

AC 2007-692: GENDER DIFFERENCES IN STUDENT ACADEMIC PERFORMANCE AND ATTITUDES

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Gender Differences in Student Academic Performance and Attitudes in an Introductory Engineering Course

Abstract

This paper examines the gender differences in student academic performance and attitudes toward their education and themselves in an introductory engineering course. Student academic performance was evaluated by comparing course work scores between the two genders using assignments, projects, exams and class participation. The students' perceptions of the course with respect to course outcomes were measured by a survey at the end of the semester. The survey was designed to measure student perceptions about themselves and their skills in several areas such as problem solving, computer usage, design process, teamwork, and communication. The survey was also intended to assess whether or not the course objectives had been achieved and to determine if students have increased their skills in the aforementioned areas.

Analysis of the academic performance and attitude of 52 male students and 49 female students enrolled in an introduction to engineering course taught by the same instructor was carried out in four semesters. The results showed that there were no significant difference between mean scores in the academic performance of the genders in the course, and this was evident in the coursework and examination performance analysis. Average marks scored by students of either gender were almost equal. The results also indicated that academic performance in the course was affected by several factors such as student ability, motivation, the quality of secondary education obtained. The female students had a slightly higher overall course grade average than men and outperformed the male students on all class assignments except the final design project.

The attitude survey showed that men reported higher gains than women on the technical skills, including confidence on engineering knowledge as a career and problem-solving skills while women indicated higher gains in teamwork and design skills. Female students were able to learn the material as effectively as the male students.

Introduction

Gender differences may exist in many different areas of education; from performance to attitudes, from classroom activities and course enrollments to perceptions about careers. There is increasing evidence that females are outperforming males in secondary education across a range of subjects. Several studies have been undertaken examining the impact of gender on undergraduate engineering performance, ranging from early year performance to that of later years, with conflicting results [1 – 10]. Some of the literature suggests that gender differences are dependent on the type of assessment utilized, reporting that females tend to perform better than males in coursework. For many years, educators have been concerned about differences in the enrollments and achievements of genders in engineering. Academic performance is affected by many factors such as motivation, student ability, the quality of secondary education received. Grades, after all, depend not only on how much students know but also on conformity to institutional demands, such as whether students follow the teacher's directions and turn in

assignments on time. These findings have been discussed in the literature and attributed these gender differences to several factors including attitude, learning style, instructional methods and testing.

Course Description

EAS 107, *Introduction to Engineering*, is a three semester-hour course [1]. It provides an introduction to the engineering profession, to engineering problem solving, to concepts of design process, to group work, to oral and written communications and to engineering ethics. The course is required for all freshman-engineering students and a large number of non-engineering majors at the University of New Haven take it as a scientific methodology elective.

Consequently, approximately 200 undergraduate students annually take the course in sections containing approximately 25 students. The pre-requisite is college algebra. The course offered is an undergraduate introductory course in Engineering. The same instructor taught all sections. All sections covered the same material, and completed similar assignments.

Course Outcomes: Students should be able to

- describe the various branches of engineering (civil, computer, electrical, industrial, mechanical, and chemical engineering);
- apply engineering problem solving techniques; and be introduced to some computer applications used in engineering;
- understand how to work efficiently as part of a team;
- demonstrate an understanding of the "Design Process", moving from initial design
- communicate effectively in writing (memos, progress reports, final reports) and orally (informally and formally);
- know engineering ethics.

Methodology

The sample consisted of all students (52 males and 49 female students) enrolled in the course taught by the same instructor during four semesters. The same instructor taught the course sections studied, used the same text, similar assignments, and test questions. These common aspects allow for direct comparison. Questions intended to assess outcomes goals were integrated into exams or other assignments. Student performance on these items was evaluated as part of outcomes assessment. Student projects were reported both in the form of a written report and orally. Written reports are evaluated on the basis of form and quality of writing as well as on content.

The questionnaire in the survey measures several facets of student skills including their opinions about the class activities and course format. Students are asked to rate their improvement in critical thinking, communication, teamwork and problem solving skills. Finally, students rate their intellectual challenges and their effort to succeed in the course.

Tools for Assessing Student Academic Performance

Two tests were scheduled for the class along with homework assignments and a final design project. The tests and other work were covering the same topics with minor variation. The exams themselves covered the same topics. A direct comparison of the average of the other assignments scores (homework and projects) was also possible.

Student attitude was measured by a survey questionnaire addressing the specifics of the course outcomes. The surveys were administered to the students in four semesters; the questionnaire included both objective and open-ended questions.

Results and Analysis

Student Performance

Class performance was evaluated by comparing course work scores between the two genders using assignments, projects, tests and as an aggregate using overall work averages. The goal was to determine if there were significant differences in student performance between genders. A direct comparison of exam scores for two exams administered in the class was undertaken. As is evident from examining Table 1, there was little mean scores difference between average exam scores. Although exam results were but one out of several criteria normally used in evaluating student performance, in this situation they serve as a readily available measure.

Course Section	Exam #1 Average	Exam #2 Average	Exams Average
Male	85	76.5	80.75
Female	84.4	79	81.7

Table 1: Average Exam Scores

As shown in Table 2, grades on average are a little higher for female students as compared to the male students. This result didn't come as a surprise. Some case studies support this observation [7]. This may be because many of the female students are generally putting more effort in the course than male students. Motivation may be another factor for their performance being slightly higher than the male students.

