

2006-2557: USING COOPERATIVE EDUCATION DATA FOR ABET REVIEWS

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Using Cooperative Education Data for ABET Reviews

Abstract

The ABET 2000 criteria require that engineering departments have external evaluation of their engineering students. One of the potential methods of accomplishing this is to use the students on cooperative education assignments. At Texas A&M, over 250 individual students per year are involved in cooperative education. For all mechanical engineering students, there are more than 200 who have experienced at least one work term.

For many years, the Cooperative Education program within the Career Center has collected data on both the student's evaluation of the company and the co-op program and the employer's evaluation of the student. These data will be reviewed and discussed in terms of our ABET analysis. Recently, the Co-op Program has developed an additional form that the employer is asked to fill out which tracks the ABET a through k criteria. The results for these surveys will be presented and discussed.

Mechanical Engineering at Texas A&M University had their most recent ABET visit in fall of 2005. The results of the surveys were successfully used as external evaluations for students' in the program.

Introduction

Texas A&M University has a Co-operative Education program that is part of the University's Career Center. Within the Coop program, the Dwight Look College of Engineering (COE) has a long history of sending students to work in industry on an alternating semester basis. In particular, mechanical engineering has had many students do Co-op as part of their degree program. During fall 2004, the Dwight Look COE had their ABET visit.

The ABET visitors stressed outside evaluation of students' performance. They were uncomfortable with using faculty evaluation of individual students. As we were preparing for the visit, mechanical engineering realized that through the Co-op program there was a direct independent evaluation of our students' performance.

This paper will describe and discuss the evaluation procedure used ~~for~~ during our most recent ABET visit. Specifically, mechanical engineering will discuss our evaluation and what we used and the Co-operative Education Office will discuss their effort to provide a college wide evaluation for ABET.

Data Collection

Co-operative Education engineering students must have a minimum grade point ratio (GRP) and generally speaking they should be in the upper division of their particular engineering program. However, exceptions are made. Prospective Co-op students' interview companies of interest and if there is a match the student is offered a position. Generally, Co-op likes the students to have three alternating semesters of work study. Of course that has many variations. Students in

mechanical earn one credit per co-op term. The credit is earned for a report that each student must turn in to his/her faculty advisor. Three co-op credits earned will count as one technical elective for mechanical engineering students.

As part of the process, each student must include an employer evaluation of their performance. It is discussed with each student and the student's supervisor must sign-off on the form. This represents an independent evaluation of each mechanical engineering student. An example of this form is shown in Figures 1a and 1b.

In addition the Co-operative Education office has requested company evaluation of Texas A&M University engineering students' academic preparation specifically for ABET. An example of this form is shown in Figure 2. This form was sent specifically to companies who hire Texas A&M University students to provide feedback on curriculum issues only and not intended to be for a specific student.

EVALUATION OF CO-OP STUDENT



The Co-op student's supervisor should complete this form and discuss it with the student near the end of each work term. Frequent communication (with or without the form) is encouraged to enhance understanding regarding performance and to facilitate development during the work term. The student must return the completed form to:

Experiential Education Programs
 Cooperative Education
 Texas A&M University
 TAMU 1476
 College Station, TX 77843-1476

Name: _____ Classification: _____ Major: _____
 Work Term Number: 1 2 3 4 5 Completed during: Fall Spring Summer 20 _____
 Employer: _____ Location: _____

| SKILL (Please check appropriate responses) | Exceeds Standards | Meets Standards | Needs Some Improvement | Needs Much Improvement |
|---|-------------------|-----------------|------------------------|------------------------|
| 1. Possesses necessary technical knowledge | _____ | _____ | _____ | _____ |
| 2. Adapts to changing work assignments and situations | _____ | _____ | _____ | _____ |
| 3. Able to cooperate and work with others | _____ | _____ | _____ | _____ |

