Freshman Engineering & Computer Science Program At Wright State University

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Abstract
The freshman program is designed to introduce engineering principles through hands-on experience, establish a sense of community, develop an understanding of how to be successful in studying engineering, and to foster collaboration among students through cooperative teaming. This paper presents an overview of the program that has evolved over the past six years.

Introduction

Six years ago the college committed to developing a freshman experience which would help in recruitment and retention. Initially it was designed on Drexel University's freshman program [1]. During the first two years enrollment was limited to approximately 60 students who exhibited high achievement in GPA and test scores. This was a three-quarter course taught by a number of professors from various college departments. Using this experience as a base, a full time director was appointed and the program was expanded the third year to include all entering freshmen except for those in the Biomedical Engineering Premedical Program. They were exempt as the freshman program could not be worked into their crowded curriculum.

For the next two years the program was a three hour per quarter, two quarter course. It had a fall-winter, winter-spring structure. Each first quarter had one 2-hour lecture and two, 1-hour laboratories per week. The curriculum the first quarter had two teaming events, basics of engineering drawing, an introduction to instrumentation, resistive circuits involving Ohms and Kirchoff's laws, and integrated circuits used for timers, flip-flops, counters, and an introduction to two of the college programs. In addition the students learned to use HTML to design their own web sites and MatLab and Excel to solve statistical problems involving normal distributions. The second quarter had one, 2-hour lecture and one, 1-hour laboratory, and one teaming event. The students were introduced to ethics and five more college programs with the labs designed and taught by the departments. The teaming event involved the construction and flying of a radio controlled, electrically powered, slow flying airplane. In addition they were introduced to the engineering use of mathematics involving algebra, calculus, and differential equations.

The biggest surprise came from the engineering mathematics effort the second quarter. Our college mathematics committee had postulated that the students were capable of handling higher mathematics earlier than programmed using the normal sequence taught by the mathematics department. They encouraged the freshman program to introduce over a four week period enough mathematics to enable the students to work an oscillatory motion problem using differential equations. This was accomplished starting with static pressure and beam problems, then projectile motion and finally mass on a spring motion. The outcome was so positive that the

college has developed a freshman engineering mathematics course that teaches first year students advanced mathematics from an engineering basis.

Starting with the 2003-2004 academic year, the program was changed to a one quarter, four-hour credit course required of all freshmen students. It is offered each quarter. Instruction manpower consists of the program director and four graduate teaching assistants (GTA). One assistant dean manages the budget, ordering materials, hiring, and unusual student problems.

Methodology

Each quarter there are two lecture sections, five computer laboratory sections, and five instrumentation sections. The lecture sections are limited to 50 students each and the laboratory sections are limited to 20 students each. The lecture sections are two hours long. The laboratory sections are two hours long. Each student is required to enroll in a lecture section, a computer laboratory section, and an instrumentation laboratory section. In addition to homework and laboratory reports there are three teaming events. The first one occurs during the first week and has teams of four students building a bridge using K'Nex pieces. The bridges are then tested to destruction. There are no labs the first week. The second event involves construction and flying of the airplane mentioned in the introduction. The third event requires designing, building and presenting a device using the knowledge they gained from the electrical portion of the course. The course was also qualified as the college's writing intensive course to meet the university's writing across the curriculum requirement [2]. The course outline for winter '05 is presented below.

EGR 190 Course Outline Winter Quarter 2005

Week	Subject
1	Bridge Building Competition
2	Engineering Art, E-mail and the Web
3	3D Art and Fundamentals of Flight
4	3D Art and Web Design I
5	Exam 1 and Web Design II
6	Instrumentation, Web Design III and Final Project Assigned
7	Circuits and Engineering Math
8	Exam 2, Timers and Flip-Flops and other IC's
9	Blinky and How Things Work
10	Stress & Strain and Ethics, and Presentation of Final Projects

Each lecture period is made friendly and inviting using some interesting techniques. Prior to lecture the room lights are dimmed and popular music is played. The latest news from Google or CNN is projected on a pull down screen and an aromatic candle is lit. When lecture starts the music fades and the news changes to the day's subject. The lights are kept dimmed unless they are needed for a physical demonstration or student participation. Student participation in small groups is periodically called for to solve examples from lecture. Each lecture is presented in two parts. One involves content that focuses on the computer lab and the other on the instrument lab. A ten minute break is taken at the half way point at which time the music is turned back up. The

students are invited to introduce the instructor to the music they like. Sometimes special music is played to introduce lecture material. Futuristic space music is use to transition from 2-D to 3-D drawing.

