# Project Based Freshman Introduction to Engineering Technology Course

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## ABSTRACT

All engineering technology students at Middlesex County College are required to take MCT–101: Introduction to Technology, except Civil/Construction Engineering Technology students who take CIT-110: Introduction to Civil/Construction Engineering Technology. These courses have no prerequisites and requires students to work in teams of 3-4 on several projects over the fourteen weeks of the semester. Time is spent during the first week on team building skills and these skills are enhanced during the semester. During the semester, the students concentrate on a design project with a competitive and analytical component. All projects involve faculty and student assessment.

This paper guides the reader through the development of the course, its implementation and discusses the outcomes. Examples of the courses' projects are presented along with the assessment tools. The course outline will be discussed to provide an overview of all material covered. The paper will also present interviews with both students who took the course and the faculty who taught the course.

## INTRODUCTION

In 1994 the Department of Mechanical–Civil/Construction Engineering Technology at Middlesex County College began a comprehensive review of all of its courses in the Mechanical Engineering Technology and Civil/Construction Engineering Technology programs. The intent of this review was to enhance both programs by improving the interaction among students as well as interaction between faculty and students. Classes in the past were typically conducted by the professor who expected the student to sit, listen, then go to the lab and perform a lab experiment that was designed to complement the lecture. Students were graded on their individual performance on exams, quizzes, homework and lab reports. Some attempts were made to get students to work in groups by assigning lab partners and asking them to submit a group lab report for which they would receive a group grade. However, the students were not evaluated on how well they worked as a team. All this was about to change.

The department faculty who teach the Civil/Construction Engineering Technology courses began a three-year project designed to develop and implement changes to all of the programs' courses. They would use cooperative and activity based learning and embraces a just-in-time approach to the delivery of instruction in the related areas of writing, computer applications and use of a calculator (TI-85). The strategy was to include these learning techniques and delivery method starting in the first semester by introducing a new course; "Introduction to Civil/Construction Engineering Technology". This new course was developed using a modular structure. In order to develop a module, the faculty first researched competencies related to the fundamental skills needed by an engineering technician. This was accomplished be reviewing industry standards,

provided by civil and construction engineering companies, discussion with industry representative working as technicians and employers who have hired our students. These competencies were grouped into clusters to make up the competencies that were used in the development of a module.

**CIT-110 Introduction to Civil/Construction Engineering Technology**

The introduction to Civil/Construction Engineering Technology course was offered for the first time in the Fall Semester of 1997. The course has no pre-requisite however, the students needed to demonstrate a proficiency in High School Algebra I by passing the Colleges' placement exam, required for all entering students.

The course meets twice per week each for eighty minutes but there is no formal lecture or lab. The class meets for a studio session in which there will be any combination of lecture, activity, experimentation or discussion.

The students are divided into teams and are told that they will work in groups during this course as they will during the professional careers. The instructor discussed the team responsibilities and identified the roles of the team members; the facilitator, the recorder, the presenter and the taskmaster. These roles are rotated among the team members as projects change.
The course is divided into topic modules each providing introductory material along with an application and/or a design project.

The first instructional module was developed to get the students to work as a team. The faculty member treated the class as a new group of technicians hired to work as part of a design team. A discussion of their responsibilities as engineering technicians and the responsibilities of an engineer was held prior to the assignment of the project. The application project was designed to have the students:

- Connect the components of a computer and install an application software package.
- Use Windows to create directories and copy and move files
- Use word processing software to create memos
- Use of e-mail

The student teams were provided with the manufactures connection instructions, the software installation package, a simple "getting started" with Microsoft Word instruction sheet and an e-mail instruction sheet. This provided the student with the background needed to complete the project, but not specific step by step instructions. The faculty member providing assistance and guidance to the students by walking the room but did not instruct the students. Upon completing the project, each sent a memo type progress report to the instructor by e-mail. Each of the instructional modules follows this same format.

Module II was designed to introduce the students to orthographic projection and scales. The application project was designed to have the students:

- Read simple survey, site, foundation and floor plans and elevations
- Sketch, using pencil and grid paper, steel framing and floor plans
- Use a blueprinting machine

Actual building plans were used in class and students prepared site plan sketches of their house.