Please comment on deficiencies or exceptional points: _____

| PERFORMANCE | Exceeds Standards | Meets Standards | Needs Some Improvement | Needs Much Improvement |
|--|-------------------|-----------------|------------------------|------------------------|
| 4. Listens and carries out instructions | _____ | _____ | _____ | _____ |
| 5. Works effectively without close supervision | _____ | _____ | _____ | _____ |
| 6. Meets deadlines and schedules | _____ | _____ | _____ | _____ |
| 7. Produces acceptable quality of work | _____ | _____ | _____ | _____ |
| 8. Produces acceptable quantity of work | _____ | _____ | _____ | _____ |

Please comment on deficiencies or exceptional points: _____

Figure 1a. Co-op employer evaluation form.

| JUDGMENT | | Exceeds Standards | Meets Standards | Needs Some Improvement | Needs Much Improvement |
|---|---|--|-----------------|------------------------|------------------------|
| 9 | Demonstrates ability to make decisions or seek appropriate help | _____ | _____ | _____ | _____ |
| 10 | Shows problem solving ability | _____ | _____ | _____ | _____ |
| Please comment on deficiencies or exceptional points: _____ | | | | | |
| _____ | | | | | |
| _____ | | | | | |
| ATTITUDE | | Exceeds Standards | Meets Standards | Needs Some Improvement | Needs Much Improvement |
| 11 | Accepts responsibility and is a self-starter | _____ | _____ | _____ | _____ |
| 12 | Exhibits interest and enthusiasm about the job | _____ | _____ | _____ | _____ |
| 13 | Maintains appropriate dress and grooming habits | _____ | _____ | _____ | _____ |
| 14 | Maintains good attendance and tardiness record | _____ | _____ | _____ | _____ |
| 15 | Adheres to organizational regulations | _____ | _____ | _____ | _____ |
| Please comment on deficiencies or exceptional points: _____ | | | | | |
| _____ | | | | | |
| _____ | | | | | |
| Additional comments about performance and/or areas for improvement: _____ | | | | | |
| _____ | | | | | |
| _____ | | | | | |
| SUPERVISOR'S OVERALL EVALUATION OF STUDENT'S PERFORMANCE | | | | | |
| _____ | Excellent Performance | Student exceeded expectations | | | |
| _____ | Above Expectations | Student performed better than expected | | | |
| _____ | Met Expectations | Student performed satisfactorily | | | |
| _____ | Below Expectations | Student requires improvement | | | |
| Evaluation has been discussed with student <input type="checkbox"/> Yes <input type="checkbox"/> No | | | | | |
| Number of weeks worked during present Co-op assignment: _____ | | | | | |
| Start date of next work assignment: _____ | | | | | |
| Supervisor's name (print): _____ | | | Phone: _____ | | |
| Supervisor's signature: _____ | | | Date: _____ | | |
| Supervisor's Email: _____ | | | | | |

Figure 1b. Co-op employer evaluation form.

EMPLOYER ASSESSMENT OF ACADEMIC PREPARATION OF CO-OP STUDENT

Thank you for completing an assessment of this student's ACADEMIC PREPARATION. We are seeking to provide continuous feedback to the faculty on the engineering curriculum. The information you provide will be forwarded by the Cooperative Education office to the College of Engineering, without reference to the student or company. The goal of this evaluation is to provide feedback on curriculum issues ONLY – NOT individual students. Please circle the most appropriate evaluation in each

