

Introductory Course in Engineering Technology: Evolution of Course Content and Resulting Student Opinions

Daniel K. Jones¹, Daniel M. Chen², and Albert Peng²

¹Department of Mechanical and Industrial Engineering Technology, Institute of Technology, State University of New York, Utica, NY 13504

²Department of Industrial and Engineering Technology, Central Michigan University, Mt. Pleasant, MI 48859

Introduction

Introductory courses in engineering technology (ET) have been added to many programs so that entry-level students gain exposure to ET early in their college experience. Many ET programs face the common challenge of recruiting and retaining qualified students. At the same time, substantial portions of the incoming students lack basic skills in math and science that are needed for them to succeed in ET. Consequently, some introductory ET courses teach basic math and science while exposing student to career opportunities in ET.

This paper discusses the experience of faculty teaching Introduction to Engineering Technology, IET 120, over the past seven years. The course has gradually shifted from a pure lecture format to incorporate hands-on activities, plant tours, and design-and-build projects. A questionnaire was developed to assess the effectiveness of the changes in the course. The goal was to continue improving the course during consecutive semesters, based on the feedback from students.

Background

For the past seven years, freshmen and transfer students who are entering ET at Central Michigan University (CMU) have taken a three-credit course entitled Introduction to Engineering Technology, IET 120.¹ The objectives of IET 120 were to expose students to the fields of electrical, manufacturing, and mechanical ET and to provide them with some basic skills to help them succeed in these majors.

For entry-level courses, the conventional hour-long lecture has not been an effective method for maintaining student interest. Consequently, many professors realize that they must use new techniques to reach the current student population.² In some cases, the teaching techniques that are most effective are dramatically different than the techniques that professors were exposed to when they were students.

Course Content

IET 120 was developed as an entry-level course for freshmen and transfer students interested in engineering technology. The objectives were to introduce ET curriculums and majors offered at CMU. An overview of the engineering world was presented with a technologist's perspective. Students also learned same basic skills and knowledge required to pursue an ET career.

Several texts are in print for introductory ET courses,^{3,4,5,6} but none of them was a good match for the programs available at CMU. For IET 120, a text was selected to teach basic technical skills, such as measurement systems and applied mathematics.³ This text was supplemented by lectures in plastics, electronics, mechanics, CAD, and manufacturing. Whenever possible, lectures were provided by instructors that specialize in the particular area. After the lecture, students toured the corresponding ET laboratories.

Over the past three years, the course evolved to incorporate more hands-on activities, more laboratory work, and less lecture time. The grading policy reflected these changes, as shown in the Table 1. These changes were implemented to emphasize active learning during class. Less emphasis was placed on the passive learning techniques of lecturing followed by homework and tests.

Table 1. Portion of Grade (%)

Item	Spring 1999	Spring 2000	Spring 2001
Assignments, Projects, and Quizzes	30	40	60
Mid-term Exam	30	30	20
Final Exam	40	30	20
Total	100	100	100

Each semester, design-and-build projects were assigned to give students hands-on experience working in small teams. Cardboard boat races⁷ were held during the Fall semesters, and bridge-building contests were held during the Spring semesters. These contests were organized by student officers of the SAE and SME clubs at CMU. Student members of the SAE and SME clubs also participated in the design-and-build projects. Their involvement proved to be very inspirational for the IET 120 students. The projects culminated with competitions, and winners were awarded gift certificates and free memberships to the clubs.

Student Surveys

The instructors were initially apprehensive about these changes in the course content and format. Coming from rigorous engineering backgrounds, the instructors viewed this "game-playing" as foolish distractions from the technical skills that students must learn. The instructors were reluctant to sacrifice technical content in order to provide motivation and inspiration. In order to assess the response of the students, surveys were administered toward the end of each semester.

During the Fall and Spring semesters for the past three years, each student completed an anonymous questionnaire, providing information about their skills and interests, effectiveness of the course, and perceptions about ET. The survey was designed to quantify the various course attributes via multiple-choice and numerical responses to a series of thirty questions. In addition, students completed standard opinion surveys near the end of each semester, recommending improvements for the course content and delivery methods.

Numerical results have been tabulated in a series of spreadsheets, and written responses have been summarized. Although the trends in students' opinions have been difficult to quantify numerically, the results have been very useful from a qualitative perspective. This paper focuses on the short-essay responses by the students; this portion of the surveys proved to be most useful in assessing the opinions of hands-on activities.

Despite the very diverse backgrounds of the students, several common themes emerged. Students wanted much less lecture, more tours of industry, more hands-on work in the laboratories, and more design-and-build projects. Students particularly enjoyed the design-and-build competitions. However, they did not enjoy returning to the lecture format at the end of the semester.

Another popular activity was a plant tour of a local manufacturer of electric motors. This tour was conducted toward the end of each semester, after covering the fundamentals of electronics, mechanical, manufacturing, and plastics technology. Students enjoyed seeing the direct relevance of material covered in class.

Advantages of Hands-On Activities

The most obvious results were the instructors' observations of students participating in classroom activities. While lecturing to a class, it was very apparent when some of the students were not paying attention or falling asleep. In general, the attention span of freshmen was less than that of upper-level students. The authors have speculated that this was due, in part, to the fact that freshmen did not understand the context in which the technology applied. A goal of IET 120 was to give the students a grasp of "what" and "why" engineers use science and mathematics. This, in turn, would motivate them to study science, mathematics, and engineering with more enthusiasm.

