AC 2008-1608: PROJECT-BASED INTRODUCTION TO ENGINEERING FOR FRESHMAN STUDENTS

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Project-based Introduction to Engineering for Freshman Students

Abstract

After six years of discipline-specific freshman engineering courses for Civil Engineering, Mechanical Engineering and Electrical Engineering majors, it was decided that all Engineering and Construction Management majors would share the same curriculum during their freshman year. The two main objectives of this change were to improve retention within the School of Engineering by facilitating a switch from one engineering major to another during or following the freshman year and to increase efficiency from a human resources perspective.

A team of experienced and junior faculty from all three engineering disciplines developed two new project-based Introduction to Engineering courses, one for each semester of the freshman year. The overall design of the courses was guided by three principles. First, each of the ABET Criterion 3 Outcomes a-k should be covered in the courses, with several of them being reinforced multiple times. Second, the steps for problem solving and design, which lie at the heart of engineering, should be introduced at the beginning of the first course and reinforced through a series of challenging engineering projects across each of the three engineering disciplines. Third, and perhaps the most important, retention within the school of engineering should be improved by means of imparting more excitement and less mundane work and better response to the varied backgrounds and learning styles of the students.

The courses are project-based. Besides technical and design objectives, the courses are to address ABET outcomes in the areas of economic, safety, environmental, social, and political implications of engineering work. Therefore, a project is defined by first selecting the desired ABET outcomes and then creating or evaluating potential exercises that are most suitable for reinforcing those outcomes. In addition, the primary skills that are necessary to successfully complete each of the projects, such as computer aided design, research methodologies, computer programming, communications, and time management are provided in a “just-in-time” mode with an interspersing of discussions about engineering professional topics. Working in teams and improving team dynamics for successful completion of the projects are emphasized.

The new courses are also developed with assessment in mind. The course goals are evaluated by the students through an online questionnaire and used with student's performance to define if a course goal has been satisfied. Benchmarks to be used include retention numbers within each of the engineering disciplines and across the entire school of engineering, and the number of contact hours of the instructors.

Introduction

Introduction to Engineering (EG109 and EG110) is a new two course sequence that all Engineering and Construction Management majors are required to take in their freshman year. The course introduces the students to engineering problem solving and the design process through project-based instruction with a blend of technical skills and non-technical or so-called “soft” skills. At the time of the writing of this paper, the first semester course, EG109, had been completed, and EG110 had just begun. The objective of this paper is to describe the development, design, and first year implementation of the course.

After six years of discipline-specific freshman engineering courses for Civil Engineering, Mechanical Engineering and Electrical Engineering majors, it was decided that all Engineering and Construction Management majors would share the same curriculum during their freshman year. The core curriculum includes Calculus, English, Chemistry, and an Introduction to Engineering course about which this paper is written. There were several reasons why this change occurred; two primary reasons were to improve retention within the School of Engineering and to increase efficiency from a human resources perspective. During the course, students learn what engineering is all about and what the differences are among the various engineering disciplines and construction engineering management. The students have the entire freshman year to decide which major is best for them. The changes also allowed the previous Introduction to Engineering courses to be redesigned and combined in a way that is responsive to the current and future needs of society. The ABET criterion 3 outcomes are a driving force in making sure the course outcomes are appropriate.

Freshman Engineering courses have undergone significant evolution in the past few decades. In recent years great emphasis has been placed upon broadening the freshman engineering experience and improving retention in engineering programs. Several programs have made significant changes in recent years to address these issues. [1, 2, 3, 4, 9] Many programs are less skills-based instruction and more project-based instruction with an emphasis on problem solving and engineering design. [1, 6,7,8] The United States Air Force Academy, as well as other institutions, have taken a multidisciplinary approach in the first year by making the course open to or required by all engineering students. [1, 6, 7] Assessment has also become more important in recent years, and student surveys are often used to better understand the freshman experience from the point of view of the students. [1, 5]

Design and Development of Course

The design and development of the Introduction to Engineering course at our institution began during the 2006/2007 school year with a study and design concept committee comprised of representatives from each of the engineering disciplines. The committee started with a very lengthy list of potential topics and desired outcomes, culled from the three discipline-specific courses the new sequence would replace. This list of topics and outcomes was reduced to a size and scope more appropriate for a general introduction to engineering course. The committee also directed that the course be developed with the following goals in mind. The freshman experience should engender improved retention, be efficiently delivered, allow students to postpone selection of a major field without consequence, be project-based, and place equal emphasis on design, analysis, some important technical skills, and "soft" skills like ethics, societal sensitivity, communication, and teaming.

