently</i> ?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
How would you rate your likelihood to perform volunteer service in the community at the <i>beginning of this academic year</i> ?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

(Q21A) If your likelihood to perform volunteer service in the community has changed, please cite any engineering courses you took *this academic year* that contributed to this change.

(Short Answer Response)

(Q22A) Have you performed volunteer service in the community *this academic year*, or do you plan to in the future?

- Yes
- No

(Q23A) During your volunteer service in the community, did you use skills learned in your engineering course work? Which courses? Which skills?

(Short Answer Response)

Appendix II: Faculty Survey Questions

(Q1B) Please enter your campus ID number or netID:

--

(Q2B) Did you teach at least one undergraduate engineering course this year?

- Yes
- No

(Q3B) Please list the *engineering* you taught this academic year.

1.
2.
3.
4.

(Q4B) Think about your experiences in ____ (each course listed in Q3B). Please rate your agreement with the following statements.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Not Applicable
For this course, I asked students to explore problems with more than one solution.						
For this course, I asked students to determine the validity or usefulness of information or methods.						
The curriculum and instruction of this course helps to improve students' ability to work as a team.						
The curriculum and instruction of this course helps to improve students' leadership skills.						
The curriculum and instruction of this course helps to improve students' awareness of cultural issues related to engineering.						
For this course, I integrated topics from various engineering or non-engineering disciplines.						
For this course, I thought about or discussed the value of volunteer service in the community.						

(Q5B) Have you integrated material from other disciplines (engineering or non-engineering) into your course(s) *this academic year*?

- Yes
- No

(Q6B) (If “Yes” to Q5B) What was your reasoning for integrating material from other disciplines?

(Short Answer Response)

(Q7B) Have you integrated material that requires students to think critically into your course(s) *this academic year*?

- Yes
- No

(Q8B) (If “Yes” to Q7B) What was your reasoning for integrating material that requires students to think critically? How did you know that students were better able to think critically?

(Short Answer Response)

(Q9B) Have you integrated material that discusses cultural issues related to engineering into your course(s) *this academic year*?

- Yes
- No

(Q10B) (If “Yes” to Q9B) What was your reasoning for integrating material that discusses cultural issues related to engineering? How did you know that students were better able to understand these issues?

(Short Answer Response)

(Q11B) Have you integrated material that enhances students’ collaboration skills into your course(s) *this academic year*?

- Yes
- No

(Q12B) (If “Yes” to Q11B) What was your reasoning for integrating material that enhances students’ collaboration skills? How did you know that students were better able to collaborate with each other?

(Short Answer Response)

(Q13B) Have you integrated material that enhances students’ leadership skills into your course(s) **THIS ACADEMIC YEAR?**

- Yes
- No

(Q14B) (If “Yes” to Q13B) What was your reasoning for integrating material that enhances students’ leadership skills? How did you know that students were better able to be an effective leader?

(Short Answer Response)

(Q15B) Have you integrated material that included or motivated volunteer service in the community as a part of the course *this academic year*?

- Yes
- No

(Q16B) (If “Yes” to Q15B) What was your reasoning for integrating material that included or motivated volunteer service in the community? How did you know that students had gained a better ethic of service to the community?

(Short Answer Response)

Appendix III: Email Invitations

SUBJECT TEXT: COE 2010 Invitation from Dean Paul Percy

FROM NAME: Office of Dean Percy

FROM EMAIL: elc@cae.wisc.edu

BODY OF EMAIL:

As a UW-Madison undergraduate engineering student, you are invited to help determine the impact of some new engineering courses taught this year. This is a new survey; the first survey was about engineering campus climate. Please take a moment to go to the website below and complete the 10-15 minute online survey.

After you complete the survey, your name will be included in a random drawing for a \$100 gift card for the UW Bookstore, which will be awarded to one survey respondent. We are hoping to get at least 500 responses, so your odds of winning will be approximately 1 in 500. Your participation is voluntary and you may omit questions you don't want to answer.

Your responses are confidential and the results will only be presented in aggregate form so that individuals cannot be identified in the final report.