Instead of passively sitting in class, students took on an active role in the learning process. Their behavior indicated that hands-on group activities inspired students to interact closely with each other, instilling teamwork skills that are vital for careers in industry. Laboratory work was effective at bringing together students of diverse backgrounds, skills, and interests. Students learned from each other, and they were much more likely to ask questions.

Recommended Changes

Due to the current structure of the ET curriculum at CMU, IET 120 is a three-credit course. A lecture portion must be retained, but lecturing for more than a half-hour is ineffective for most students. A more effective delivery would result from changing the pure three-hour lecture format to a lecture/laboratory format. This would also help to schedule a reasonable number of students in each section with adequate laboratory facilities.

Students enjoyed the laboratory tours; many viewed them as pleasant breaks from pure lecture. Many students commented that they wanted more demonstrations and hands-on use of the equipment. This could be facilitated by small-group laboratory assignments that could be completed within one week. By focusing these assignments in electronics, manufacturing, and mechanical areas, students might gain a better feel for their interests.

Many students stated that they became tired of hearing the same professor every lecture. A team-teaching approach would help to introduce the students to other faculty members and to expose students to different perspectives. Recently, the lab tours, design projects, and plant tours were directed and supervised by student members of the SAE and SME clubs, graduate students, and volunteers from industry. Although this mentoring was provided at no additional cost, these activities needed to be monitored by faculty to be effective.

The recommended changes may require additional laboratory resources and higher faculty-to-student ratios. The authors believe that the higher costs associated with these changes will be eventually offset by increased retention. At CMU, supplies for several of the design-and-build projects were purchased using student retention funds.

In the past, the design-and-build projects occupied three to five weeks of a fifteen week semester. Groups were given freedom to complete the projects as they saw fit. An advantage of this approach was that students learn to work under time constraints, but students overwhelmingly felt that this was an insufficient amount of time. Intermediate deadlines would help to keep the teams on track. If more time was allocated for these projects, students could be required to produce a more detailed design, using hand- and/or computer-drawings, before the teams began the construction phase. The project duration could be extended to six or eight weeks. Although this would sacrifice some of the technical breadth of the course, it may be more likely to inspire students to pursue ET careers.

Conclusion

Over the past three years, enrollment in IET 120 has grown from 24 to 57 students per semester. This growth in enrollment, however, may not be entirely attributed to the changes discussed in this paper. During the same period of time, the enrollment capacity was increased, and the class meeting times were changed to better suit the students' schedules. Quantitative data on recruitment and retention statistics is currently under investigation.

During the initial years of teaching IET 120, the instructors were reluctant to include hands-on projects, primarily because they detracted from the technical content. However, observations of students during design projects and plant tours have convinced the instructors otherwise. The anonymous, hand-written responses from students proved to be a very useful form of feedback. The responses indicated that students approved of the recent changes in course content, and they generally wanted to see more dramatic changes in the same direction. Ongoing changes in IET 120 are needed to continue accommodating the new students entering the field of engineering technology.

Acknowledgement

The authors would like to thank Prashant Sopory and Xin Zhang for compiling and summarizing the results of the student surveys.

Bibliography

- ¹Peng A, Chen D, and Jones DK, "A New Freshman Course for Engineering Technology Majors," Proceedings of the ASEE North Central Section Annual Meeting, Erie, Pennsylvania, April 1999.
- ²Chautauqua Short Course, sponsored by the National Science Foundation, "Enhancing Student Success through a Model Introduction to Engineering Technology Course," University of Dayton, Dayton, Ohio, April 26-28, 2000.
- ³Pond, Robert J., Introduction to Engineering Technology, 4th Edition, Prentice Hall 1999.
- ⁴Cheshier, Stephen R., Studying Engineering Technology: A Blueprint for Success, Discovery Press, 1995.
- ⁵Hawks, Val D., and Strong A.Brent, Introduction to Engineering Technology and Engineering, Prentice Hall 2001.
- ⁶Holtzapple, Mark T. and Reece, W.Dan, Foundations in Engineering, McGraw-Hill 2000.
- ⁷Jones DK, "The Cardboard Boat Race: Introducing Freshmen to Engineering Design," Proceedings of the ASEE North Central Section Annual Meeting, East Lansing, Michigan, March 2000.

Biography

DANIEL K. JONES, Ph.D., P.E., is currently an assistant professor at the SUNY Institute of Technology in Utica, NY. He received a Ph.D. in Engineering from the University of Pittsburgh, and B.S. and M.S. degrees in Mechanical Engineering from Pennsylvania State University. He is a member of ASME, ASEE, SAE, and SME. Dr. Jones taught IET 120 for three years, and he served as the faculty advisor for the student SAE/SME club.

DANIEL M. CHEN, Ph.D., P.E., is currently a professor and chair of the Department of Industrial and Engineering Technology at Central Michigan University. He was an instructor for IET 120. Dr. Chen's primary teaching responsibilities are in mechanical engineering technology and computer-aided design. He is the author of the Applied Kinematics Worktext, published by Prentice Hall.

ALBERT PENG, Ph.D., is currently a professor in the Department of Industrial and Engineering Technology at Central Michigan University. He received M.S. and Ph.D. degrees from Case Western Reserve University in Cleveland, Ohio. Dr. Peng was the founder of IET 120 at CMU, where he taught the course for several years. His primary teaching responsibilities are in the area of electronic engineering technology.