With this charge, the detailed development of the course was conducted during the summer of 2007 by a team of four experienced and junior faculty from all three engineering disciplines. These four faculty members would also become the instructors for the course, which allowed for a seamless transition from the development to the implementation stages.

Establishing the Course Outcomes

The overall design of the course was guided by three principles. First, the outcomes of the course should have cross correlation with the ABET Criterion 3 Outcomes a-k with the goal being to cover all eleven outcomes. Second, the steps for problem solving and design, which lie at the heart of engineering, should be introduced at the very beginning of the course and reinforced through a series of challenging engineering projects across each of the three engineering disciplines. Third, and perhaps the most important, retention within the school of engineering should be improved.

Several changes were made to improve retention. The first change was to impart more excitement and less mundane work into the course through hands-on projects, in-class exercises, teamwork, field trips, and guest speakers from industry. Also, the course was to be more responsive to the varied backgrounds and learning styles of the students. Instead of the instructor just lecturing in front of the students the entire time, a more active and collaborative approach was to be taken in the classroom. The formats for homework and tests were varied throughout the course. Finally, the flexibility to choose their major at the end of the freshman year should help with those students who don't know which major is best for them when they start.

In addition to the three global principles described in the previous paragraphs, the design of the course was guided by additional goals. The students need to be educated on what it means to be an engineer and the differences among the three engineering majors and construction management. The students need to learn how to utilize and apply select engineering software and tools to assist in problem solving. In particular, Computer Aided Design (CAD) and computer programming (MATLAB) are two important tools that all engineering students need to learn. Finally, the students need to consider non-technical considerations (environmental, political, social, safety, etc.) in a project.

After considering all of the guiding principles and goals, ten specific, measurable outcomes were defined for the course. All topics, projects, and activities in the course would have to support one or more of the outcomes. Assessments done on the course would also be based upon the outcomes. The ten outcomes are:

1. To be able to perform well in multidisciplinary, multi person, complex team projects.
2. To be able to apply the technical project design steps including library research, project planning and management to subsequent engineering projects.
3. To be able to apply problem solving steps when solving a mathematical, science or engineering problem.
4. To be able to use a CAD software to construct a 2d, three-view representation (i.e. front, top, side) of a 2d object, complete with dimensions, annotations, etc., as well as an isometric and/or 3d view of an object.
5. To embrace the responsibilities of the engineer in regards to the well being and safety of the people in whatever they discover, design or build.
6. To be able to communicate effectively results and ideas through written or oral means to different audiences.

7. To be able to acquire, analyze and present data of experimental analysis.
8. To be able to describe the various engineering/management disciplines (ME, CE, ECE, EMN), and the various engineering functions (research, development, testing, design, construction, etc).
9. To understand and to be able to subsequently apply logic and basic programming fundamentals and statistics to future engineering courses.
10. To be able to understand, address and resolve non-technical considerations (economic, safety, environmental, social, political, etc.) during the project design cycle.

Figure 1 gives a mapping of course outcomes to ABET Criterion 3 Outcomes a-k, showing specific course topics used to accomplish each.

Course Structure

The course was structured in a way that would best support the goals and outcomes. Our institution uses a semester system, and the course is designed to span the entire year with EG109 in the fall and EG110 in the spring. Designed to be three credits in each semester, there are two lecture hours and three laboratory hours each week. The delivery of material in the lectures supports the projects and skills that the students work on in their laboratory. With a nominal class size of 100 students, two lecture sections were created with approximately 50 students in each section, and five laboratory sections were created with approximately 20 students in each lab section. Four instructors from each of the three engineering disciplines shared the course load each semester. This diversity in the instructors supports the multi-disciplinary nature of the course. The specific projects, lecture topics, and homework assignments were common to all sections; however, each instructor was responsible entirely for the delivery of the material in their section. Each instructor was responsible for grading in their sections except for hour exams and the final exam where the grading was shared between instructors.

Project Descriptions

1. The two course sequence started with a team building challenge. Teams were required to design and assemble a tinkertoy tower with formal documentation of the design steps required, and a goal of building the highest tower while minimizing the cost. This first project achieved its goal well: introduction of teaming skills, the brainstorming and design processes, and excitement of cooperative learning .

