CONFIDENCE AND CONTINUATION: THE NORTHEASTERN FIRST YEAR ENGINEERING STUDENT SURVEY †

Patricia B. Campbell¹, Ph.D., Sara Wadia-Fascetti², Ph.D. Lesley Perlman³, B. S. and Earl N. Hadley⁴, MPA

Abstract 3/4First year engineering students are surveyed to determine if a relationship between confidence and Pre and post questionnaires are continuation exist. completed by two cohorts of students who entered their freshman years in engineering at Northeastern University in 1999 and 2000. Student confidence is measured at the beginning and end of the freshman year and compared to academic achievement. The results confirm that women tend enter their freshman engineering year with higher grades than men, while there was no substantial difference in SAT scores. At the end of the freshman year women tend to be in better academic shape than men with more women in good standing, more women advancing to sophomore standing, and better retention. However, the women who entered in 1999 experienced a decrease in confidence compared to men while confidence increased for women entering in 2000.

Index Terms 3/4 academic confidence, first year students, gender differences, engineering

INTRODUCTION

At the beginning and end of their first year at Northeastern University (NU), women and men engineering students from the entering classes of 1999 and 2000 completed a survey focusing on their academic experiences, confidence levels and their interest in engineering. The following is an overview of the findings.

Gender differences in academic confidence and the impact of those differences on girls' and women's mathematics, science and engineering achievement and their continuation in these fields have been a concern for a number of years. In the 1970s Fennema and Sherman (1978) found a decline in middle schools girls' mathematics confidence preceded a decline in their mathematics achievement. In the 1990s elementary school girls were found to have lower confidence in their mathematics capabilities than did boys, even though many of the girls had higher mathematics grades (Eccles et al., 1993; Casey, et al., 2001).

At the college level, women students have been found to feel less confident of their intellectual abilities than men students, again even when their grade point averages were at least as good as men's (Crawford and MacLeod, 1990; Raymond and Brett, 1995). Women's lower self-confidence in mathematics-related subjects was found to strongly predict a non-science and non-engineering major, while declining confidence during the early years of college often lead to a switch from science and engineering to other fields (Seymour and Hewitt, 1997; Sax, 1995). In a recent cross college study, Brainard, et al. (2001) found no differences by gender in college students' confidence in mathematics or chemistry courses, although men students' confidence was higher in engineering and physics courses as was their overall academic self-confidence.

The objective of this study is to move a step further, to look at the academic confidence of engineering college students during their first year and to explore the relationship between academic confidence and academic achievement, reflected in standardized test scores and grade point averages.

THE STUDENTS

A total of 354 pre and 254 post questionnaires were received from the entering Class of 1999 including 201 pre/post matches. The entering Class of 2000 provided 454 and 309 pre and post questionnaires, respectively with 273 pre/post matches. Women students represented 20% of the 1999 entering class and 18% of the 2000 entering class, while the largest racial ethnic group was European-American (1999-45%; 2000-54%) and other (1999-30%, 2000-22%). The make up of those for whom there were pre/post data available was similar (women 1999-22%; 2000-20%; European-Americans: 1999-47%; 2000-57%; other 1999-28%, 2000-21%). The small number of data from minority women students made analysis by sex and race/ethnicity inappropriate. Women students had higher high school grades than men students; however, there were no significant differences in their SAT I: Math scores.

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¹ Patricia Campbell, Campbell-Kibler Assoc., Inc. 80 Lakeside Dr., Groton, MA 01450; campbell@campbell-kibler.com; http://www.campbell-kibler.com

² Sara Wadia-Fascetti, Civil & Environmental Engineering & Connections, Northeastern University, Boston, MA 02115; swf@neu.edu

³ Lesley Perlman, Campbell-Kibler Assoc., Inc. 80 Lakeside Dr., Groton, MA 01450; lperlman@campbell-kibler.com

⁴ Earl Hadley, Campbell-Kibler Assoc., Inc. 80 Lakeside Dr., Groton, MA 01450; enhadley@campbell-kibler.com

TABLE I HIGH SCHOOL ACHIEVEMENT Entering Class of 1999 2000 Women Men Women Men High School GPA 3.6** 3.4 3.6** 3.4 632 635

627

636

SAT: Math Score **p<.01

This pattern of women's higher grades continued through the fall and winter quarters for first year students, but there were no significant gender differences in spring quarter grades. Both men and women's grades decreased during their first year, with women students experiencing a significantly greater decline.