| | | |
|--|---|--|
| <p>Ability to apply knowledge of mathematics, science and engineering – at this point in the engineering education process.</p> <p>Excellent Very Good Average Below Average Very Poor Not applicable to this position</p> | <p>Ability to design and conduct experiments.</p> <p>Excellent Very Good Average Below Average Very Poor Not applicable to this position</p> | <p>Ability to analyze and interpret data.</p> <p>Excellent Very Good Average Below Average Very Poor Not applicable to this position</p> |
| <p>Ability to design a system, component, or process to meet desired needs.</p> <p>Excellent Very Good Average Below Average Very Poor Not applicable to this position</p> | <p>Ability to identify, formulate and solve engineering problems.</p> <p>Excellent Very Good Average Below Average Very Poor Not applicable to this position</p> | <p>Ability to use the techniques, skills and modern engineering tools necessary for engineering practice.</p> <p>Excellent Very Good Average Below Average Very Poor Not applicable to this position</p> |
| <p>Ability to function on multidisciplinary teams.</p> <p>Excellent Very Good Average Below Average Very Poor Not applicable to this position</p> | <p>Ability to effectively communicate in writing.</p> <p>Excellent Very Good Average Below Average Very Poor Not applicable to this position</p> | <p>Ability to effectively communicate orally.</p> <p>Excellent Very Good Average Below Average Very Poor Not applicable to this position</p> |
| <p>Possesses the broad education necessary to understand the importance of engineering solutions in a global/societal context.</p> <p>Excellent Very Good Average Below Average Very Poor No opportunity to observe</p> | <p>Recognition of the need for and an ability to engage in life-long learning.</p> <p>Excellent Very Good Average Below Average Very Poor No opportunity to observe</p> | <p>Understanding of professional and ethical responsibilities.</p> <p>Excellent Very Good Average Below Average Very Poor</p> |

What is your assessment of the student's academic preparation for this position? (Overall academic preparation, not specific equipment or software training)
 Exceptionally well prepared Very well prepared Satisfactorily prepared Some deficiencies Very poorly prepared

Does it appear that the student's academic program is oriented to the particular needs of your organization?
 Yes No Comments: _____

What changes would you like to see implemented in the curriculum to better prepare future students for your organization?

Student's major: _____ Work Term #: _____

THANK YOU FOR YOUR ASSISTANCE

Texas A&M University • 209 Koldus Building • College Station, Texas 77843-1476 • (979) 845-7725 • Fax: (979) 845-0067 • co-opweb.tamu.edu

Figure 2. Evaluation form designed specifically for ABET.

Results

The ABET a through k Program Outcomes are listed below in Table 1. Potentially, a Co-op

Table 1. ABET Criterion 3. Program Outcomes and Assessment.

Engineering programs must demonstrate that their graduates have:

- a) an ability to apply knowledge of mathematics, science, and engineering
- b) an ability to design and conduct experiments as well as to analyze and interpret data
- c) an ability to design a system, component, or process to meet desired needs
- d) an ability to function on multidisciplinary teams
- e) an ability to identify, formulate, and solve engineering problems
- f) an understanding of professional and ethical responsibility
- g) an ability to communicate effectively
- h) the broad education necessary to understand the impact of engineering solutions in a global and societal context
- i) a recognition of the need for, and an ability to engage in life-long learning;
- j) a knowledge of contemporary issues
- k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

student may satisfy a number of the criteria. For example, a number of ABET criteria are related to the questions shown in Figure 1a and 1b: ability to work as a team member, technical knowledge, analytical skills, strong work ethic, and ability to learn. The questions asked of the co-op student's employer about the individual student's job performance correspond to the following a through k ABET Program Outcomes.

ABET a- Q 1

ABET b- Q 9

ABET d- Q 2 and 3

ABET e- Q 10

ABET f- Q 6, 7, 8, 11, and 12

ABET g- Report

The Employer Assessment of Academic Preparation shown in Figure 2 are also designed to collect data on the ABET a through k criteria. The 12 box scores cover 10 of the Criteria – a through i and k. Criteria b on experimentation was split into two categories since their ability to analyze and interpret data may vary more due to their academic classification (Sophomores vs. Seniors). Criteria g was also split to provide additional feedback on their written communication vs. oral communication preparation. Criteria j feedback on knowledge of contemporary issues is provided in the last 2 questions on Figure 2. Employer responses and comments about the curriculum meeting the particular needs of their organization and changes they would recommend keep Texas A&M areas where we may be lagging.