2. The second project was a multi-week design of a new dorm. Given minimal specifications at first, teams brainstormed designs. In the same time frame, lectures focuses on the design process, teaming, and brainstorming. Subsequently, orthographic and isometric concepts,

Course Outcomes	ABET Criterion 3 Outcomes	Topics/Activities	Projects
1.To be able to perform well in multidisciplinary, multi person, complex team projects.	(d) an ability to function on multi-disciplinary teams	Teamwork Skills	All projects
2.To be able to apply the technical project design steps including library research, project planning and management to subsequent engineering projects.	(c) an ability to design a system, component, or process to meet desired needs	Library research Time management Design Process	All projects
3.To be able to apply problem solving steps when solving a mathematical, science or engineering problem.	(a) an ability to apply knowledge of mathematics, science, and engineering (e) an ability to identify, formulate, and solve engineering problems	Analytic method Problem solving Programming	Beam Fluids
4.To be able to use a CAD software to construct a 2d, three-view representation (i.e. front, top, side) of a 2d object, complete with dimensions, annotations, etc., as well as an isometric and/or 3d view of an object.	(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.	CAD Visualization Sketching	Dorm
5.To embrace the responsibilities of the engineer in regards to the well being and safety of the people in whatever they discover, design or build.	(f) an understanding of professional and ethical responsibility	Ethics Responsibility to Society	Contemporary Issues
6.To be able to communicate effectively results and ideas through written or oral means to different audiences.	(g) an ability to communicate effectively	Technical writing Powerpoint Oral skills	All projects
7.To be able to acquire, analyze and present data of experimental analysis.	(b) an ability to design and conduct experiments, as well as to analyze and interpret data	Data analysis, Spreadsheets	Beam Fluids
8.To be able to describe the various engineering/management disciplines (ME, CE, ECE, EMN), and the various engineering functions (research, development, testing, design, construction, etc).	(d) an ability to function on multi-disciplinary teams	Engineering Fields Engineering Functions	All projects
	(i) a recognition of the need for, and an ability to engage in life-long learning	Careers/Jobs Guest speakers Field Trips	
9.To understand and to be able to subsequently apply logic and basic programming fundamentals and statistics to future engineering courses.	(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.	MATLAB Robot programming Statistics	Guitar Fluids Water Systems
10. To be able to understand, address and resolve non-technical considerations (economic, safety, environmental, social, political, etc.) during the project design cycle.	(c) an ability to design a system, component, or process to meet desired needs	Design, Economics Manufacturability, Standards	All projects
	(h) the broad education necessary to understand the impact of engineering solutions in a global and societal context	Responsibility to Society, Political Implications	Dorm Water Systems
	(j) a knowledge of contemporary issues	Contemporary engineering issues	Contemporary Issues

Figure 1. Mapping of Course Outcomes to ABET Criterion 3, showing specific course topics used to accomplish each.

scaling drawings, and CAD were introduced. For the final deliverable, after several weeks work, teams were required to provide multiple integrated CAD drawings – floor plan, profile, site, utilities. Figure 2 gives an example of an AutoCAD drawing created by a student team. The instructors' overall assessment was that this was the least successful project of the first semester. The introduction to CAD skills was too cursory for most students, and those with experience in the area carried team members to an extent that learning suffered. A more structured introduction of skills has been incorporated into the design of the second semester course and will be implemented in the next offering of the CAD portion.