Please complete the survey by May 16, 2008. Click the following link to start the survey:
<URL>

If you do not wish to respond to this survey, please click on the link below to decline: <URL>

Thank you in advance for your participation. Good luck with your final exams!

Dean Paul Percy
Dr. Sandra Courter
University of Wisconsin-Madison

SUBJECT TEXT: Invitation from Dean Paul Percy

FROM NAME: Office of Dean Percy

FROM EMAIL: elc@cae.wisc.edu

BODY OF EMAIL:

As a member of the UW-Madison COE faculty, you are invited to help determine the impact of some new engineering courses taught this year. Please take a moment to go to the website below and complete the 10 minute online survey.

Your responses are confidential and the results will only be presented in aggregate form so that individuals cannot be identified in the final report.

Please complete the survey by May 16, 2008. Click the following link to start the survey:
<URL>

If you do not wish to respond to this survey, please click on the link below to decline: <URL>

Thank you in advance for your participation.

Dean Paul Percy
Dr. Sandra Courter
University of Wisconsin-Madison

Appendix IV: Faculty Focus Group Questions

(Q1) How do the goals of your courses align with the goals and learning outcomes of the COE 2010 Initiative? These goals are:

1. Disciplinary Excellence with Multidisciplinary Perspective
2. Multicultural Competence
3. Critical Thinking
4. Leadership and Collaboration Skills
5. Ethic of Service to the Profession

(Q2) How and why did you set these goals and learning outcomes?

(Q3) How well do you think the COE addresses these goals and learning outcomes of the COE 2010 Initiative?

(Q4) How well do you think you address these goals and learning outcomes of the COE 2010 Initiative?

(Q5) If you participated in one of the COE 2010 projects, how successful do you think your project was?

(Q6) If you participated in one of the COE 2010 projects, what barriers prevented you from executing your project as you had envisioned?

(Q7) If you participated in one of the COE 2010 projects, what would you have done differently if you could start your project over again?

(Q8) Is there anything else you would like us to know?

Appendix V: Survey Construct Analysis Diagram: Student and Faculty Survey**Table XXVI: Analysis of Student Survey Questions**

<i>Question</i>	<i>Disciplinary Excellence</i>	<i>Multidisciplinary Perspective</i>	<i>Critical Thinking</i>	<i>Multicultural Competence</i>	<i>Collaboration Skills</i>	<i>Leadership Skills</i>	<i>Ethic of Service</i>
Q4	X						
Q5	X						
Q6		X					
Q7		X					
Q8		X					
Q9		X					
Q10		X					
Q11		X					
Q12		X	X	X	X	X	
Q13				X			
Q14				X			
Q15				X			
Q16					X		
Q17					X		
Q18						X	
Q19						X	
Q20							X
Q21							X
Q22							X
Q23							X

Table XXVII: Analysis of Faculty Survey Questions

<i>Question</i>	<i>Disciplinary Excellence</i>	<i>Multidisciplinary Perspective</i>	<i>Critical Thinking</i>	<i>Multicultural Competence</i>	<i>Collaboration Skills</i>	<i>Leadership Skills</i>	<i>Ethic of Service</i>
Q4		X	X	X	X	X	X
Q5		X					
Q6		X					
Q7			X				
Q8			X				
Q9				X			
Q10				X			
Q11					X		
Q12					X		
Q13						X	
Q14						X	
Q15							X
Q16							X

Appendix VI: Selected Student Survey Questions

Table XXVIII: “Since the beginning of this academic year, have you considered taking a course(s) outside of your discipline not required by your major?”

<i>Course</i>	<i>Percentage (Yes)</i>
MSE 350	76%*
INTEREGR 101	71%
EMA 202	71%
ME 240	71%
EMA 201	62%
INTEREGR 160	62%
ME 231	60%
EPD 690	60%
EPD 155	56%
ECE 252	52%
Overall	63%

*76% of survey respondents who took MSE 350 have considered taking a course outside of their major.

Table XXX: “Since the beginning of this academic year, have you considered adding a second major or certificate?”

<i>Course</i>	<i>Percentage (Yes)</i>
INTEREGR 101	67%*
EMA 202	62%
EPD 690	60%
EPD 155	58%
EMA 201	54%
INTEREGR 160	52%
ME 231	50%
ECE 252	48%
MSE 350	47%
ME 240	36%
Overall	53%

*67% of survey respondents who took INTEREGR 101 have considered adding a second major or certificate.

