

What to Introduce in Introduction to Engineering?

Fahmida Masoom, Abulkhair Masoom
University of Wisconsin-Platteville

Abstract

Approximately a decade ago, engineering educators at several institutions began introducing the concept of a freshman engineering or introduction to engineering course. Today there is hardly any undergraduate engineering program that does not require the freshman student to take such a course. With its large undergraduate engineering program the University of Wisconsin-Platteville (UW-Platteville) now offers 12-15 sections of a similar course entitled Introduction to Engineering every fall semester. Earlier assessments indicated that the course was generally well received, and several key issues were addressed. The issue at hand now, is the content of the course. Because of the wide range of background in math, science, and computing of our freshmen group, it is a challenge for any instructor to go in depth on any engineering concept without running the risk of losing those at the lower competency level and at the same time keeping the course interesting and challenging for those who are well into the advanced sequence. Faculty with varied backgrounds teaching the course are grappling to find innovative ways to fulfill the main objectives of the course, viz., retention, offer a better understanding of engineering disciplines, and prepare students well for the intended course of study. Nine years after the first offering of this course, it is time to reflect on what this course has accomplished, and the dilemmas faced by the instructors.

Introduction

Towards the end of the 1980s, engineering educators around the country began to tackle the issue of large attrition rates in undergraduate engineering programs by introducing the concept of a freshman engineering or introduction to engineering course. The idea was to teach basic college survival skills to incoming freshmen and introduce them to the different fields of engineering in order to help them make an informed choice about their future career path. Since this problem was common to most undergraduate engineering programs nationwide, this new teaching concept caught on very quickly and spread like wildfire across the nation's engineering schools. Today there is hardly any undergraduate engineering program that does not require the freshman engineering student to take such a course. UW-Platteville also joined the trend in the early 1990's. Initially, a pilot one-credit course was offered to one section of 40 students. It was well received among students and faculty alike. After much discussion and review, the three-credit Engineering Methods course which involved computer programming was dropped and in its place a two-credit Introduction to Engineering course was designed and offered to freshmen. With its large undergraduate engineering program, every fall semester, 12-15 sections of this course with an enrollment cap of 30 students are offered. Faculty from all engineering majors having varied

backgrounds, teach these classes. Earlier assessments indicated that the course is generally well received. Although several key issues are addressed every semester, with the changing circumstances, the contents of the course are continuously modified. Because of the wide range of background in math, science, and computing of our freshmen group, it is a challenge for any instructor to go in depth on any engineering concept without running the risk of losing those at the lower competency level and at the same time keeping the course interesting and challenging for those who are well into the advanced sequence. In addition, more recently, the pre-requisites for courses in existing majors like electrical engineering and industrial engineering, and new majors like software engineering and environmental engineering changed significantly. Faculty are grappling to find innovative ways to cover the pre-requisites as well as fulfill the main objectives of the course. The following is an account of what was tried, and based on assessments what may be implemented to keep up with the changing circumstances. The possibilities range from updating of the course periodically by adding and deleting time appropriate topics, to completely refurbishing the introductory course sequence using a different format.

How it Started

Landis³, as part of his NSF grant activity, ran a workshop in 1992 with faculty from several engineering programs around the country including one from UW-Platteville. The workshop identified five major themes as the focus of his project: 1) community building, 2) academic success skills, 3) personal development, 4) professional development, and 5) orientation. As per agreement, resource materials in support of these activities were developed at participating institutions throughout the following year. Like many other colleges an experimental course, as mentioned above, was developed at UW-Platteville. The group again met in 1993 to review course objectives and participate in a training workshop. Following a test run in Fall 1993, the college of engineering at UW-Platteville officially adopted the course in Spring 1994. As of Fall 1994 it is required of all engineering freshmen.

Goals and Objectives

The goals for the course is described in the program catalog as follows:

This introductory engineering course provides students with the opportunity to develop and improve their problem-solving ability, computer literacy and study skills in order to maximize their chances for success in their college careers and prepare them for the subsequent courses.

The objectives of the course include:

- § Introducing students to the engineering profession, and to show them that it is interesting, rewarding, worthwhile, and people oriented.
- § Helping students choose their major within engineering.
- § Helping students to develop basic computer literacy and learn tools which will be useful in future courses.
- § Introducing engineering and computational concepts such as statistics, error analysis, curve fitting, graphing, etc.