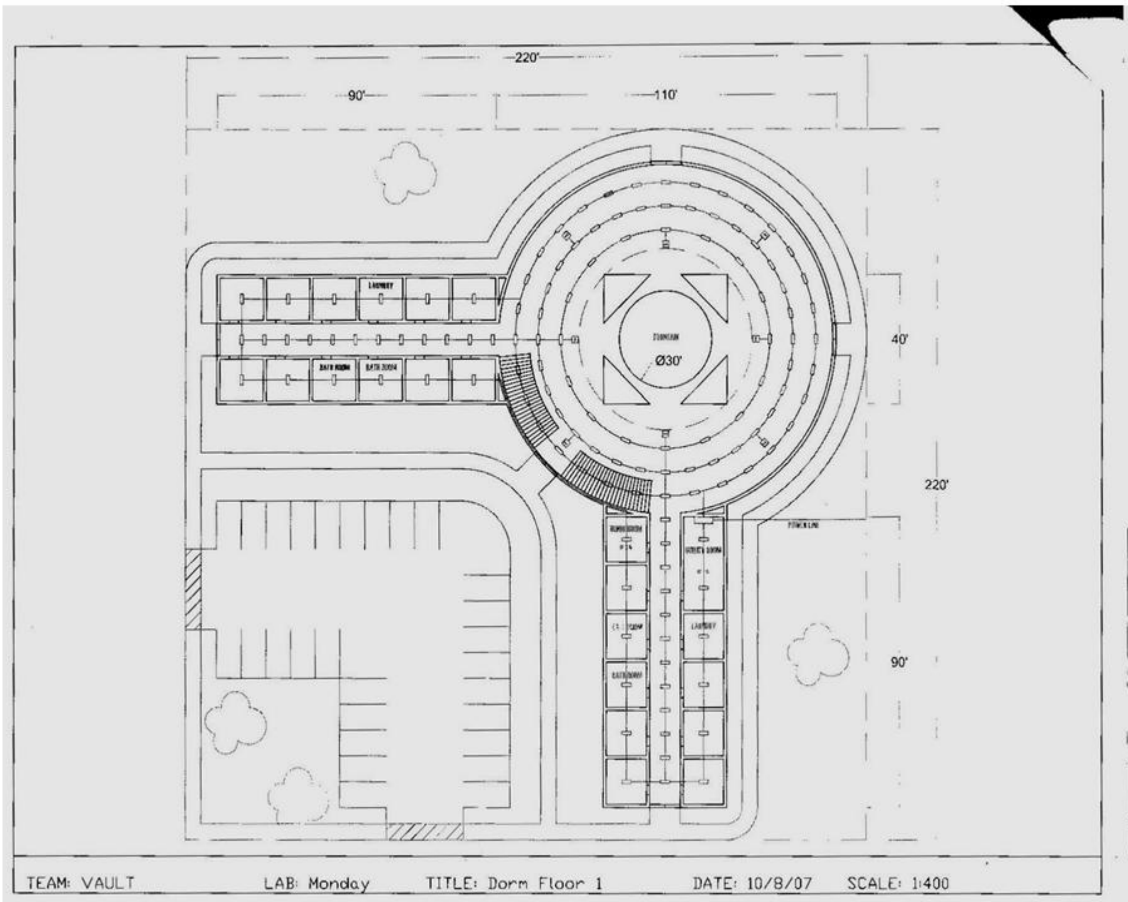

Figure 2. Student Dorm AutoCAD Drawing

3. The third project, given a brief introduction to beam deflection theory, required teams to gather data in the mechanics laboratory on physical dimensions, load and deflection for an 'I' beam, then use spreadsheets to plot the data and compute the modulus of elasticity. An ancillary goal of bringing new engineering students into a lab to perform real experiments was achieved. Students worked in teams and demonstrated a great deal of enthusiasm for the project. In addition, there was an individual component that required each student to utilize the spreadsheet software to complete data reduction. This was a well designed project that nicely fulfilled several course goals.

4. A Contemporary Issues presentation project was preceded by an introduction to the use of University Library resources and research techniques. Research teams brainstormed and chose a contemporary engineering topic, conducted a literature review of their topic, developed visual presentation materials, practiced and presented, received critique, then presented again. A written report was also required. Many of the research products were insightful, and all were presented with professional Powerpoint visuals. The critique and representation was awkward in some cases, and team grading presented distinct challenges. A modified form of "Signature Block"[16] peer assessment was utilized, wherein non-contributors were given a grade of zero.

5. The final project of the first course was a Robot construction and programming challenge using Lego Mindstorms Kits. The challenge was to build a robot that could push a heavy object, find and differentiate between two types of objects, and push two of the objects of interest out of the arena. Figure 3 shows one of the teams performing a test of their robot. After a slow start, this project exceeded expectations. Teams, for the most part, functioned better than earlier in the semester. Although learning the programming skills, robot sensor capabilities, and physical principles needed was daunting, most of the 20 teams scheduled extra design and development time (evening and Sunday afternoon access to the robot materials was arranged) and were able to accomplish the challenges.

