Attitude of Students Entering Engineering Technology Programs

Daniel Chen[1], Albert Peng[1], Daniel Jones[2]

Central Michigan University[1]/SUNY Institute of Technology[2]

Introduction

The purpose of this study is to learn more about the attitudes of engineering technology freshmen in terms of their educational backgrounds, orientations and experiences in ET programs. A survey was designed and conducted to carry out this study. It was used to measure attitudinal differences among engineering technology freshmen in the following areas:

- Career goals and elements for career decision.
- Preparation in high school and college.
- Study and work habits.
- Difficult subjects for ET majors.
- Confidence in ET knowledge/skills and elements for success.

Educators are always interested in learning more about their students' attitudes. Many studies of this kind were conducted for engineering programs in the last five years[1,2,3,4]. The focuses of this study are primarily on the engineering technology students' own ratings relative to different knowledge bases, skills and abilities and their levels of educational and occupational aspirations[5,6]. The results were used to compare the attitude of ET freshmen with those who prefer engineering over ET within the normative data in the academic backgrounds and achievements.

Engineering Technology Programs at CMU

The engineering technology programs at Central Michigan University (CMU) are designed to prepare students who aspire to careers in electronic, manufacturing, or mechanical areas[7]. Each major requires a minimum of 24 semester credits in mathematics and science, 21 credits in technology core that emphasizes hands-on laboratories, 21 credits in technology specialization that emphasizes engineering science and design, and 9 credits in technical electives that students can use to strengthen their technical backgrounds in one of the areas.

The students who wish to pursue one of the ET majors must be first admitted into the university. A typical student who receives a general admission would have a high-school GPA of 3.3 and ACT score of 22 (or a SAT score of 1030). Students usually sign up for one of the ET majors

and start to take the technical courses in their sophomore year. Those who plan to major in engineering technology can take the freshman-level Introduction to Engineering Technology. The three-credit course provides an introduction to the engineering world with a technologist's perspective to provide the skills and knowledge required to pursue an engineering technology career[8]. A 20-questions survey instrument was used to measure the attitude and reflection of 30-35 students in this class at the end of semester. The surveys were completed in each of the three semesters from August 1999 to December 2000.

Survey Instrument Design

The following were some of the sample questions used in the survey instrument:

1. List three crucial elements you should consider when deciding on a career.
2. In your opinion, what does it take to be a successful engineering technologist?
3. In general, are you satisfied with the preparation you received from high school?
4. To prepare well for engineering technology at college, how many years of mathematics and science does one need to take in high school?
5. If you've already decided to major in engineering technology, which subject area you think you'll need to improve the most?
6. Overall, are you satisfied with the courses you have taken related to your major?
7. In general at CMU, do your classroom activities need improvement?
8. In general at CMU, did your instructors help you learn?
9. Do you think an engineering technology major will be able to meet your career needs?
10. How many hours each week did you study in high school and at CMU?
11. According to your own estimation, how many hours each week do you need in order to do well in all of your classes at CMU?

Questions 1 and 2 were used to find out students' career goals and general impression of engineering technology. Questions 3-5 were employed to determine the level of preparation in mathematics and science. Questions 6-9 were used to measure confidence in basic engineering technology knowledge and skills. Questions 10 and 11 were employed to probe students' study and work habits.

Survey Results and Discussions

All the survey results collected in the three semesters were combined and organized based on the attitudinal differences mentioned in Introduction. The data collected in one semester was not used to compare with that of other two semesters, because the differences among them were very small.

Career Goal

Many ET majors had a career goal in engineering instead of engineering technology. Figure 1 indicates that almost 44 percent of ET majors preferred a job title (such as engineering technologist) that would accurately reflect the type of training they received at CMU. However, 42 percent of ET majors preferred a job title of engineer. The question for this group was: why

didn't they go to schools with engineering programs? We believed this had to do with the fact that CMU offered no engineering program, but it was closer to their homes and provided good-quality education.