The five computer lab and five instrumentation lab sections meet once per week. The computer lab consists of Pentium work stations running Windows XP Professional. One student is assigned per computer station. The instrumentation labs consist of ten work stations containing a Windows XP Professional Pentium computer integrated with an instrumentation package consisting of an oscilloscope, power supply, multimeter, and signal generator. In addition there are small tools, breadboards, interconnect wiring, a soldering station, and a collection of resistors, capacitors, integrated circuits, and LEDs. Two students are assigned per instrumentation station.

The computer lab exercises involve e-mail and web searching, designing an airplane wing, HTML scripting, MatLab, Excel, and statistics, and how things work as the writing intensive assignment. The instrument labs cover 2-D and 3-D drawing using TurboCAD and SolidWorks, use of lab instruments, circuit measurements on resistive circuits, and building and testing a multivibrator, decade counter, and flip-flop using integrated circuits. In addition, basic soldering is taught using a simple kit that contains a circuit board and LEDs. During the fall and spring quarters the students also build a temperature based radio frequency transmitter which is then flown using a balloon. It is not feasible to do this in the winter quarter because of erratic weather. Instead, there is a lab that covers stress and strain using an unopened soda pop can to which the students solder a bridge circuit and hook up to the instrumentation. The can is then opened and the output of the bridge recorded. All of the laboratory requirements are available to the students on the program's web site [3]. The course instructor manages the site.

Homework is given using the course text book [4]. Reading assignments are made and homework is expected by lecture time each week. There are no lectures based upon the text. The students are expected to read and study the text material on their own. They are encouraged to study together and some of the homework requires student interaction. All homework must be done using MS Word. Grading is done by the GTAs.

There are two in-class exams and a final exam. The first exam covers engineering drawing. The second exam covers statistics and web page design using HTML, and final exam involves instrumentation, resistive circuit analysis, and flight. This is a graded A thru F course. A passing grade means they have attended the lectures, performed the lab assignments, completed homework and projects and actively participated in the course. Labs are 20%, projects 30%, homework 15%, exams 10% each, and participation 5%. The writing intensive component is graded pass-incomplete. Homework is not an option. All homework must be turned in to receive a course grade. Attendance is strict. If a student has two unexcused absences in lecture or two labs they fail the course. The maximum absences unexcused and excused is three. Student progress is kept on-line using the university WEBCT program. A student can log on and check attendance and grades for homework, labs, and tests. The final grades are also available.

Results

The students responded well to the environmental setting in lecture. Most arrived early and there was lots of conversation. The instructor had time to personally interact with them and share opinions on the news. The students were careful to introduce appropriately worded music and appreciate it when the instructor explored different types. It took about two weeks before all of them were using MS Word for their homework. The GTAs did not grade anything handwritten.

The three teaming events were well received. Building the bridge the first week gave the students time to meet others and learn to work together. The bridges were built, tested, and rebuilt multiple times prior to the competition. During final testing there was cheering for the teams and lots of encouragement. The winning teams over the past two years had bridges that supported from 111 pounds to 132 pounds before breaking. Fifty pounds was the minimum weight to earn a "C", Seventy pounds a "B", ninety pound and "A". Grades were prorated based upon the actual weight achieved. Each team was photographed and their pictures placed on the programs web site. The winning team was treated to dinner with the instructor. The construction and flying of the airplane went well. The students looked forward to the event and participated with enthusiasm. The final project helped tie together four instrumentation lectures and labs. It also give the students practice presenting. Some of the projects were quite inventive in meeting requirements. Once, a singing fish "Billy Bass" was used with Christmas tree lights. As these simple solutions occurred, the requirements were tightened to require more originality. Almost all of the fall 2004 projects used timers and decade counters as part of the design.

Our experience with the labs was interesting. Some of the students were very versed in building a web page, but most did not have experience using HTML. This allowed them to fine tune their presentations. Several times the instructor was told by students how they appreciated the opportunity to develop their own web pages. The student response to the introduction of 3-D drawing with SolidWorks was enlightening. They grasped the concepts much faster then expected. As a result, the lab requirements were expanded to include a complex assembly problem. They had difficulty grasping what they were doing with resistive circuits. It required careful handholding by the GTAs to get the concepts across. The integrated circuit labs were also a challenge in wiring them up correctly. The detail required was a challenge for some to follow. The writing across the curriculum assignment based upon the how things work lab went well. Most of the students produced results that met the writing and lab requirements.

Overall the program appears to be helping in retention. As the course transitioned to include all freshmen, we experienced for the first time a freshman retention rate of 60% and as the course has been modified to its present structure the retention rate has increased to 69%.

References

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3. E&CS freshman web site, Internet: http://www.cs.wright.edu/egr190/start/ ,January 2005.

4. R. B. Landis, *Studying Engineering: A Road Map to a Rewarding Career*, 2d ed. Los Angeles: Discovery Press, 2000.

Biographical Information

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