Discussion

The results for three years of data of individual student performance are shown in Table 2. The data was determined on a 4-point scale with 4 corresponding to excellent, 3 corresponding to above expectations, 2 to met expectations and 1 corresponding to below expectations. Similarly a plot of the data is shown in Figure 3. Although the variation seems large, note the average score scale is only from 3 to 4.

Table 2. Average scores for employer evaluation of students and the number of students.

| | No. of Students | Student Evaluation by Employer | | | | | | | | | | | | | | | Overall |
|-------------|-----------------|--------------------------------|-----|-----|-------------|-----|-----|-----|-----|-----------|-----|----------|-----|-----|-----|-----|---------|
| | | Skill | | | Performance | | | | | Judgement | | Attitude | | | | | |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | |
| Summer 2003 | 44 | 3.5 | 3.7 | 3.8 | 3.7 | 3.7 | 3.5 | 3.6 | 3.6 | 3.5 | 3.6 | 3.8 | 3.7 | 3.5 | 3.6 | 3.5 | 3.5 |
| Fall 2003 | 27 | 3.4 | 3.7 | 3.8 | 3.4 | 3.6 | 3.4 | 3.5 | 3.4 | 3.3 | 3.5 | 3.4 | 3.5 | 3.4 | 3.6 | 3.4 | 3.4 |
| Spring 2004 | 24 | 3.4 | 3.7 | 3.7 | 3.5 | 3.7 | 3.5 | 3.7 | 3.6 | 3.4 | 3.5 | 3.5 | 3.6 | 3.5 | 3.5 | 3.5 | 3.5 |
| Summer 2004 | 36 | 3.4 | 3.8 | 3.8 | 3.5 | 3.8 | 3.5 | 3.6 | 3.4 | 3.5 | 3.5 | 3.7 | 3.6 | 3.4 | 3.5 | 3.4 | 3.4 |
| Fall 2004 | 18 | 3.5 | 3.6 | 3.6 | 3.5 | 3.6 | 3.7 | 3.5 | 3.4 | 3.6 | 3.5 | 3.7 | 3.8 | 3.5 | 3.6 | 3.5 | 3.5 |
| Spring 2005 | 19 | 3.2 | 3.7 | 3.5 | 3.5 | 3.6 | 3.5 | 3.3 | 3.4 | 3.3 | 3.4 | 3.6 | 3.5 | 3.2 | 3.3 | 3.3 | 3.1 |
| Summer 2005 | 38 | 3.4 | 3.7 | 3.7 | 3.6 | 3.6 | 3.4 | 3.6 | 3.5 | 3.6 | 3.4 | 3.6 | 3.7 | 3.5 | 3.5 | 3.4 | 3.4 |
| Fall 2005 | 22 | 3.5 | 3.8 | 3.6 | 3.6 | 3.5 | 3.5 | 3.5 | 3.5 | 3.6 | 3.5 | 3.6 | 3.6 | 3.5 | 3.5 | 3.4 | 3.5 |

