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Introducing Engineering Technology Programs to all Incoming Freshman Engineering and Technology Students – The result is better for all

Abstract

The Department of Engineering Technology at Old Dominion University participates in a freshman engineering course sequence, along with four engineering departments in the Batten College of Engineering and Technology. The two course sequence, Exploring Engineering and Technology I and II, involve the five departments in teaching at least one five week module in each of the two courses. Each department generally involves the students in a basic design project related to its discipline. Since the Department of Engineering Technology has three main programs – Civil, Electrical, and Mechanical – it has elected to divide its five week segment into three parts to introduce the students to each of the three programs in the department.

The short time available to each program has presented some unique challenges in giving the students a meaningful experience in each program. This paper presents these challenges and how the programs within the department addressed them. The freshman course sequence has provided an excellent opportunity for the Department of Engineering Technology to provide the undecided (and, at times, the previously decided) engineering students with a viable alternative to the engineering programs. It exposes all freshmen engineers to the attributes of engineering technology education and employment opportunities.

Introduction

Retention of engineering students has become a major undertaking for most institutions with engineering programs. Much of this retention effort is taking place at the freshmen level, where dropout rates have been the highest. Institutions are developing innovative ways to maintain interest of freshmen students in their disciplines and the desire to continue.^{1, 2, 3, 4, 5, 6}

Old Dominion University is a comprehensive Ph.D. granting institution located in Norfolk, Virginia. The Batten College of Engineering and Technology houses four engineering departments, an engineering management department and the engineering technology department. The departments are somewhat autonomous with very few shared courses. However, common to all undergraduate curricula are two credit freshman engineering courses, Exploring Engineering and Technology I and II. These courses were instituted by the dean in the late 1990's to help stem the fairly high attrition rate of the engineering programs. At the time, each of the engineering technology programs (civil, electrical, and mechanical) had their own freshman course of two credits and didn't really want to change. This change would add an additional two credits to the curriculum which, under university guidelines, would mean that two credits would have to be dropped elsewhere in the curriculum. Additionally, while the undergraduate engineering programs were four-year programs, with ninety percent of their students starting as new freshman, the four year engineering technology programs received a

large majority of its students through transfer from two-year schools at the junior level. At that time, each program might have ten freshman, twenty sophomores and seventy juniors. The department didn't see a need to worry about attrition of such a few freshman students. The change was implemented for all departments, but not without some kicking and screaming from the engineering technology faculty.

The design of the two courses involved all of the departments, even those (aerospace and engineering management) that were graduate programs only. The original concept was to have all departments teach at least one five-week module in one of the two courses. This module is repeated three times to different students during a semester. Since the inception of the two courses, the two graduate programs phased out their participation in the course, but the Aerospace Department is interested in returning.

Course Structure

The two courses are not designed as build-on courses. In other words, Exploring Engineering and Technology I is not required as a prerequisite to Exploring Engineering and Technology II. Each course is designed to introduce its students to at least three of the six engineering/technology disciplines. Thus by taking both courses, students are exposed to all disciplines within the college. As aerospace and engineering management phased out, the students are now exposed to some disciplines more than once (but not the same presentation). Students enter the Batten College of Engineering and Technology freshman program as "discipline intended" with many undecided when they enter. Students are encouraged to take both freshman courses before they make a decision and declare their major.

The Department of Engineering Technology was originally assigned one five-week module in the second course, Exploring Engineering and Technology II, but now has an additional module in another section of the course. This means that all students taking the course will be exposed to an engineering technology module, approximately 130 per semester at the present time. Since the Department of Engineering Technology has three programs (disciplines) the first five-week module is subdivided into three groups of approximately twelve students each. Each of the engineering technology programs will have the students for three class periods of one and one-quarter hours. The three groups of students will rotate to be exposed to all three disciplines. After the five-week period, the entire group of 36 students will rotate to another discipline and another group of 36 will rotate into the engineering technology module. Each engineering technology instructor will teach his/her section nine times during the semester. The second five-week module is taught by a Civil Engineering Technology faculty member and involves the construction industry with a construction design project⁷. This module is taught to the entire group of approximately 36 students for the five-week period. The instructor repeats this module two more times during the semester.

Course Topics

As mentioned before, the major goal of the two freshman engineering course is to reduce attrition from the College, particularly at the freshman level. To accomplish this, all freshman students are introduced to the various disciplines using various design concepts and projects.

Since each engineering discipline has five weeks, most have developed design projects appropriate to their discipline that can be performed in groups in that period of time. This is also true of the second engineering technology module with a construction project. However, the first engineering technology module, where students are exposed to each discipline for only three class sessions, presents the unique challenge of providing a meaningful experience in such a short time. Each of the three groups is given a short explanation of the differences between engineering and engineering technology and opportunities for employment as engineering technology graduates. For most students, this is the first time they have heard about engineering technology, since many high school counselors have enough difficulty discussing engineering as a profession, with little or no knowledge of engineering technology. This is followed by a discipline specific hands-on project in some area of that discipline.

