Session 2586

# Promoting Engineering Sense in the Civil Engineering Technology Education

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## ABSTRACT

The Engineering Technology profession is more sensitive to the new changes in the engineering practice. The engineering technology programs in general and the civil engineering technology program in particular are not responding well to the demand in the engineering market. This causes the gap between the education and the engineering industry to widen continuously. The new ABET Criteria was a step in the right direction but was too little too late. What was accepted in the 1970s may not be accepted today as far as civil engineering technology curriculum is concerned. The civil engineering technology industry changed drastically lately while the civil engineering technology education changed a little. Five-year study at Gaston College of the Civil Engineering Technology two-year program will be presented. The study will focus on the factors affecting the survival rate, student academic performance, initial salary, and the waiting period before getting the first job after graduation.

Techniques and procedures to enhance creative environment in the civil engineering technology program will be discussed. Reforming math and science courses in the engineering technology curriculum became a necessity to help engineering technology graduates survive with the new challenges in their careers. North Carolina statewide completion study for the Civil Engineering Technology program will be presented. The study shows the survival rate of the students in the engineering technology program. Several factors affecting the survival rate in the engineering technology program will be discussed.

## INTRODUCTION

One of the most important objectives of technical institutions is to provide a sufficient number of quality engineering graduates economically and within reasonable time. Another goal is prepare graduates for professional practice with good marketable skills in the competitive engineering market. To accomplish some

of the main objectives of engineering education, continuous evaluation of the curriculum will be needed. The engineering educators usually prepare engineers and technicians to become productive professionals in the engineering market, but, unfortunately, the engineering market is moving at faster rate than the engineering education. This ultimately puts pressure on the engineering educators to improve courses and curriculums at a faster rate.

Another approach to address this issue is to understand the problems and the challenges the students are facing with the new emerging technologies [1]. The teaching techniques should change accordingly in order to have better use of the allocated instructional time. Some of the recognized problems at the two-year level institutions can be summarized as follows:

a.) General weakness in Math/Science fundamentals
b.) Relating Math concepts to practical engineering problems
c.) Low graduation rate
d.) Wide range of students' backgrounds, students' priorities, and even age groups
e.) Teaching methods to keep students motivated

## CIVIL ENGINEERING TECHNOLOGY STUDY

A five-year civil engineering technology study at Gaston College in North Carolina was performed to have better understanding of the new challenges facing the engineering educators. The study spans the years 1996 to 2000. The study focused initially on the importance of the Coop work experience and its role in solving some of the problems facing engineering education. Table 1 shows a summary of the findings within the five-year span.

Table 1: Summary of the five-year study at Gaston College- Civil Engineering Technology

| Year | Academic Performance, % | | Average Salary Increase % | Average Waiting Period | |
|---|---|---|---|---|---|
| | With Coop | Without Coop | | With Coop | Without Coop |
| 1996 | 18 | 7 | 16 | 1.2 | 3.6 |
| 1997 | 3 | 9 | 21 | 1.6 | 3.0 |
| 1998 | 21 | 5 | 0 | 0.8 | 2.3 |
| 1999 | 13 | -7 | 3 | 0.9 | 1.7 |
| 2000 | 23 | 16 | 38 | 1.1 | 3.5 |

The academic performance percentage is calculated based on the student GPA of the second year compared to the first year, taken as percentage. Usually the student will be eligible to register for Coop work experience in his/her second year, or after he/she finished about 50% of the courses required for graduation.

Figure 1 shows graphical presentation of the academic performance differences. One can notice that the student who is taking Coop usually improves his academic performance. The reason for that is that the student will have better understanding for the need to learn concepts and fundamentals related to his/her Coop work. Also the student will understand the practical value of the lectures and labs that motivate him/her to spend longer hours studying and preparing for class work, at the same time preparing for a job after graduation.

Figure 2 shows the salary increase, expressed as percentage, of recent graduates with Coop experience compared to students without Coop work experience. It is important to mention here that most students with Coop experience get at least an offer for a job by the Coop supervisor. Most of the potential employers in the southeastern region of the state of North Carolina prefer a civil engineering technology graduate with some experience. Most potential employers prefer to offer a job to someone they already know personally.

