Educational Research Report

Pittsburgh Freshman Engineering Attitudes Survey© EC 2000 Results

Presented to the MUSE Faculty

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Introduction

Freshman students enrolled in the Mercer University School of Engineering during AY 99-00 took the Pittsburgh Freshman Engineering Attitudes Survey© as part of a cross-institutional study funded by grants from the Engineering Information Foundation and the National Science Foundation. Twenty engineering schools across the country have participated in the study at some time during the past five years. Research results have been published in the engineering education literature.[1,2,3,4]

The research instruments for AY 99-00 include a 50-item pre-survey that was administered to students enrolled in EGR 108 or EGR 126 in the fall 1999 term and a 70-item post-survey that was administered to students enrolled in EGR 107 during the spring 2000 term. This report describes data from the post-survey as it relates to EC2000 Criterion 3 a-k.

The Survey Instrument

The post-survey includes 70 questions related to students' attitudes toward math, science and engineering. Forty three survey questions use a Likert-type scale with the following values: Strongly Disagree-1 Disagree-2 Neutral-3 Agree-4 Strongly Agree-5. This section of questions begins with these instructions: "**For each statement about engineering, please fill in the number that corresponds to how strongly you disagree or agree with the statement.** Typical statements include:

Q1. I expect that engineering will be a rewarding career.
Q15. Engineering is an exact science.
Q26. Engineering involves finding precise answers to problems.
Q28. Technology plays an important role in solving society's problems.

Six survey questions ask the students to rate their confidence level in the following areas (chemistry, physics, calculus, engineering, writing, speaking, computer skills). These questions use a Likert-type scale with the following values: Not Strongly Confident-1 Not Confident-2 Neutral-3 Confident-4 Strongly Confident-5.

The post-survey also includes 20 questions concerning students' confidence level with respect to EC2000 a-k criteria. This section of questions begins with these instructions: "**For the following knowledge and skill areas, indicate your level of confidence. For example, if you have little or no confidence in your ability to use mathematics to solve engineering problems, then mark poor. If you are extremely confident of your ability, mark excellent.**" The EC2000 related questions use a Likert-type scale with the following values: Poor-1 Fair-2 Good-3 Very Good-4 Excellent-5. For example, the survey uses two questions for outcome d (teamwork).

Q58. Functioning as a technically contributing member of an engineering team
Q59. Functioning as an accountable member of an engineering team.

Copies of the pre-survey and the post-survey are available in my office.

Survey Results

The data analysis compares students' scores on the basis of gender, ethnicity, and transfer status. Each school that participates in the cross-institutional study receives an analysis of students' self-reported confidence level for each of the EC2000 a-k criteria. In addition scores are reported for the following 13 measures:

1. General Impressions of Engineering
2. Financial Influences for Studying Engineering
3. Perception of How engineers Contribute to Society
4. Perception of the Work Engineers Do and the Engineering Profession
5. Enjoyment of Math and Science Courses
6. Engineering Perceived as Being an "Exact" Science
7. Family Influences to Study Engineering
8. Confidence in Basic Engineering Knowledge and Skills
9. Confidence in Communication and Computer Skills
10. Adequate Study Habits
11. Working in Groups
12. Problem Solving Abilities
13. Engineering Compatibility

I have summarized some the results as they relate to EC2000 Criterion 3a-k outcomes in the following two tables.

Table 1: Rank-ordered overall confidence level EGR 107-Spring 2000

Outcome	*Brief Description*	*Score**
i	Lifelong learning	4.1
f	Ethics and professionalism	4.0
d	Teamwork	4.0
h	Global / societal impact	3.9
g	Communication	3.8
c	Design product or process	3.8
b	Experiment / analyze data	3.5
j	Contemporary issues	3.5
e	Formulate and solve problem	3.3
k	Tools / techniques	3.3
a	Apply math science egr	3.1

*Scale: Poor-1 Fair-2 Good-3 Very Good-4 Excellent-5

The 103 students who completed the survey held the least confidence in their ability to apply knowledge of math, science and engineering. The highest self-confidence scores were exhibited in four of the Criterion 3 a-k "soft-skill" outcomes: i-lifelong learning, f-professional and ethical behavior, d-teamwork, and h-global/societal issues. Results from the spring 1998 senior survey administered by Dr. Marjorie Davis in senior design classes exhibited a very different pattern. The 1998 seniors' self-assessed ratings of their abilities

related to outcomes i, f, and h were much lower than their ratings of their ability to apply their knowledge of math, science, and engineering. On the other hand, confidence in teamwork appears to be strong for both freshmen and seniors.