- The Civil Engineering Technology three-day session focuses on surveying one of the options in the CET program (Recall that a second module focuses on construction.). The students are instructed in basic leveling theory and how to operate a piece of basic surveying equipment. Three-to-four person teams conduct a field exercise, running a level-loop traverse on campus. Results are analyzed with respect to error causes and consequences. Grades for these portions are based on student participation.
- The Electrical Engineering Technology three-day session introduces the students to AC and DC Circuit Theory enough to build a virtual circuit to prove KVL and KCL and an AC to DC conversion circuit using Electronic Workbench. In this session, a large emphasis is also put on informing students about the differences between electrical engineering and electrical engineering technology, the history of electricity and technology, and hints on how to succeed in college. The student's grade is based on attendance and class participation.
- The Mechanical Engineering Technology three-day session introduces the students to gears. (The MET session will be discussed in a little more detail since the authors have taught in that session.) In the first session, students are provided information on the differences between mechanical engineering and mechanical engineering technology, professional registration and career opportunities for mechanical engineering technology graduates. Students are also given handout information and a lecture on mechanical gears. The emphasis is on the function of gears, including mechanical advantage, and various types and applications of gears. Students are assigned to bring in an example of gears-in-action, either through a working device or a picture from the Internet, to be presented at the second session. Students are informed of a test on the handout information which will be given at the second session. After the quiz in the second session, students then present their examples of gears-in-action to the rest of the class, explaining the example and its mechanical advantage. After their presentations, students are organized in teams of two and given LEGO DACTA 67 piece gear assembly kits. Each group is required to complete the two directed assemblies contained in the kit, including variations. They must demonstrate the operation of each assembly and turn in the calculated mechanical advantage of each assembly. During the third session each team is required to build a dual function assembly to accomplish two different mechanical advantages but without instructions. Students must rely on their

understanding of mechanical advantage and how the LEGO parts fit together, learned from their directed assemblies built the previous session. The students receives a numerical grade for this session based on the following distributions:

Attendance (5 pts/class)	15 points
Example of gear application	15 points
Directed assemblies (10 pts each)	20 points
Test	20 points
<u>Final Project</u>	<u>30 points</u>
Total	100 points

Average grades for this session of the class are currently between 80 and 85 points. In previous years, students were required to do projects individually, with some students being very adept while others struggled with the basic concepts. Average grades in those sessions were slightly lower, but a significant number of students had grades of 50 points or less. Teaming has helped the struggling students attain a better understanding of the fundamental operation of gears.

Results

The two freshman courses have been found to be an excellent avenue for attracting engineering technology students. While the engineering programs concentrate on providing a meaningful team design experience in their disciplines, they also promote career opportunities in fields related to their disciplines, the importance of professional registration and opportunities for graduate study. It is reasonable to expect that they also discuss the differences between engineering and engineering technology, though these differences may not be exactly the same as those expressed in the engineering technology modules. Because the first five week module for engineering technology is divided into three parts, making a complete design experience difficult, it concentrates on giving the students three hands-on experiences with some elements of design. There is also a strong element concerning engineering and engineering technology education and career opportunities as well as guidelines to being a successful student.

While the Department of Engineering Technology was not originally keen on participating in the freshman courses, the benefits have been tremendous. Because of the freshman students' introduction to engineering technology, many undecided students have opted for one of these programs. Also, several who originally wanted an engineering discipline, opted to change to engineering technology. In addition, many who start in engineering change to engineering technology at a later date because of the experience in these classes. This obviously increases engineering technology enrollment at the freshman and subsequently all levels, thus providing a stronger student body. One measure of this is the increase in enrollments in sophomore level classes. Enrollments in MET 200, Manufacturing Process, a course taken by only MET students has almost doubled, from 20 to 35, in the past five years. MET 230, Computer-Aided Drafting, and CET 200, Statics, which are taken by CET and MET students has had enrollment increases of approximately fifty percent during that same period. The benefit for the College is that since engineering technology is shown to be a viable alternative for engineering students, fewer students are migrating from the College to other colleges, such as the College of Business and

Public Administration. With these courses, and engineering technology's participation, retention of students within the College has increased considerably.

Conclusion

Universities can spend an enormous amount of time in recruiting good students by visiting high schools, community colleges, job fairs, etc. While the Department of Engineering Technology participates in recruitment efforts outside the University, it has found a great recruitment opportunity in its own backyard, the freshman course. We use some of our best faculty to teach in these courses and present engineering technology as a viable alternative to engineering. The authors recommend that if the opportunity arises for engineering technology programs to become involved in freshman courses involving engineering or engineering-intended students, they should seize the opportunity.

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