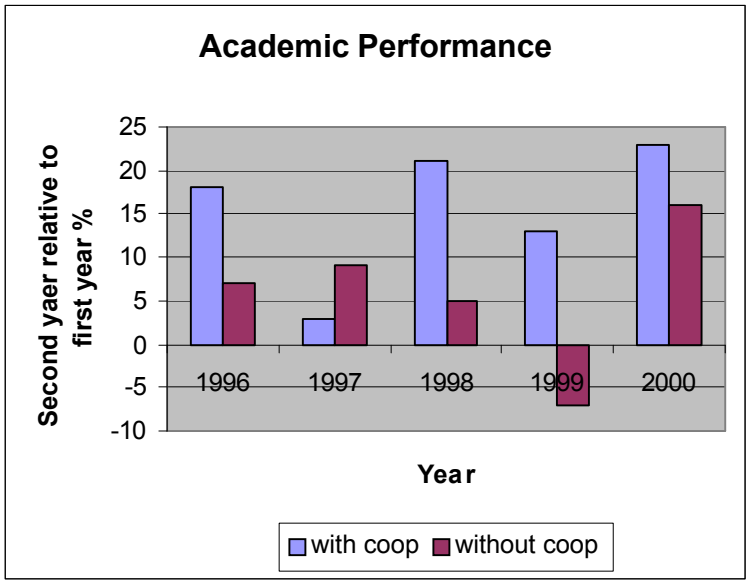


Figure 1: Academic Performance

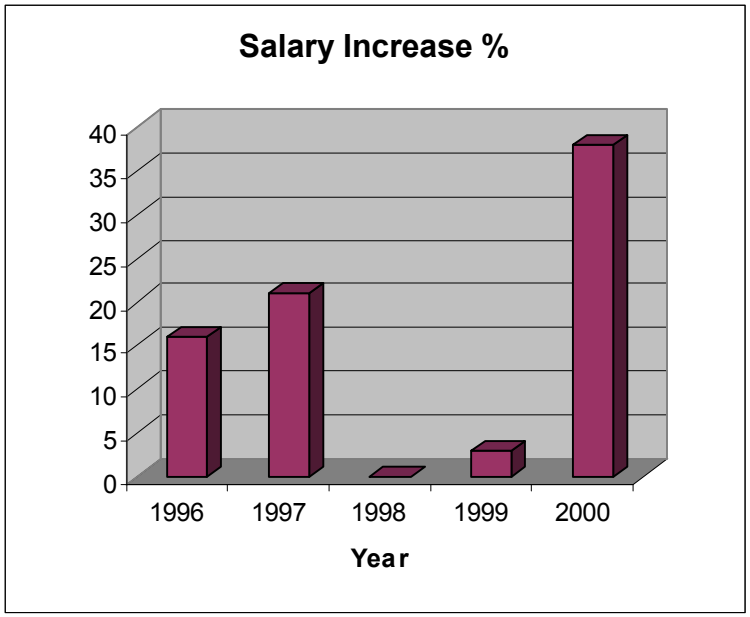

Figure 2: Relative Salary Increase of Graduates with Coop

Figure 3 shows the difference between students with Coop experience and students without Coop experience, as far as the waiting period is concerned. The waiting period here is calculated as the average number of months a graduate waits to get his/her first full-time job in the field after graduation. One can notice that the student with Coop experience gets his/her fist job in the field sooner than the one without Coop experience. It is important to mention here that the civil engineering technology graduate with an AAS degree from Gaston College does not have to relocate to get his/her first job, and he receives it within a relatively short period of time.

**NORTH CAROLINA STATEWIDE COMPLETION STUDY**

Statewide completion study for the Civil Engineering Technology program was performed [2]. The study shows the low survival rate due mainly to high dropout rate and financial and academic difficulties. The results of the study are summarized in Table 2. Math and science courses required to satisfy ABET re-accreditation usually cause some delay in student graduation and some times cause student to drop out or change majors.

Table 2: NC Statewide Curriculum Completions

| Major Hours Completion | % Complete |
|---|---|
| 0 – 6 | 38% |
| 7 – 12 | 11% |
| 13 – 24 | 18% |
| 25 – 36 | 11% |
| 37 – 48 | 10% |
| 48 – up | 12% |

Figure 4 represents the completion rate, expressed as percentage, at different

ranges of major hours completed in the civil engineering technology program. The percent complete takes the trend of decreasing as the major hours completed increases. The graduation rate can be roughly calculated as 11.9% of the total number of students initially enrolled the civil engineering technology program. The same study was performed on the surveying technology program. The results of the surveying technology program are quite similar to the results of the civil engineering technology program.