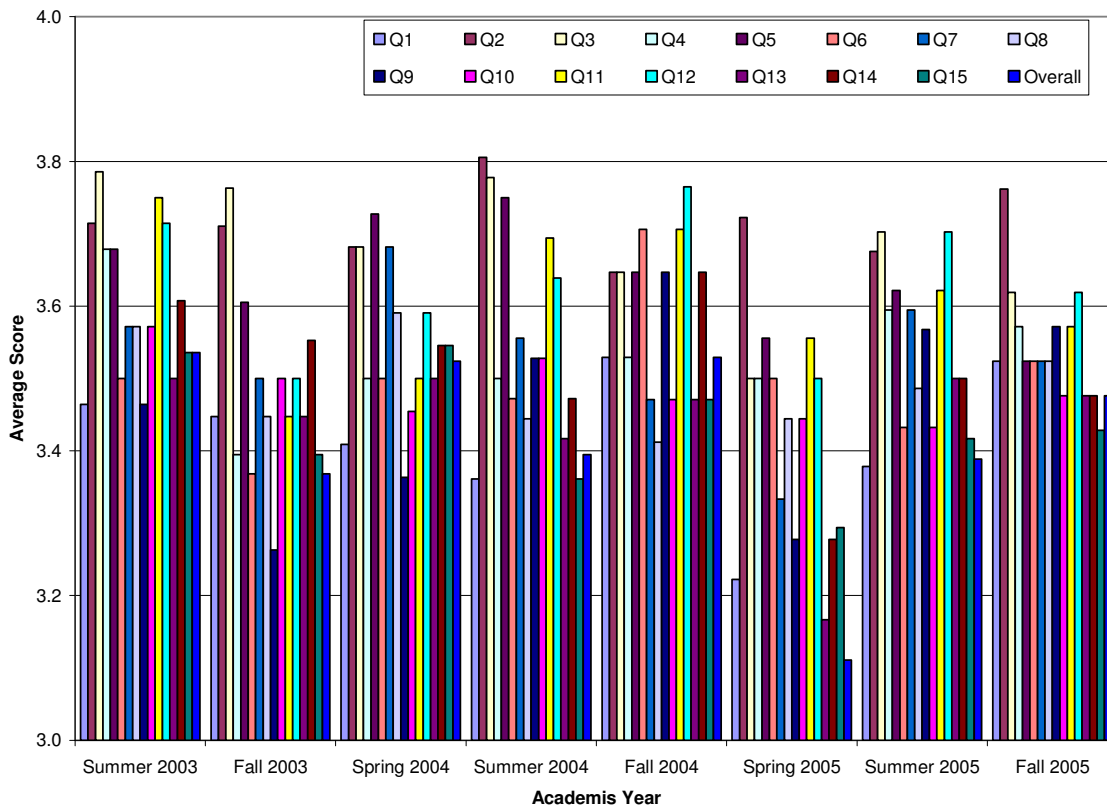


Figure 3. Average scores for the 15 questions and the overall for the employer evaluation.

For ABET purposes mechanical engineering choose to use 70% as passing. On a 4-point system that would be 2.8. From Figure 3, we can observe that all of the numbers are above 2.8. If we consider the overall evaluation the averages vary from a low of 3.1 to a high 3.5 and an average of 3.4 over eight semesters and a total of 228 students.

Our understanding is that this is a valid external evaluation of a group of mechanical engineering students in mechanical engineering. The evaluators do not have a vested interest in the students being Texas A&M University students specifically. While this is not the only piece of information that ABET requires it does provide a useful result.

The results for three academic years of data of academic preparation performance are shown in Table 3. The data was determined on a 5-point scale with 5 corresponding to Excellent, 4 corresponding to Very Good, 3 corresponding to Average, 2 corresponding to Below Average, and 1 corresponding to Very Poor. Similarly a plot of the data is shown in Figure 4.

Table 3 Average Scores for Employer Evaluation of Academic Preparation of Students