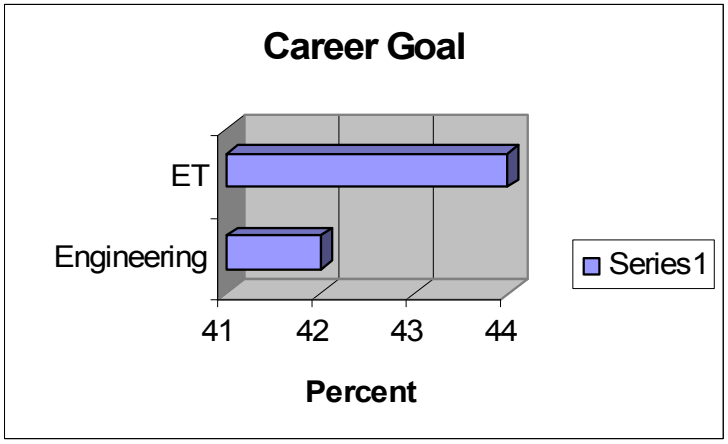

Figure 1. Career Goal: ET vs. Engineering

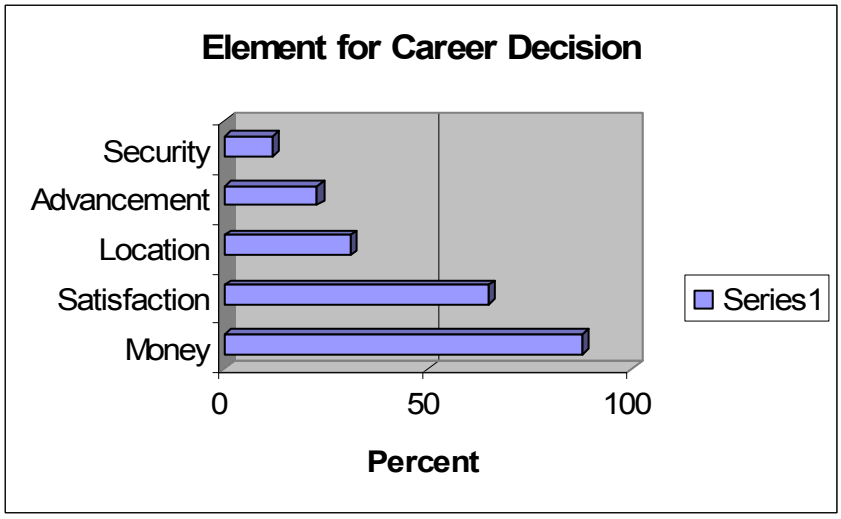

Figure 2. Elements for Career Decision among ET Majors

Elements for Career Decision

Figure 2 lists five of the crucial elements for a career decision among ET majors. Salary/pay (88%) and job satisfaction (65%) are the most popular choices by far. Other popular elements include location (31%) and opportunity for advancement (23%). To our surprise, the job security didn't rank high among ET majors. We believe this particular element, which has to do with job market conditions, might rank higher if the economy got worse.

Preparation in High School and College

Figure 3 depicts the differences between the two groups of ET majors shown in Figure 1. The first set of data shows the comparison of high school GPA: 3.0 for Group A (in blue: preferred a job title consistent with ET) vs. 2.8 for Group B (in red: preferred a job title of engineer). The second set of data shows the comparison of ACT scores: 24.1 for Group A vs. 21.5 for Group B.

The third and forth sets show the comparison of the average number of hours per week for study in high school and at CMU, respectively. The first three sets of data indicate Group A worked harder, received relatively better grades, and secured higher scholastic test scores – quite contrary to what we expected before the survey result was available.

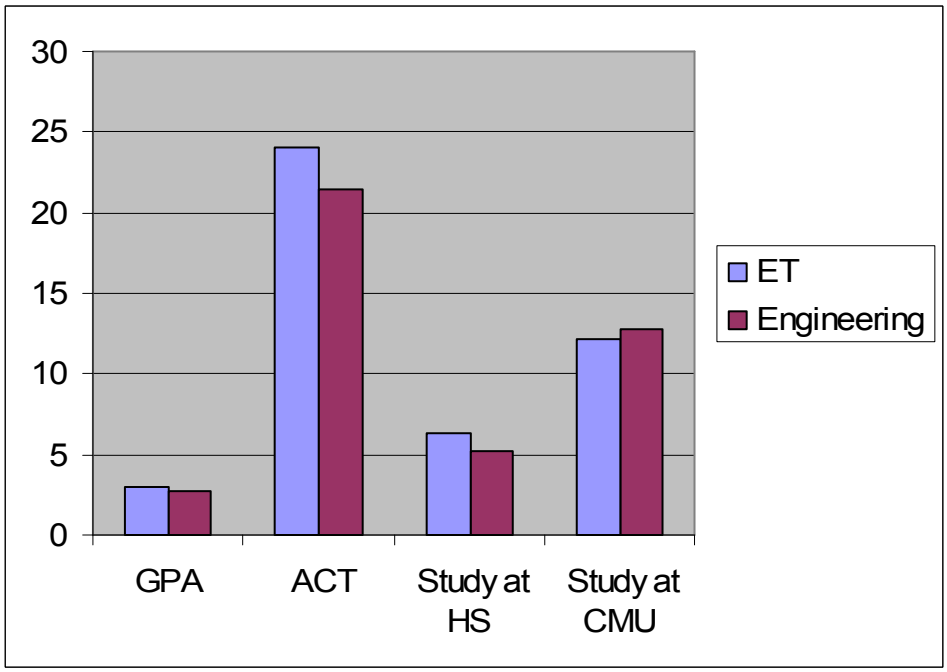

Figure 3. Differences between Groups Preferring ET and Engineering

The overall average ACT score for the students entering ET is a little higher than that for those received general admission to CMU. However, it's noted that the overall GPA for the students entering ET is lower than that for those received general admission (2.9 vs. 3.3). This is probably because the ET students tended to take more challenging classes, such as those in mathematics and science, in high school.