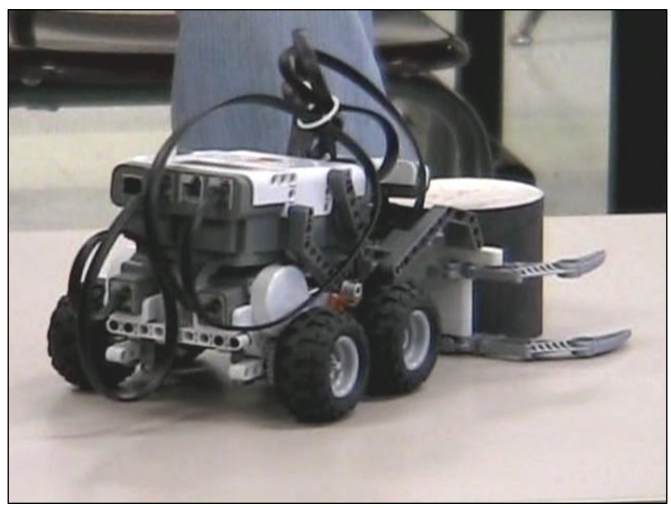

Figure 3. Robot Competition

6. The initial project of the second semester course involved working with an electric guitar. Following several weeks of lecture and lab materials intended to help the students acquire fundamental and necessary skills in MATLAB, student teams were required to write MATLAB programs to process signals received from an electric guitar and to generate signals that simulate an electric guitar. To address instructor concerns with work sharing in teams raised in the first semester, this project was designed with both team and individual components. Student teams designed the programs to process and plot the input signals, but each individual was required to make the program function for a unique piece of music. This project attracted the students because it merged some of their avocational interests with their profession.

7. The second project of the second semester includes hands-on work in the fluids laboratory. Students will measure the height of water above a weir and the amount of water flowing over it. They will then use MATLAB to show the relationship between the two and determine the appropriate weir coefficients.

8. The final project of the second semester, which will serve as a capstone for the two-course sequence, involves the design of a water system for a medium-sized town. The design will include economic, environmental, and societal considerations as well as technical aspects of the design such as the size of reservoirs and pipes and the locations and capacities of pumps. Each team will be required to design, test, and debug a small scale model of the water system based on actuators and control using Lego Mindstorm kits introduced in the first course. They will produce a set of CAD drawings, a spreadsheet containing an economic analysis, a written report, and a Powerpoint presentation.

9. Field trips were incorporated each semester to expose students to engineering in industrial settings. In the first semester an all day trip included visits to a municipal material recycling facility and a manufacturer of wind measurement instrumentation that houses its facility in a green designed and engineered building (See Figure 4). In the second semester, the trip is integrated with the students' water system design project and encompasses a visit to a municipal water storage and treatment facility.

Figure 4. Field Trip, NRG Systems, Inc.

Lectures and Laboratories

The Introduction to Engineering course was designed to be project-based from the first meeting forward. The lab projects set the pace; lectures delivered skills and knowledge just in time for the projects. Thus, for example, brainstorming was discussed in lecture just before being used in the dorm design project. The concepts of beam theory or friction at the wheels of the robot were covered in lecture just before the lab sessions when needed.

Because the course was designed for large lecture sections and some of the material was viewed by students as "soft", (and therefore considered by some to be non-challenging) the lecture instructors made conscious plans to incorporate interactive exercises into virtually every period. Often using team exercises, individual problems, or "Think-Pair-Share"[15] challenges, the lecture material was reinforced and students actively learned. These exercises were usually not graded.

Lecture notes were prepared for computer projection before each session, using word processor, spreadsheet, or Powerpoint, as appropriate. Each session began with an outline for that lesson and assignment of homework or announcements. Homework and pop quizzes were sometimes delivered and collected in paper format in the lecture section. More often, homework was distributed through the University Intranet and students were required to submit their individual solutions for grading by uploading to the system. The intranet system is new; students and instructors alike had to gain a level of comfort with it. The system has capabilities for return of graded homework to the students, but generally graded assignments were returned in traditional paper format in class. In the future, electronic returning of homework may lead to improved feedback to students.

A typical example of a 50 minute lecture lesson plan follows:

EG109 Lesson Plans
Week5, Lecture 10: Evaluation of Alternatives and Selection of a Concept; Using Excel

1. Return AutoCAD HW

2. Student club representative: discuss ASCE (5 min)

3. Homework Assignment (due Tues, Oct. 2) (5 min)

   This assignment can be found on the EG109 Homepage

   (Individual) Open Excel 2007 and select the Help Menu. Select "Training" and then select "Get to Know Excel 2007: Enter Formulas". Do the online tutorial.