| ABET Criteria | Question | 2002-03 | 2003-04 | 2004-05 |
|---|--------------------------------|----------------|----------------|----------------|
| A) Apply mathematics, science, and engineering | 1 | 4.2 | 4.1 | 4.2 |
| B) Design and conduct experiments | 2 | 4.0 | 4.0 | 4.2 |
| B) Analyze and interpret experiments data | 3 | 4.1 | 3.9 | 4.5 |
| C) Design a system, component, or process | 4 | 4.1 | 3.8 | 4.3 |
| E) Identify, formulate, and solve engineering problems | 5 | 4.0 | 4.1 | 4.3 |
| K) Techniques, skills, and modern engineering tools | 6 | 4.4 | 4.2 | 4.5 |
| D) Function on multidisciplinary teams | 7 | 4.1 | 4.3 | 4.5 |
| G) Effective written communications | 8 | 3.7 | 3.9 | 4.1 |
| G) Effective oral communications | 9 | 3.7 | 4.0 | 4.2 |
| H) Impact of engineering solutions in a global and societal context | 10 | 3.9 | 3.9 | 4.3 |
| I) Engage in life-long learning | 11 | 3.9 | 4.3 | 4.4 |
| F) Professional and ethical responsibility | 12 | 4.1 | 3.9 | 4.4 |
| Overall Assessment of Academic Preparation | 13 | 3.9 | 3.7 | 4.1 |
| | Number of Employer Assessments | 15 | 10 | 47 |

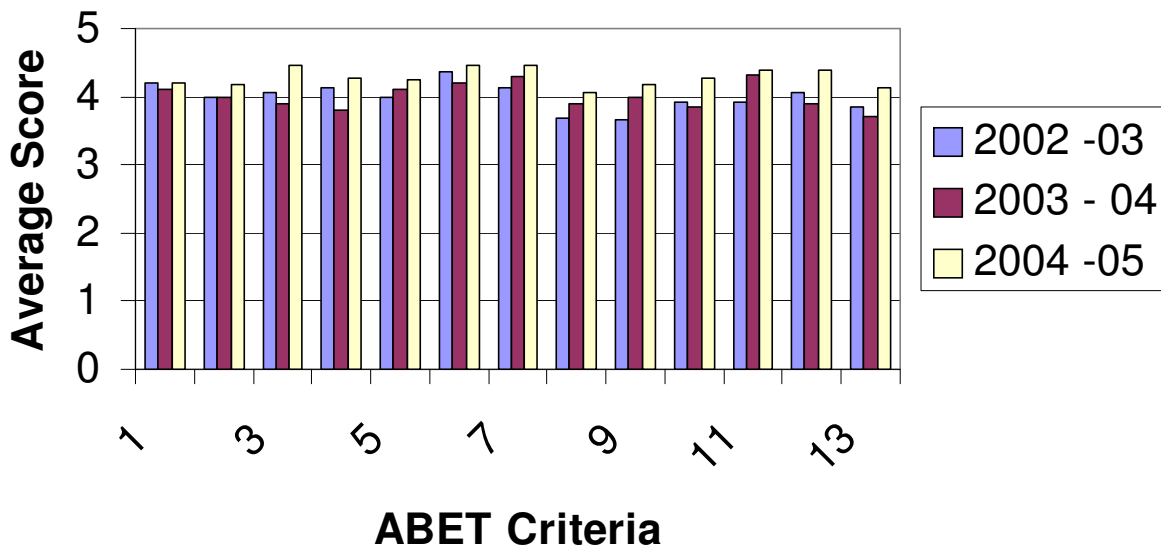


Figure 4. Average Scores for ABET Criteria and Overall Assessment of Academic Preparations

From Figure 4, we can observe that all of the numbers for the 2004-05 academic year are 4.1 or above (Very Good +) and is the largest number of Employer assessments (47). These are also the highest scores since we started collecting this data. The slight decline in some criteria that we recorded in the 2003-04 year was probably due to the small sample size.

In their assessment of criteria J) knowledge of contemporary issues, 100% of the Employers responded that the academic program is oriented to the particular needs of their organization. Their comments indicated that the students were well prepared to enter into the engineering workforce and have positive impact on their organizations. Further enhancements in the curriculum that were recommended included items such as more technical writing and presentation skills, more design using CAD, general project management skills, and continued emphasis on working in teams.

Conclusions

Cooperative education can be a very useful tool for the ABET assessment process. It provides an independent measurement of student's performance. In our opinion, the results that we have collected demonstrate that usefulness. While certainly this is not the only measure that a program would want to use, it is a very helpful indicator.