Table XXIX: “Do you plan to participate in a study abroad program?”

<i>Course</i>	<i>Percentage (Yes)</i>
ME 231	50%*
EPD 690	47%
ME 240	43%
MSE 350	41%
INTEREGR 101	38%
INTEREGR 160	38%
EMA 201	38%
EPD 155	31%
ECE 252	24%
EMA 202	24%
Overall	31%

*50% of survey respondents in ME 231 plan to participate in a study abroad program.

Table XXXI: “Since the beginning of this academic year, have you become a more contributing member of the groups and/or organizations to which you belong, OR have you joined a new group or organization?”

<i>Course</i>	<i>Percentage (Yes)</i>
EMA 202	62%*
EPD 690	60%
MSE 350	59%
INTEREGR 101	57%
EMA 201	57%
ME 231	55%
EPD 155	50%
INTEREGR 160	50%
ME 240	43%
ECE 252	38%
Overall	45%

*62% of survey respondents in EMA 202 have become a more contributing member or join a new group or organization.

Table XXXII: "Do you plan to pursue any type of leadership position?"

<i>Course</i>	<i>Percentage (Yes)</i>
EMA 202	81%*
INTEREGR 101	81%
EPD 690	80%
ME 231	78%
EMA 201	75%
INTEREGR 160	70%
ME 240	68%
ME_ 240	64%
ECE 252	57%
MSE 350	53%
Overall	62%

*81% of survey respondents in EMA 202 plan to pursue a leadership position.

Table XXXIII: "Have you performed volunteer service in the community this academic year, or do you plan to in the future?"

<i>Course</i>	<i>Percentage (Yes)</i>
ME 231	80%*
EMA 201	80%
EPD 690	73%
EMA 202	71%
INTEREGR 101	71%
INTEREGR 160	68%
EPD 155	61%
MSE 350	59%
ME 240	57%
ECE 252	38%
Overall	57%

*80% of survey respondents in ME 231 plan to perform volunteer service in the community.

Appendix VII: Comparison of Student and Faculty Responses**Table XXXIV: Comparison of Student and Faculty Responses**

<i>Course</i>	<i>CBE 250</i>	<i>CBE 562</i>	<i>CEE 320</i>	<i>ECE 220</i>
Critical Thinking				
S* - For this course, I was asked to explore problems with more than one solution.	4.6	4.0	4.4	4.8
F - For this course, I asked students to explore problems with more than one solution.	4.0	4.5	3.5	5.0
S - For this course, I was asked to determine the validity or usefulness of information or methods.	4.9	4.0	4.0	4.8
F - For this course, I asked students to determine the validity or usefulness of information or methods.	4.5	4.5	3.0	5.0
Multidisciplinary Perspective				
S - This course integrated topics from various engineering or non-engineering disciplines.	3.3	3.0	4.6	4.3
F - For this course, I integrated topics from various engineering or non-engineering disciplines.	3.0	4.5	4.0	4.0
Collaboration				
S - This course helped to improve my ability to work as a team.	4.1	3.0	3.1	4.5
F - The curriculum and instruction of this course helps to improve students' ability to work as a team.	4.5	2.0	2.0	5.0
Leadership				
S - This course helped to improve my leadership skills.	4.0	2.0	3.0	4.3
F - The curriculum and instruction of this course helps to improve students' leadership skills.	3.0	4.0	2.5	3.0
Multicultural Competence				
S - This course helped to improve my awareness of cultural issues related to engineering.	3.4	1.5	3.1	3.8
F - The curriculum and instruction of this course helps to improve students' awareness of cultural issues related to engineering.	3.0	4.0	4.0	4.0
Ethic of Service				
F - For this course, I thought about or discussed the value of volunteer service in the community.	2.0	2.0	3.0	2.0
Overall				
Student Overall	4.0	2.9	3.7	4.4
Faculty Overall	3.4	3.6	3.3	4.0
Number of Students	8	2	7	4
Number of Faculty	2	2	2	1

*S and F indicate questions for students and faculty respectively.