   (Individual) Given the following spreadsheet file containing a table of information, use Excel to complete the decision matrix. Enter the given values into Excel, and use equations to compute the values for the remaining cells. Submit your excel file by uploading it in the EG109 Homepage.

4. Discuss methods for choosing a final design concept. (5 min)

5. Discuss decision matrices. Weighted versus non-weighted. Normalized weighting factors. (10 min)

6. Team Exercise; NASA is interested in improving the heat shield for next generation space vehicles as they enter into Earth's and other planetary atmospheres. Create a list of five working criteria that can be used in a decision matrix to determine the best thermal protection system for those vehicles. Assign appropriate weighting factors to each of the criterion. Normalize the weighting factors such that their sum is equal to 1. (15 min.)

7. Discuss how Excel can be used to solve engineering problems. Excel demonstration of decision matrix. (10 min.)

Some topics, such as time management, statistics, and guest speakers on engineering and management careers, did not relate directly to lab work. These were interspersed in the semester as the demands of just-in-time instruction for projects allowed. Scheduling was challenging.

The course used three textbooks. Engineering Your Future[12] was used mostly in the lecture classes covering problem solving, the design process, and many of the soft skills such as teamwork, oral and written communication, and time management. Reading assignments were given and sometimes followed by a pop quiz in class. Homework problems out of the textbook were also assigned. Discovering AutoCAD 2008[13] and MATLAB 7 for Engineers[14] were the two textbooks utilized in the laboratory for the development of CAD and programming skills.

All of the laboratory work involved team-based projects providing important experience in engineering and multi-disciplinary teamwork. Teams typically consisted of four persons with a few five person teams. Teams were maintained through several projects, changing once in the middle of the semester to give experience with the team forming and developing process. Team members were assigned to teams randomly during the first semester. A more systematic process for choosing team members, possibly based upon first semester grades, knowledge of individual personalities, and choice of major, is being considered for the second semester. Teams were instructed to organize, communicate, and assign tasks to members according to perceived strengths. Teams were also required to hold meetings outside of lab time to work on projects and prepare reports and presentations.

One challenging aspect of the teamwork was what to do with the team member(s) that did not contribute much to the team. Often, a team would be able to take up the slack from underperforming members, but then the question was how to assign grades. There were a few cases when it was clear that an individual did very little, if any, work on the project, and that person received a zero grade. In most cases, the underperformers received the same grade as the performers. Students commented that they did not think that it was fair[11]. For some of the projects, the students were required to discuss in their reports what the contribution was from each member of the team, a form of peer assessment.[16] However, it is apparent that more practice with peer assessment and peer evaluation needs to be incorporated. According to Felder[16], three or more rounds of peer assessment may be required before students become comfortable with giving insightful and valuable evaluations of team mates. For the second semester, there will be a mix of team and individual work, and peer-evaluation-based bonus points or faculty grade adjustments will be used on some projects.

In some of the lab projects, skill tutorials preceded the design work. For example, AutoCAD tutorials, Excel practice problems, and Robot programming tutorials were assigned as pre-lab work or as the initial parts of a lab project session. Students, in general, had limited patience with tutorials, feeling that they could jump right into the design and learn on the fly. In the opinion of the instructors, those that took the tutorials seriously gained the most learning. This was one of the biggest challenges – providing skills instruction (particularly AutoCAD) with limited instructor-student communication and time. In the second semester course, a good deal more drill on skills will be incorporated into lectures and homework. The first several lab sessions will be devoted to supervised instruction and individual exercises on basic MATLAB skills. At the conclusion of the second course, the instructors will evaluate the results of the two distinctly different approaches and make modifications for the following year. In all probability, some increase in traditional instructional methods will be implemented next year as student comments indicated they felt they did not feel they gained the CAD skills we hoped they would.

The field trips to a complex automated recycling facility, a wind power industry (housed in a green designed and engineered building) and a water treatment and supply facility provided a welcome break from the regular academic schedule and gave students an opportunity to see some real world applications of engineering that required technical skills, design abilities, and had very positive societal benefits. An added benefit was an opportunity to spend time with their instructors in a casual environment (including a stop at the Ben & Jerry's factory!). Student comments on the field trips were unanimously positive.

Costs

Starting up a new project-based course such as EG109/EG110 inherently has associated equipment costs. The first semester course required equipment for the first tower project and for the robot project. In addition, the field trip for 100+ students was expensive. The second semester course also plans to incorporate a field trip, though a less costly one, and new equipment is required for the water system project. The total cost of the new course, including the cost of new equipment and costs associated with the field trips is calculated below as $5550.