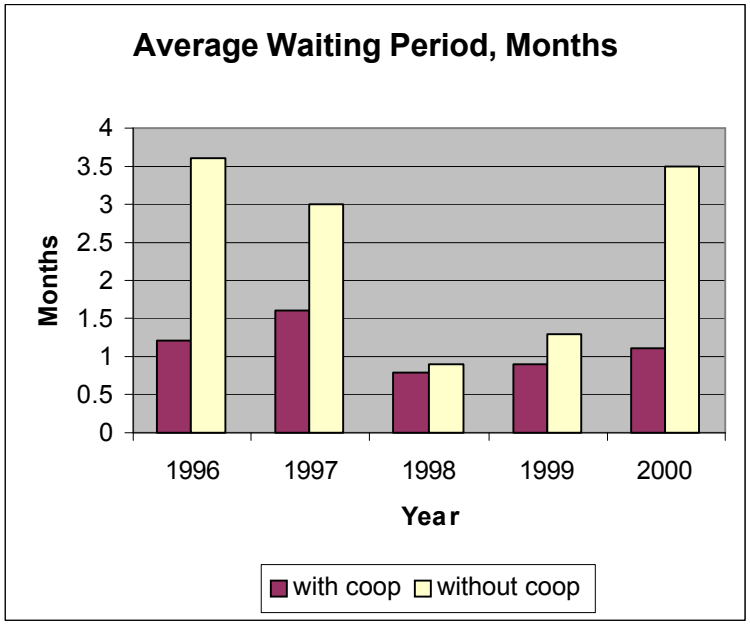


Figure 3: Average Waiting Period for the First Job

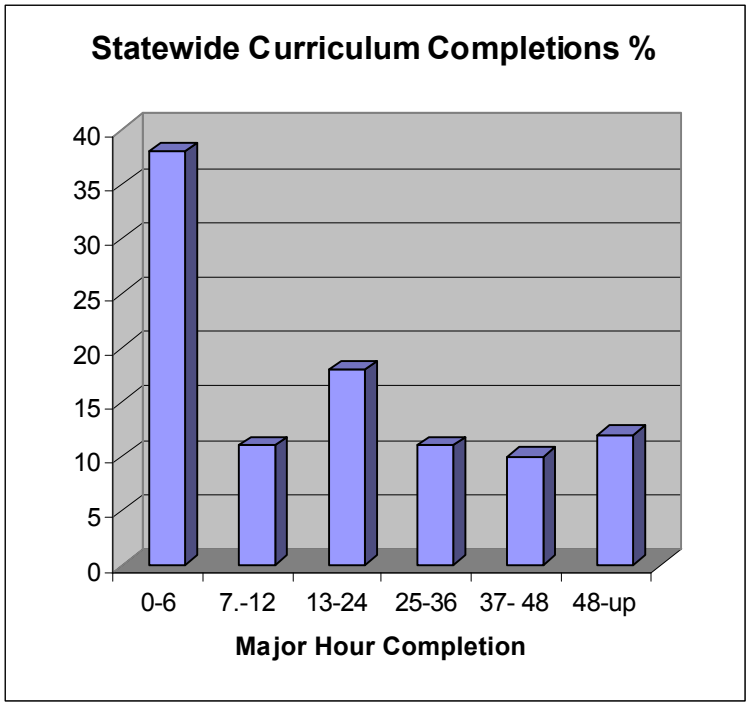

Figure 4: NC Statewide Study, CET Program

## SUGGESTED TECHNIQUES TO ENHANCE CREATIVE ENVIRONMENT

One of the most critical elements in teaching an engineering course is to make students interested in learning and participating in the teaching/learning process. A student can learn better if he/she is interested in the subject. Students' active participation creates a productive and creative learning environment. Teaching engineering course should be different from teaching other courses since engineering courses prepare students to face the highly demanding engineering market. Team projects along with lectures and labs are proven to be very effective. The following are suggested points to be considered in dealing with class team projects:

1.) Encourage team skill building.
2.) Encourage each team to elect a team leader to be responsible for team communications and co-ordinations.
3.) Encourage competition among groups by setting up clear criteria to judge each group work. Introduce incentive, such as extra credit, for meeting higher standards.
4.) Reduce communications among groups to none if possible.
5.) Provide efficient procedure to control the presentations of the teams.

6.) Provide clear evaluation procedure by the instructor, other teams, and peer evaluations.
7.) Provide clear procedure about dispute resolution among team members and among teams.
8.) Emphasize communication skills.
9.) Encourage students to collect data and information from wide range of resources.
10.) Encourage students to ask other college professors some prepared specific questions related to the project.
11.) Encourage students to make engineering decisions and defend their decision.

Working on real life projects under construction or in the process of developing makes students appreciate the practical value of the theory taught in the classroom. This makes the teaching/learning process more productive. In addition, assigning students to work on a real life project gives students opportunity to meet practicing engineers and potential employers.

## CONCLUSIONS

Coop work experience is proven to improve students' academic performance, at the same time helping them getting their first full-time job sooner. The Coop work experience provides the students with the initial engineering experience needed to understand the connection between the theory and the engineering industry. Another factor that often is ignored that the Coop work experience breaks the psychological barriers and enhances the self-confidence to produce useful professional engineering work. Also dealing with engineering firms and construction companies helps the engineering instructor upgrade his engineering courses and improve the curriculum.

A math instructor teaches math courses usually from a mathematician's point of view. The students have to take several math courses and learn large number of mathematical concepts, but relating these concepts to a real-life engineering problems is still a major difficulty. Reforming math courses to prepare students for engineering courses becomes an urgent need.

Having students involved in an active project improves the creative environment in the teaching/learning process. The students can participate in the studying of several feasible engineering alternatives and contribute to the engineering decision-making process. Class projects improve the students' communication skills.

## REFERENCES

1.) Alnasra, M., Application of Math Principles in Engineering, Frontier in Education, San Jose California, 1994.

2.) North Carolina Community College System, Civil Engineering Technology and Surveying Technology Study, Raleigh, NC

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