Module III was designed to introduce the students to bridge structures. The application project was designed to have the students:

- Identify bridge structures: Beams, trusses, frames, and suspensions
- Identify structural members: Tension, compression (long and short) bending, shear and twisting and explain their function.
- Identify methods of joining truss members

Field trips to near by construction sites and to the Brooklyn Bridge were used to meet the objectives of this module.

At this point in the course, the teams of students began working on their competitive bridge truss design project by completing a full-scale layout and planning the balsa wood construction. They were provided with specifications for the competition. The competition will take place during the last week of the semester.

Module IV was designed to introduce the student to special usage of a graphing calculator (TI85 or TI86). The project was designed to have the student:

- Use the simultaneous equation operation
- Use the Solver operation
- Store frequently used equations for areas and volumes and recall them when required for an application
- Use trigonometry functions in surveying applications

Actual building planes were used for students to calculate room areas and concrete volume needed for a patio.
The solver operation was used to calculate beam deflections.
Surveying drawings were used for trigonometry applications.

Module V was designed to introduce the student to a variety of measuring instruments. The project was designed to have the students:

- Use a micrometer and vernier caliper
- Use weight and mass scales
- Use a multi-meter for measuring resistance and voltage
- Use a clip-on meter for measuring current
- Demonstrate knowledge of errors associated with taking measurements

Actual structural sections were measured and students were asked to identify the sections.
Multi-meter was used to measure voltage at a panel box.
The multi-meter was used to measure the resistance of a house hold toaster and its current flow was measured with the clip-on meter.
Each team collected date and an error analysis was performed to identify gross, systematic and random errors.

Module VI was designed to introduce the student to research. The project was designed to have the student:

- Use the college library to research a variety of topics
- Use the Internet to research a variety of topics

Th faculty prepared a list of topics that the students needed to research. They included local highway projects, building collapse, construction safety, commercial building construction techniques, etc. Each team reported their finding by e-mail.

Module VII was designed to introduce the student to engineering ethics. The student teams were asked to read NSPE case studies, write memos with their opinion and be prepared to discuss it in class.

A video titled "True Steel Affair" was viewed by the class and each team discussed the case prior to viewing the conclusion of the video. There are many NSPE case studies to choose from and a variety commercially available videotapes depicting ethical case studies.

Module VIII was designed as a competition. Each team of students build a balsa wood truss bridge that spanned 24 inches and could not exceed 6 inches at its widest point. Each truss was evaluated by the department faculty for overall design and workmanship. Each truss was weighed and then subjected to a gradually increasing load, applied to its mid span until it failed. The team with the highest breaking load to weight ratio was declared the winner. Videotape of the competition is available.

**ASSESSMENT**

The students performance was evaluated as follows:

- Quizzes 25% (one per module)
- Written memos 15% (one per module)
- Team function 15%
- Bridge Competition 20 %
- Final exam 25% (comprehensive)

The most difficult assessment for the faculty member was to team function. This assessment was base on the observation by the professor of the teams performance throughout the semester. Students tend to cover for the shortcomings of other team member. Unless there was open conflict or lack of participation by a team member, it was difficult to assess the team performance. It was necessary for the professor to maintain accurate notes throughout the course to determine how well the team organized itself, recorded and presented information and met deadlines so that a fair assessment could be made of team function.

**FACULTY INTERVIEW**

Professor Raymond J. Nolan taught the course this first time, he commented "This was the most pleasing educational experience I have had in years, but it was also the hardest course I have ever

taught." He went on to state "I was constantly preparing, assessing, and evaluating. I know the students enjoyed the hands-on activities, the construction site visit and bridge tour. I could not believe the number of students who never visited a construction site." When asked how the course could be improved he stated "The project need more work, some are too short and others too long."

## STUDENT INTERVIEW

Many students interviewed stated, "this was the best course I have had in college". When asked what was the best part of the course, it was unanimous "the bridge competition." Other went on to state that they enjoyed the hands-on activities and the use of the computer. When asked what was the worst part of the course most had no comment but four students out of 16 stated they did not like working as a team member.

## CONCLUSION

My assessment of the course was that it was a success. A strong bond was developed between the students. New learning styles were used. The students come away from the course with a clear understanding of the function and responsibilities of an engineering technician and a working knowledge to the tools needed to succeed in the profession.