Tower materials: 5 sets Tinkertoys; $150
Robot materials: 20 sets Lego Mindstorms; $3000
Field trip, 1st semester: $1500
Water system materials: 5 sets; $500
Field trip 2nd semester: $400
Total: $5550

One of the objectives considered in the design of thte EG109/EG110 course was to improve the efficiency with which the courses are delivered. A comparison of Instructor time needed for the freshman courses with previous mode of instruction and new newly designed EG109/EG110 course follows. A net savings of 20 instructor contact hours per week was achieved in the newly designed course.

Previous system

Civil 1 lecture section, 2 lab sections
Fall: 7 hours/week
Spring: 13 hours/week
Electrical/Computer 1 lecture, 1 lab section
Fall: 6 hours/week
Spring: 6 hours/week
Mechanical 1 lecture section, 2 lab sections
Fall: 8 hours/week
Spring: 7 hours/week
Engineering Mgmt 1 lecture, 1 lab section
Fall: 4 hours/week
Spring: 7 hours/week

Total instructor time: 58 hours/week

EG109/EG110 system

2 lecture sections, 5 lab sections
Fall: 19 hours/week
Spring: 19 hours/week

Total instructor time: 38 hours/week

Net savings: 20 hours/week; objective met

Assessment and Feedback

Students were anonymously polled on three occasions in the first semester as to how they perceived the first semester course. Similar feedback opportunities have been incorporated into the second course. Student responses provided the instructors some valuable insights which will be used to refine course content and procedures.

Students were asked to give their opinion on the value of five first semester laboratory projects: Beam Deflection, Dormitory Design, Contemporary Issues Research, Robot Programming, and Field Trip.[10]The highest rated project was the Contemporary Issues Research Project and Report involving library research, design of visual aids, oral presentation, and written report. Students seemed to feel comfortable with Powerpoint, and with making presentations. In addition, teaming in many of the groups seemed to go well on this, the fourth project. The Lowest was the Dormitory Design Project involving teamwork, brainstorming, CAD work. This not unexpected result paralleled student complaints that CAD skills instruction was too brief. Further, this was the first project, so teaming skills were largely undeveloped.

At the close of the first semester, students were asked to rate their personal sense of accomplishment of the Course Goals.[10] Development of teaming skills seemed to be an achievement recognized by most students, as the highest accomplishment average, 4.296/5.0, was given to the goal: “To be able to perform well in multidisciplinary, multi person complex team projects.” In the area of communications, the faculty felt that the students enjoyed, and did well on the preparation and delivery of their oral presentations, in general, but less well on the written reports. The lowest accomplishment average, 3.366/5.0, was given to the goal: “To be able to use a CAD software to construct a 2d, three-view representation (i.e. front, top, side) of a 2d object, complete with dimensions, annotations, etc., as well as an isometric and/or 3d view of an object." As noted above, this is consistent with less formal feedback and grounds for redesign discussions. The instructors concur that CAD instruction did not go well.

Students were asked to select one portion or aspect of the course that went well for them and one that did not.[11]

- 38% of students chose Labs/Projects for the best portion of the course
- 30% of students chose Teamwork for the best aspect
- 51% of students answered that AutoCAD went poorly for them

Finally, students were asked whether the course had influences on their decision to stay in Engineering or Engineering Management.[11] Important objectives for the freshman engineering sequence are improvement of retention and helping students select the best career. We wanted to know whether, in their opinion, this course accomplished those objectives

- 62% said it did help them decide to stay
- 11% said it helped them decide to leave

Grades in the first offering of the course, for 99 students were distributed as follows:
21 A's; 64 B's; 10 C's; 2 D's; 2 F's

Conclusions

The two course freshman sequence is still in the middle of its first delivery. The first semester went well, in general, but several areas have been identified for refinement.

The most significant area for improvement is in AutoCAD learning – a better delivery mode than asking students to learn by tutorials and project work is needed. This appears to be a case where more traditional supervised instruction will serve students best. This mode will be tried in the first part of the second semester course where MATLAB programming language will be introduced through lecture examples, homework problems, and laboratory exercises designed to provide learning and practice in fundamentals. After the second semester, a final assessment will form the basis of revisions to the delivery mode for AutoCAD next year.