Table XXXV: Comparison of Student and Faculty Responses

<i>Course</i>	<i>EPD 160</i>	<i>EPD 275</i>	<i>EPD 397</i>	<i>ISYE 349</i>
Critical Thinking				
S* - For this course, I was asked to explore problems with more than one solution.	4.8	4.0	4.3	3.0
F - For this course, I asked students to explore problems with more than one solution.	5.0	5.0	5.0	5.0
S - For this course, I was asked to determine the validity or usefulness of information or methods.	4.0	4.0	5.0	4.5
F - For this course, I asked students to determine the validity or usefulness of information or methods.	4.0	5.0	5.0	5.0
Multidisciplinary Perspective				
S - This course integrated topics from various engineering or non-engineering disciplines.	4.3	4.0	4.3	4.0
F - For this course, I integrated topics from various engineering or non-engineering disciplines.	5.0	5.0	5.0	5.0
Collaboration				
S - This course helped to improve my ability to work as a team.	5.0	4.5	4.3	3.0
F - The curriculum and instruction of this course helps to improve students' ability to work as a team.	5.0	4.5	4.7	5.0
Leadership				
S - This course helped to improve my leadership skills.	4.8	4.0	4.3	3.0
F - The curriculum and instruction of this course helps to improve students' leadership skills.	4.0	4.5	4.8	4.0
Multicultural Competence				
S - This course helped to improve my awareness of cultural issues related to engineering.	3.3	4.0	4.7	4.5
F - The curriculum and instruction of this course helps to improve students' awareness of cultural issues related to engineering.	4.0	4.0	5.0	5.0
Ethic of Service				
F - For this course, I thought about or discussed the value of volunteer service in the community.	4.0	3.0	4.3	1.0
Overall				
Student Overall	4.3	4.1	4.5	3.7
Faculty Overall	4.4	4.4	4.8	4.3
Number of Students	5	2	3	2
Number of Faculty	1	2	4	1

*S and F indicate questions for students and faculty respectively.

Table XXXVI: Comparison of Student and Faculty Responses

<i>Course</i>	<i>ME 306</i>	<i>ME 313</i>	<i>ME 340</i>	<i>ME 361</i>	<i>NEEP 271</i>
Critical Thinking					
S* - For this course, I was asked to explore problems with more than one solution.	4.1	5.0	4.0	4.0	2.0
F - For this course, I asked students to explore problems with more than one solution.	4.0	3.5	4.5	4.0	4.0
S - For this course, I was asked to determine the validity or usefulness of information or methods.	4.4	5.0	4.0	4.6	2.0
F - For this course, I asked students to determine the validity or usefulness of information or methods.	5.0	3.5	4.5	3.5	3.0
Multidisciplinary Perspective					
S - This course integrated topics from various engineering or non-engineering disciplines.	3.4	4.0	3.5	4.2	3.0
F - For this course, I integrated topics from various engineering or non-engineering disciplines.	5.0	5.0	4.0	3.5	5.0
Collaboration					
S - This course helped to improve my ability to work as a team.	3.0	5.0	3.0	3.0	3.0
F - The curriculum and instruction of this course helps to improve students' ability to work as a team.	3.0	4.5	3.5	2.5	5.0
Leadership					
S - This course helped to improve my leadership skills.	2.7	5.0	2.0	2.5	2.0
F - The curriculum and instruction of this course helps to improve students' leadership skills.	2.0	4.0	3.0	2.0	3.0
Multicultural Competence					
S - This course helped to improve my awareness of cultural issues related to engineering.	2.5	5.0	2.5	3.8	1.0
F - The curriculum and instruction of this course helps to improve students' awareness of cultural issues related to engineering.	2.0	4.5	2.5	1.5	3.0
Ethic of Service					
F - For this course, I thought about or discussed the value of volunteer service in the community.	2.0	1.5	1.0	1.0	1.0
Overall					
Student Overall	3.4	4.8	3.2	3.7	2.2
Faculty Overall	3.3	3.8	3.3	2.7	3.4
Number of Students	7	1	2	5	1
Number of Faculty	2	2	2	3	1

*S and F indicate questions for students and faculty respectively.