Table 2: Statistical comparison of data by gender EGR 107-Spring 2000

Outcome	*Brief Description*	*Average Score by Gender**		*P-value*	*Number of Students*		*Weighted Score**
		M	*F*		*M*	*F*	*All Students*
a	Apply math science egr	3.18	2.87	**.04**	68	34	3.08
b	Experiment / analyze data	3.61	3.39	.21	68	35	3.54
c	Design product or process	3.88	3.54	**.06**	68	35	3.76
d	Teamwork	4.03	3.83	.21	68	35	3.96
e	Formulate and solve problem	3.40	3.14	**.09**	67	35	3.31
f	Ethics and professionalism	3.93	4.24	**.05**	68	35	4.04
g	Communication	3.73	3.91	.22	68	35	3.79
h	Global / societal impact	3.85	4.00	.43	68	35	3.90
i	Lifelong learning	4.07	4.17	.59	68	35	4.10
j	Contemporary issues	3.49	3.54	.92	68	35	3.51
k	Tools/techniques	3.43	2.97	**.02**	68	35	3.27

*Poor-1 Fair-2 Good-3 Very Good-4 Excellent-5

Table 2 shows gender-related differences in students' confidence levels for EC2000 criterion 3 a-k criteria at the end of the freshman year. Five of the outcomes show a difference at the .10 significance level. At the end of the freshman year, the male students were more confident than their female classmates in the following four areas: 1) outcome a - an ability to apply knowledge of mathematics, science, and engineering, 2) outcome c - an ability to design a system, component, or process to meet desired needs, 3) outcome e - an ability to identify, formulate, and solve engineering problems, and 4) outcome k - an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice. Although it was not statistically significant at the .10 level, it is interesting to note that male students scored higher on teamwork and female students scored higher in the communication area. On the other hand, the women students' greater confidence in their understanding of professional and ethical responsibility was statistically significant. Potential explanations for these differences are left to the reader.

Reference 4 contains further information on how our results compare with those from other schools. Our school code is 06.

Implications for the Curriculum

It appears that the existing MUSE curriculum which includes team design experiences at the freshman level in EGR 107 and concludes with a significant teamwork design experience at the senior level in XXX 487 and 488 helps to give our graduates the confidence they need to effectively participate in multidisciplinary teams in the

workplace. The strong ethics-related EGR 108 curriculum may be the reason why the students rate outcome f so highly.

Finally, freshman students' lack of confidence in their ability to apply math, science or engineering should be mediated by our strong technical curriculum in the sophomore, junior, and senior years. Hopefully, a comparison of the freshman AY 99-00 survey results with the AY 02-03 senior survey results will indicate a marked increase for outcome a.

References

1. Besterfield-Sacre, M., Atman, C. & Shuman, L. (1997). Characteristics of freshman engineering students: Models for determining student attrition in engineering. Journal of Engineering Education, 86(2), 139-149.

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3. Hoare, R., Besterfield-Sacre, M., Shuman, L. Shields, R. & Johnson, T. Cross-institutional assessment with a customized web-based survey system. 2001 ASEE/IEEE Frontiers in Education Conference. Paper under review.

4. Moreno, M., Besterfield-Sacre, M., Shuman, L., Wolfe, H. & Atman, C. (2000). Self-assessed confidence in EC-2000 outcomes: A study of gender and ethnicity differences across institutions. Proceedings of the 2000 ASEE/IEEE Frontiers in Education Conference.

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