TABLE II FIRST YEAR GRADE POINT AVERAGES (GPA) (REGISTRAR REPORT)

Entering Class of	1999		2000	
	Women	Men	Women	Men
Fall quarter grades	3.0*	2.8	3.3**	3.1
Winter quarter grades	2.9*	2.7	3.1***	2.8
Spring quarter grades	2.6	2.6	2.8	2.7

*p<.05; **p<.01, *** p<.001

By the end of their first year, according to registrar data, 73% of women students and 61% of the men students from the 1999 entering class remained in engineering in good standing. Women students were slightly more apt than men students to be at full sophomore standing (18% vs. 12%) and men students were more apt to have left Northeastern (13% vs. 5%). About the same percentage of men and women students transferred to other fields within Northeastern (9% vs. 10%).

Women and men students had a strong commitment to their engineering majors at the beginning and end of their first year at NU as measured by the pre/post questionnaires.

TABLE III COMMITMENT TO AMAJOR IN ENGINEERING (5=VERY MUCH; 1=NOT AT ALL)

	Enter	ing NU	At the en	d of 1 * year	
Entering Class of	Women	Men	Women	Men	
1999	4.3	4.3	4.2	4.1	
2000	4.3	4.4	4.3	4.3	

While these data are from students who remained at NU in engineering, there were no differences in their initial commitment to an engineering career between those for whom there were post data (4.3) in the spring of their first year and those for whom there was only pre data (4.2) in the fall of their first year.

ISSUES OF CONFIDENCEⁱ

Student confidence was explored using a variety of measures including registrar report (registrar) versus self report (self) of grades; student self report of academic confidence at the

beginning and end of their first year, student self report of changes in confidence and student rating of their academic skills compared to other students.

For their first year fall and winter quarters, student GPAs were collected both from the registrar and from student self report. In a measure of academic confidence, both women and men students significantly overestimated their GPAs.

TA	ABLE IV	
Comparisons of Registrar & Student Self-Reported 1 $^{\mbox{\tiny ST}}$ Year GPA		
	Women	Men

	Women		Men	
	Registrar	Self	Registrar	Self
Fall quarter grades				
1999 Entering Class	3.0**	3.2	2.9**	3.0
2000 Entering Class	3.2**	3.4	3.1**	3.2
Winter quarter grades				
1999 Entering Class	3.0**	3.1	2.8**	3.0
2000 Entering Class	3.1**	3.3	2.9**	3.1
11 01				

** p<.01.

Students were asked to rate their academic ability compared to their high school class and to other NU engineering students. In each case women's rating of themselves as in the top 10-25% of students was about the same as or significantly higher than were men's. Students' ratings of their academic ability was quite high with 40% or more of the students seeing themselves as being in the top 10-25% of students.

TABLE V

SIUDENI KATING OF THEIR ACADEMIC ABILITY						
					Top 10-25	5% of End
			Top 10)-25% of	of first y	ear NU
Entering	Top 10-25	% of High	Enter	ing NU	Engin	eering
Class	Schoo	l Class	Engineeri	ng Studen	ts Stuc	lents
	Women	Men	Women	Men	Women	Men
1999	84%	71%	45%	39%	45%	39%
2000	82%	81%	39%	42%	47%	45%

Students were asked about their confidence in a number of academic areas. In the entering Class of 1999, women students entered Northeastern slightly more confident in their ability to complete an engineering degree, but by spring, while men's confidence stayed at about the same level, women's had decreased significantly. The pattern was similar in academic confidence. Women and men came in at the same level of confidence in their academic ability, over their first year, men's confidence in their academic ability stayed at the same level as women's significantly decreased.

The pattern was very different for the entering Class of 2000. For these students, the only significant sex difference was in men students' greater confidence in their ability to do engineering, although during their first year women students confidence increased while men students' confidence remained about the same. Over their first year, there were significant changes in student confidence in their ability to

TABLE VI STUDENT REPORT OF SELF-CONFIDENCE IN ACADEMIC AREAS (5=VERY CONFIDENT: 1= NOT AT ALL CONFIDENT)