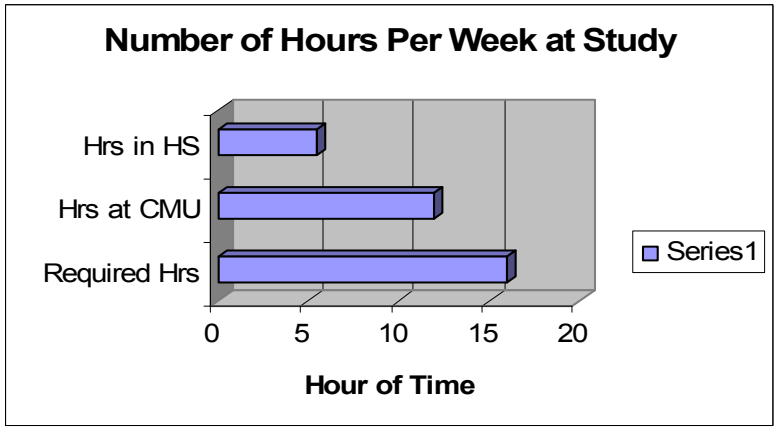

Figure 4. Study and Work Habits

Study and Work Habits

Figure 4 depicts the study habits among ET majors. In general, they had been working much harder in college (12.1 hours per week) than in high school (5.5 hours per week). However, they expected to work at least 16 hours per week (if they could) in order to do well academically at CMU.

Difficult Subjects for ET Majors

Figure 5 shows which subject areas most ET students had difficulties and needed improvement. Just as we'd predicted, most ET majors (71%) considered the courses in mathematics most challenging. They felt the improvement was needed in the courses of Pre-Calculus, Calculus I, and Calculus II. The majority (63 %) thought they needed improvement in science that includes primarily College Physics I and II. Only 21 % felt they needed to improve in the major courses. In overall, 39% of ET majors thought they needed to receive some sort of help, and 92% indicated they did received help when needed.

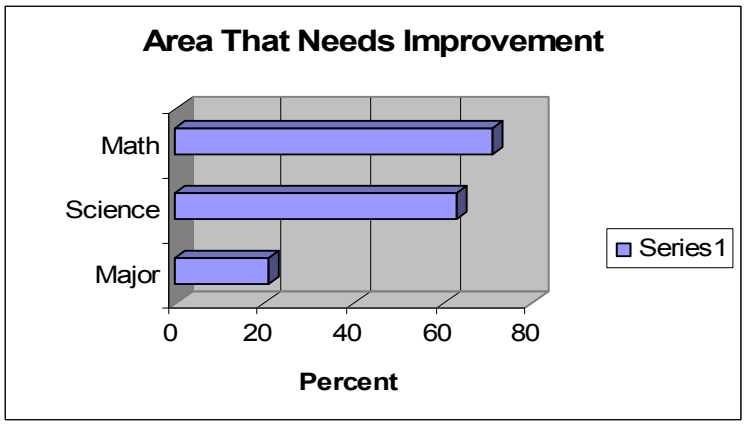

Figure 5. Difficult Subjects for ET Majors

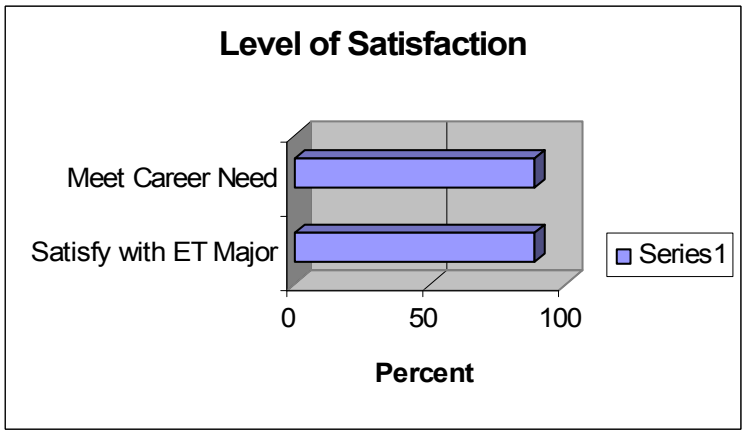

Figure 6. Confidence in ET Major

Confidence in ET Major

Figure 6 shows that 89% of students surveyed were satisfied with the knowledge/skills learned from ET programs. The exact same percentage felt their major would fulfill their career objectives.