- § Introducing academic success skills such as study skills and time management.
- § Developing a spirit of camaraderie among the students, and a sense of identification with the engineering programs.
- § Improving the rate of retention in the engineering program.

With changing circumstances like improved computer literacy among the incoming freshmen, shrinking resources, and continued pressure to keep the number of credits required for graduation at a marketable level, the goals and objectives have not changed significantly, although the challenge of presenting the course has increased.

Original Course Structure

Introduction to Engineering was offered for two years in this original structure. It was taught as one two hour laboratory/discussion session per week. A part of the discussion session was used to deliver lecture and to provide a forum for disseminating information about campus resources, majors within engineering, and presentations by guest speakers.

Lectures covered topics on study skills, time management, problem solving in general, statistics, learning styles, careers in engineering, women in engineering, and ethics. A locally developed handbook and "Introduction to Engineering" by Wright were used as required texts. Two hour hands-on sessions were devoted to topics like word processing, spreadsheets, electronic mail, curve fitting, matrix algebra, etc. Some evening sessions were held during which a half of the freshmen class (per session) attended presentations by representatives from all engineering majors, campus resource/service areas, registration, etc. Then newly developed Engineering Instructional Center located in the engineering building with twenty networked PC's and projection facility was reserved during the assigned hours for these students. They worked on the main-frame or the programs on networked PC's to improve their ability and/or to get familiar with new communication and computing tools.

Students were required to submit a weekly journal (about one page) to the instructor. The purpose of the journal was to:(a) help improve writing skills,(b) communicate a problem that one experienced and could not solve, (c) provide a personal link between student and instructor, (d) provide the instructor with input about the topics presented or suggestions for additional topics. 10% of the course grade was assigned to interview one= advisor or a faculty member in whose class the student was enrolled. To complete this assignment the student was asked to:(a) schedule and keep an appointment with the faculty member, (b) come prepared to the interview with at least 12 questions, and (c)write a short essay (using a standard word processor) on what he/she learned from the interview.

Tours to all engineering department laboratories and the library were conducted so as to give the students a first-hand look at the facilities. Most of these tours were guided by upper-class students from the different engineering departments. In addition to attendance in class, students were required to attend five campus activities in order to become better acquainted with campus

life. As partial fulfillment for the requirements of the grade in the course, students worked in groups on an independent project from start to finish. They were required to make presentations during the last two weeks of the semester. During their project work students were encouraged to work together as a team and communicate with the instructor for guidance, suggestions, etc.

Students, instructors, and other faculty were all asked their opinions of everything covered in the course. Attendance was excellent due to the nature of activities involved in each session. The quizzes, assignments, and exercises were less demanding compared to the other courses they were taking concurrently. Overall, the students evaluated the assignments highly. They particularly liked the interaction with upper-division students as tour guides and resource persons for information on majors in engineering. Many indicated that they found it easier to ask these upperclassmen questions than to ask the professors. The students overwhelmingly liked the timely introduction to communication and computational tools and other resources provided as part of the course. They felt that they had clear advantages in other courses because of the exposure and knowledge of such important applications. At first many questioned the necessity of the weekly journal, but after a few weeks most indicated it was an excellent way for them to gather and organize their thoughts once a week. Most students who completed their interview of a faculty member found it to be a positive experience, in particular, finding that faculty have other interests besides academia.

Several areas were identified where improvements could be made. Because the classes were meeting only once a week contact between instructors and students were not enough to forge the desirable level of familiarity. Continuity of topics and discussion also suffered. Too many topics were being discussed to fill the two hour sessions resulting in poor attention spans among many students. Large evening sessions where guest speakers from major fields of engineering and campus resource areas were presented did not work well. Consequently, the general feeling was that the students did not get enough exposure of different engineering disciplines. The instructors were given leeway of picking independent activities such as design projects. The students enjoyed the experience, but spent too much time, quite a few getting overwhelmed. Another area that needed much improvement was co-ordination among instructors of different sections.