Work Assigned (Weight)	# of Points Males	# of Points Females
Participation (10%)	89.75	91.1
Quizzes (30%)	80.75	81.7
Labs (30%)	89.6	89.8
Homework (10%)	86.9	88.56
Final Design Project (20%)	90	89.6
Class Average (100%)	86.8	87.5
Overall GPA	2.85	3.05

Table 2: Class Average

Letter Grade	Males N= 52	Females N= 49
Percentage receiving A	31.9	29.7
Percentage receiving B	45	46
Percentage receiving C	17	19
Percentage receiving D	6	5.4
F	0	0
Percentage passing (100%)	100	100
Average grade (A= 4.0)	3.47	3.5

Table 3: Performance in the course

As Table 3 shows, there were no significant differences in the gender performance. The women are scored higher on all activities or the same as their counterpart except for the final design project. However somewhat higher percentage of male students earned A's in the course than their counterpart.

Self-Assessments and Attitudes

Figure 1 shows student perception about their significant improvement in specific course outcomes. The students were asked to rate their improvement in the following areas: appreciation of good design, oral and written communication skills, problem solving skills,

knowledge of Engineering disciplines, team skills, awareness of design process and appreciation for good design. The results show that men rated their improvement in the technical skills higher than women, including communication, critical thinking, knowledge of engineering fields and design skills, while women rated themselves higher in teamwork skills and appreciation for good design. This assumes that male students feel better than female students about gaining more problem solving skills in the course. Greater gain in the communication skills among male students was also noted. This could be attributed to the better background of female students than male students in communication skills. The analysis showed that women scored significantly higher than men in written reports and oral presentations. It was observed that women frequently reported a preference for cooperative learning style and interactive classroom dynamics.

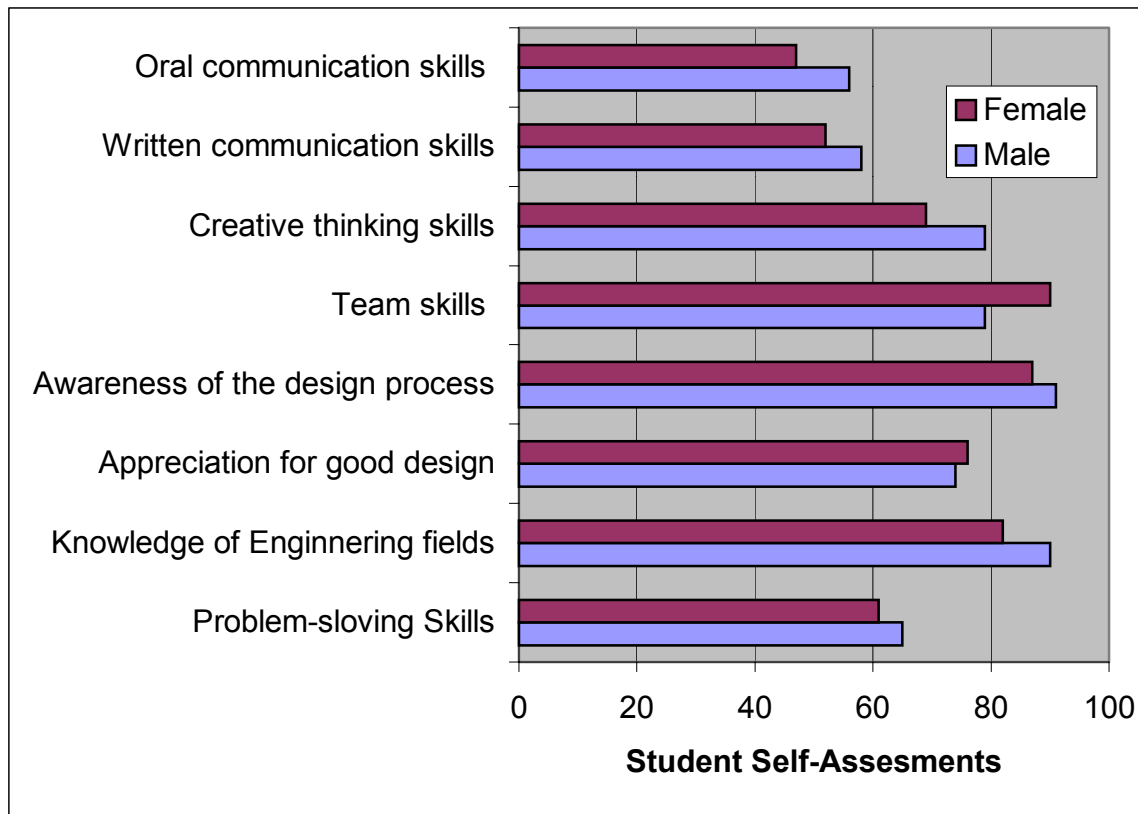


Figure 1: student perception about their significant improvement in Soft Skills

The women indicated higher expectations than men. The survey shows, 52% of the female students and only 22.5 % of the male students thought they deserve an A in the course. As shown in table 3 both genders over predicted their grades. The rate of attrition was the first notable point of comparison. The female attrition rate (students who started but never finished the course) was 4 % while in case of male; the attrition rate was 6%.. When it came to actual performance however, the results were much more consistent between the two genders.

Conclusion

This paper examined the gender differences in educational achievements based on a sample of more than 100 students in an introductory engineering course over the last two years. Mean score differences were examined using coursework and examination performance data. The results of the survey showed that no significance difference was found between men and women in any of the coursework and examination performance analysis. Both genders emphasized the importance of teacher/student and student/student interactions through the use of cooperative learning groups. In spite of the differences in skills ratings found between genders, they indicated significant gains across all course outcomes. The study indicates that it is not academic capacity that hinders women from pursuing engineering topics and career in engineering.

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