In the area of team skills, some teams worked well, others not. How to deal with "slackers" is a problem area. We need a mechanism to encourage – positive reinforcement or penalty – those students who seem not to carry their share. Conflict resolution was not completely successful. There seems to be a need to spend more time on team development and dynamics, but little time is available. Our plan is to announce peer assessment rules early in each course and give more practice with the technique, then begin to use quantified peer evaluations to assign bonuses or grade adjustments. In addition, teams were constructed randomly. Some thought is being given to managing the team assignments to ensure diversity.

More homework assignments are needed to provide drill on basic issues. This clear need is being acted upon through a more traditional process of skills introduction prior to project initiation in the second semester course.

As to administrative course delivery issues, use of the University's intranet for assignments, student submittals and returns of graded work worked fairly well. Students and instructors need a greater level of comfort and familiarity with the system, but its use allows students instant access to assignments and an easy way to check on lecture notes, receive late-breaking announcements, and submit assignments. In the future, electronic returning of homework may lead to improved feedback to students.

Students commented that the lecture topics jumped around too much. Perhaps fewer topics are needed or organize the topics in blocks of "soft" skills and technical skills. This arrangement is being tried in the second course.

Bibliography

1. Lynnane George, Robert Brown, Engineering 100: An Introduction To Engineering Systems At The US Air Force Academy, U.S. Air Force Academy, Proceedings of the 2007 American Society for Engineering Education Annual Conference and Exposition.
2. Christopher J. Rowe, Anita Mahadevan-Jansen, Module-based Freshman Engineering Course Development Vanderbilt University, Proceedings of the 2004 American Society for Engineering Education Annual Conference and Exposition.
3. Leo H. McWilliams, Stephen E. Silliman, Catherine Pieronek , Modifications to a Freshman Engineering Course Based on Student Feedback, University of Notre Dame, Proceedings of the 2004 American Society for Engineering Education Annual Conference and Exposition.
4. J.B. Connor 1, V.K. Lohani , E. Bull , T.M. Wildman, S.G. Magliaro , T.W. Knott , O.H. Griffin, Jr , J.A. Muffo , An Analysis of Freshman Engineering: A Cross-College Perspective, Office of Academic Assessment, Virginia Polytechnic Institute and State University, Proceedings of the 2004 American Society for Engineering Education Annual Conference and Exposition.
5. Dr. Mary R Anderson-Rowland, Understanding Freshman Engineering Student Retention through a Survey, Arizona State University, Proceedings of the 2004 American Society for Engineering Education Annual Conference and Exposition.
6. Jean Nociti-Gobel, Samuel Daniels, Michael Collura, Bouzid Aliane "Project Based Introduction to Engineering– University Core Course" School of Engineering and Applied Sciences, University of New Haven, Proceedings of the 2004 Society for Engineering Education Annual Conference and Exposition
7. Sohail Anwar, Todd Batzel, Ed Sell "Integration of Project Based Learning Into a Freshman Engineering Design Course", The Pennsylvania State University, Altoona College, Proceedings of the 2004 Society for Engineering Education Annual Conference and Exposition
8. Rafiqul Noorani, Louis Rodriguez, Michael Givens, Drew Christensen, Joe Foyos "Project-Based Learning in a Freshman Computer Graphics Course", Loyola Marymount University, Proceedings of the 2007 Society for Engineering Education Annual Conference and Exposition
9. Taryn Melkus Bayles, Anne M. Spence, Claudia Morrell "Improving the Freshman Engineering Experience" University of Maryland Baltimore County , Proceedings of the 2004 Society for Engineering Education Annual Conference and Exposition
10. EG109 End of semester course evaluation
11. EG109 On-line course survey data
12. W. Oakes, L. Leone, and C. Gunn, Engineering Your Future, A Comprehensive Approach, Great Lakes Press, Inc., Fifth Edition, 2006. ISBN: 188101886-5
13. Dix & Riley, Discovering AutoCAD 2008, Prentice-Hall, 2007
14. W. J. Palm III Introduction to MATLAB 7 For Engineers, The McGraw-Hill Companies, Second Edition, 2003. ISBN: 9780072922424.
15. Lyman, F. (1981). "The responsive classroom discussion." Anderson, A. S. (Ed.), Mainstreaming Digest, College Park, MD: University of Maryland College of Education.
16. http://www.foundationcoalition.org/publications/brochures/2002peer assessment.pdf