Entering Students	Fall		Spring		
	Women	Men	Women	Men	
Overall academic					
confidence					
1999 *	4.0	4.0	3.5	3.9	
2000	4.0	4.1	4.1	4.0	
Confidence in ability to					
do Engineering					
1999	3.9	4.1	3.8	4.1	
2000	3.8*	4.4	4.1*	4.3	
Confidence in ability to					
do complete a degree in					
Engineering					
1999**	4.3	4.2	3.9	4.3	
2000	4.4	4.4	4.4	4.3	
Confidence in ability to					
do Math					
1999	4.1	4.1	4.0	4.0	
2000**	4.2	4.1	4.3	4.0	
Confidence in ability to					
do English					
1999	3.7	3.4	3.6	3.6	
2000*	3.6	3.4	3.8	3.5	
* .05 ** .01					

*p<.05; **p<.01

Along with looking at actual changes in their academic self-confidence, students were asked the degree to which they felt their confidence had changed over their first year at NU. Both men and women students in the entering Class of 1999 felt their academic confidence had increased slightly in mathematics and English, while men students to feel their academic confidence had increased in science and engineering.

For the entering Class of 2000 the pattern was somewhat different with women students being significantly more apt to feel their academic confidence had increased in English, while there were not significant differences between men and women students' ratings of changes in their overall academic confidence nor of their confidence in mathematics or science.

TABLE VII
SELF REPORT OF CHANGES IN SELF-CONFIDENCE IN ACADEMIC AREAS
DURING STUDENT FIRST YEAR AT NU
$(5-INCDEASE \cdot 1-DECDEASE)$

(J=INCREASE; I=DECREASE)		
Entering Students	Women	Men
Changes in overall academic self-confidence		
1999*	3.0	3.4
2000	3.7	3.5
Changes in Math self-confidence		
1999	3.3	3.4
2000	3.6	3.3
Changes in Science self-confidence		
1999*	2.8	3.3
2000	3.5	3.5
Changes in English self-confidence		
1999	3.6	3.6
2000*	3.9	3.5

*p<.05.

DISCUSSION

A study that quantifies the academic confidence compared to the academic performance and achievement of first year engineering college students' is presented. Academic confidence is measured through self-report of grades, position in class, confidence and change in confidence. Academic performance and academic achievement is reflected in standardized test scores, grade point averages and continuation in engineering as a student in good standing. Pre and post questionnaires were received from two cohorts of first year engineering students. The following observations are made:

- Women begin their engineering college careers with higher (self reported) high school grade point averages than men, with no significant difference in SAT scores.
- At the completion of the first year, women experienced a significantly greater decline in grade point average (fall through spring of the first year) than men moving to about the same GPA as men.
- Women experienced greater academic achievement than men. For the 1999 entering class, 73% of women students and 61% of men students remained in engineering in good standing. Women were slightly more apt than men to be at full sophomore standing and men were more apt to leave Northeastern at the end of the first year. Women did better than men on the academic achievement measures of grade point average, retention and advancement.
- Women and men reported a similarly strong commitments to engineering majors.
- As a measure of confidence, both men and women overestimated their grade point averages and their class performance relative to other students.
- The change in confidence during the first year was different for the 1999 and 2000 entering classes. The women in the 1999 entering class suffered a decrease in academic confidence and a decrease in their confidence

to complete an engineering degree, while men's confidence remained the same. The pattern was different for the 2000 entering class, in which women experienced an increase in confidence relative to their ability to do mathematics and English compared to men. For both years there were not sex differences in others areas.

The observations listed above demonstrate the importance of looking at confidence relative to achievement. The issues surrounding confidence are complex and gender considerations represent only one variable. Interestingly, women and men who entered in 1999 and 2000 started with similar profiles, yet the 2000 entering class experienced a much better first year than the 1999 entering class in terms of grades and confidence measures.

The data suggest that women are preselected prior to entering the NU undergraduate engineering program. In other words, women who begin the engineering program are those who are prepared and determined to succeed. The retention of women in engineering is better than that of men, which suggests that efforts should lay in the recruitment of women.

Northeastern University and the College of Engineering offer a number of services to help first year students make successful transitions into college. Further research is required to understand better the factors that influence the different patterns in confidence observed with the two cohorts. At this time, there are no known differences between services offered to students who entered in 2000 compared to 1999.

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ⁱ Post data was not available for students who were no longer in Engineering. However, comparisons between students for whom there was no post data and students for whom there was found no difference in their initial confidence in being able to complete a degree in engineering (1999 – 4.2 for both groups; 2000 – 4.3 students with pre data only; 4.4 students with pre and post data nor in their confidence in their academic ability (1999 – 4.0 both groups; 2000 – 4.1 both groups).