Present Course Structure

After two years of offering the course, based on the experience and assessment, some major changes were made. The latest modifications were made in fall 2001. Starting in fall 1996 the course is being offered as two one hour sessions per week. Class size was capped at 30. Evening or large sized halls are not used for lectures. A math co-requisite was added to ensure that the students were at similar minimum competency level. Instructors were asked to cover the main topics related to the course goals and objectives to remain in tune with ABET requirements. Topics such as ethics, discussion of engineering majors, team work, utilization of library and web resources, etc. were to be emphasized. Instructors having varied backgrounds in engineering disciplines and expertise are allowed flexibility as to how to cover the core topics. Some choose to have one project, some require two small group projects. Some of the approaches that worked

well include: one research project, and a second project involving design and construction. Last Fall students in a class were asked to write a research paper on past, present, and future expeditions to Mars, the Red Planet. For this five week project students were required to perform extensive literature review. The second project involved designing and construction of a bridge using only a limited amount of supplies. Size and weight limitations were specified. Many instructors incorporate a competition aspect to their projects. Another component which received good review is a second interview - students are required to interview a professional engineer in their chosen field, and submit a report detailing the interview. At least three lecture/lab sessions are devoted to providing an introduction to computer-aided engineering graphics. Again, individual instructors decide how in-depth they want to explore. Yet other changes are due to improved computer literacy level of the incoming freshmen. For instance, now students are asked to work on putting together a web-page of their own work group rather than working on assignments on word processing or e-mail, etc.

A survey conducted by the engineering advising office in spring 1998 targeted about 400 students who completed one of the two versions of the course- Introduction to Engineering. Clear differences exist in responses from students in the one credit vs. two credit version. One of the main goals of the survey was to learn if the instructors and the students had a good idea of the objectives of the course. A vast majority of the students indicated that they were well aware of the goals, and that they knew why this course was made mandatory. When asked to rank the topics in order of importance the responses were spread over a wide range. Such responses are expected due to the fact that the freshmen come to college with varied background and preparation. Topics like journal writing, literature search, library exercises were rated negatively. Instructors' responses suggested that better co-ordination was warranted. It also became clear that conscious efforts were to be made to include more discussions and presentations on different engineering disciplines.

In the spring of 1999 a survey instrument was developed based on the core ideas of previous surveys. Retention, choice of majors within engineering, and usefulness of the contents were the issues addressed. About 200 students who participated in the 1998 study were targeted. By the time they were responding to this survey they would have been at least second-semester sophomore students. Close to 26% had already left engineering following their first year in college. Fear of math and science courses or interest in other areas were cited to be reasons for exodus. Interestingly, this number is very close to the national average. More than half of the students agreed that the course helped them in their decision making. About 49% of the respondents said that they were continuing in the same engineering major as their original choice when starting out as freshman. The same number indicated that the course topics had no influence in their decision making. But about a third said the course topics were useful in some manner during the semesters that followed.

A major revision is currently being considered. The possibility of combining components from the two-credit Engineering Graphics course with the two-credit Introduction to Engineering course and offering it as a three-credit course is being explored. Apart from the benefit (from the

administration=s point of view) of lowering the total credit requirement for graduation by one credit, it is likely that it would be well received by students and faculty in this format. The graphics concepts could be directly incorporated into the design project making both aspects more meaningful to the students and worthwhile for the faculty. At the time of this writing however, a final decision on this or a target date of implementation has not been arrived at.

Conclusions

The instructors agreed that although extremely time consuming, it is a delightful experience for them. Surveys and end of semester evaluations suggested that it is reasonably effective. It was judged by the students to be a good introduction to the engineering profession as well as the university community. Changes are made almost every semester, but the basic content is repeated. Continued success of any freshman course depends on the amount of effort that must be put forth by the faculty each semester. The benefits to the students and the engineering programs far outweigh the extra burden carried by those faculty involved in the course.

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Biographical Information

FAHMIDA MASOOM is a Lecturer in the College of Engineering, Mathematics and Science. She graduated from the University of Rajshahi, Bangladesh with a B.Sc. Honors in Applied Physics in 1983. She completed her M.S. (1986) in Engineering Mechanics at the University of Wisconsin. Fahmida taught at Savannah State College in Georgia for two years before coming to UW-Platteville. Her research interests are in the areas of Digital Design.

ABULKHAIR MASOOM is a Professor in the College of Engineering, Mathematics and Science. He graduated from Bangladesh University of Engineering and Technology with a B.Sc. in ME in 1977. He completed an M. Eng in Mechanical and Aeronautical Engineering at Carleton University, (1980), and M.S. (1982), Ph.D.(1987) in Engineering Mechanics at Wisconsin. Abulkhair taught at Savannah State College for three years before coming to UW-Platteville. His research interests are in the areas of Applied Mechanics and Mechanical Design.