Elements for Success in ET

Figure 7 shows what it takes to be successful in ET from the students' point of view. The majority of ET majors (62%) considered dedication and hardwork ought to be the most crucial element. Only 38% thought the ability to learn and strong problem solving skills was a more important element.

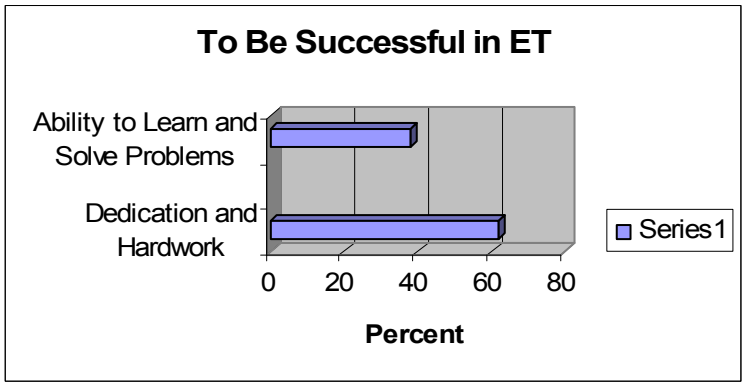

Figure 7. Crucial Elements for Success

Conclusion

One surprising and interesting result from this study is in the relationship of attitudinal differences and learning outcomes among engineering technology freshmen. In general those with higher cumulative GPA at CMU spent fewer hours per week at study compared to those with lower GPA. The only explanation we could find was that the former tends to have higher high school GPA and higher ACT scores. We believe their good scholastic standing allowed them to be more effective at study in their first year at CMU. It would be interesting to determine whether this factor would sustain as they continue their course of study in engineering technology.

New accreditation guidelines will force us to learn more about our students. It is important for us to have a more informed understanding of students' underlying attitude as they begin their engineering technology studies. This study made a first attempt to sort out some of the important parameters that we have always been interested in trying to identify. The future studies will focus on why students are interested in engineering technology rather than engineering. In addition, we will also study differences in attitude among students that may help to explain differences in academic performance and retention in engineering technology program.

Bibliography

1. Zhang, G., Anderson, T., Ohland, M., Carter, R. and Thorndyke, B., Identifying Factors Influencing Engineering Students Graduation and Retention: A Longitudinal and Cross-Institutional Study, *2002 ASEE Annual Conference Proceedings*.
2. Khachikian, C. & Guillaume, D., Attitudes vs. Performance in the Engineering Classroom, *2002 ASEE Annual Conference Proceedings*, Montreal, Canada, June 16-19, 2002.

3. Besterfield-Sacre, M., Moreno, Magaly., Shuman, L., and Atman, C., Comparing Entering Freshman Engineers: Institutional Differences in Student Attitudes, *1999 ASEE Annual Conference Proceedings*.
4. Landis, R. & Prather, E., Enhancing Engineering Student Success: Working With Students to Change Their Attitudes, *1998 ASEE Annual Conference Proceedings*.
5. Hawks, V. & Strong, A., *Introduction to Engineering Technology and Engineering*, Prentice Hall, Upper Saddle River, NJ, 2001.
6. Cheshier, S., *Studying Engineering Technology*, Discovery Press, Los Angeles, CA, 1998.
7. CMU Engineering Technology Majors Website: http://www.cmich.edu/bulletins/ug-bulletin/programs/cst/iet.htm#Engineering%20Technology.
8. Jones, D., Chen, D., and Peng, A., Introduction Course in Engineering Technology: Evolution of Course Content and Resulting Student Opinions, *2002 ASEE Annual Conference Proceedings*.

DANIEL M. CHEN, Ph.D., P.E.
Daniel Chen is currently a professor and chairperson of the Department of Industrial and Engineering Technology at Central Michigan University. His primary teaching responsibilities are in mechanical engineering technology and CAD/CAE. His most recent publications include a textbook in kinematics/mechanism design - Applied Kinematics Worktext, published by Prentice Hall.

ALBERT PENG, Ph.D.
Albert Peng is currently a professor in the Department of Industrial and Engineering Technology at Central Michigan University. He received M.S. and Ph.D. degrees in Electrical Engineering from Case Western Reserve University in Cleveland, Ohio. He was the founder of the course of Introduction in Engineering Technology at CMU, where he taught the course for several years.

DANIEL K. JONES, Ph.D., P.E.
Daniel Jones 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 taught Introduction in Engineering Technology for three years, and he served as the faculty advisor for the student SAE/SME club.