FEMALE AND MALE ENGINEERING STUDENT PERCEPTIONS OF AND PREFERENCES FOR THE CLASSROOM ENVIRONMENT

Karen Paulson
Research Assistant

Center for the Study of Higher Education
The Pennsylvania State University
University Park, Pennsylvania

Introduction

This study is a preliminary report of findings from dissertation research investigating what relationship exists between a student's perception of and preference for the classroom environment and her/his persistence in engineering. Previous studies have either focused primarily on the role of the institutional environment on student retention or on classroom pedagogy, but little has been done to link the classroom environment with persistence. Another unique feature of this research is its attention to not only student perceptions of the classroom environment, but to preferences for the classroom environment. The question addressed in today's presentation is, "Are there gender differences in perceptions of and preferences for the engineering classroom environment?"

Methodology

A paper and pencil survey was administered to students enrolled in lower-division, required pre-engineering courses at two large research institutions--University of Washington and The Pennsylvania State University. The courses surveyed were typical pre-engineering courses such as engineering graphics, statics, dynamics, thermodynamics, and strength of materials. The survey was adapted from the Science Learning Environment Inventory[1], the College and University Classroom Environment Inventory[2] and had additional items added to assess awareness of gender discrimination[3]. The environment dimensions included on the survey were open-endedness, integration of subject matter, rule clarity, student cohesiveness, faculty interaction, material environment, and awareness of gender discrimination. Students were asked to indicate first their perception of and then their preference for the environment of the class in which the survey was administered. The following response scale was used: 1 - Almost Never, 2 - Seldom, 3 - Sometimes, 4 - Often, 5 - Very Often. Finally, students were asked background and demographic questions such as whether they previously had been employed as an engineer, their parent's educational background, as well as, age, gender, etc.

At Penn State University, a single lower-division, required pre-engineering course with fifteen sections was surveyed, and each professor gave permission for the survey to be administered during class time. At Washington, five courses consisting of fourteen total sections were surveyed; six professors were able to give class time for administration of the survey, and the remaining eight professors allowed an explanation and distribution of surveys and return envelopes at the beginning or end of class.

Analysis

T-tests were done to determine statistically significant gender differences in the mean responses to each of the 48 perception and 48 preference items. The Cochran correction was used when the group variances were unequal.

Results

The response rate at The Pennsylvania State University was 88%. The overall response rate at the University of Washington was approximately 50%. Washington's response rate is skewed because some students were enrolled in multiple courses that were surveyed, but they were asked to complete only one survey in the first class surveyed.

Table 1 is a summary of the number of items by classroom environment dimension that exhibited statistical significance ($p<0.01$) in t-tests of gender differences in the mean item responses. Those items which were statistically significant are summarized with means, standard deviations, and number responding in Tables 2-6.

Discussion

While most of the survey items do not exhibit statistically significant gender differences, those that do are interesting. For both schools, nearly all of the perception items for awareness of gender discrimination have statistically significant differences in responses by gender. Data such as these indicate that, even when the magnitude of perceived discrimination is low (note that item means are in the "almost never" to "seldom" range), women are more aware of discrimination in the environment that their male classmates.

For Penn State, several of the preference items of the faculty interaction and student cohesiveness dimensions have statistically significant gender differences. These findings support much of the qualitative research done recently that hypothesizes that women learn using "connected knowing", particularly by forging personal interaction with others[4]. Fewer items--perception or preference--were statistically significant at the University of Washington. Both schools had one or two items of the integration dimension have statistically significant differences by gender. This finding also supports the desire of women to have their knowledge and information presented to them in an integrated manner rather than in segmented units.

Conclusion and Future Research

These data indicate women are more aware of gender discrimination in the engineering classroom; the second phase of this research will help shed light on whether their heightened awareness has any interaction with persistence in engineering. Furthermore, this research lends empirical credence to recent qualitative investigations which have found differences in ways of knowing between women and men. Again, it will be in the second phase of the research when any interaction between student's responses to the survey and their persistence in engineering is determined.

References

1. Fraser, B.J., Giddings, G.J., & McRobbie, C.J. (in press). Evolution and validation of a personal form of an instrument for assessing science laboratory classroom environment. Journal of Research in Science Teaching.
2. Fraser, B.J., Treagust, D.F., & Dennis, N.C. (1986). Development of an instrument for assessing classroom psychosocial environment at universities and colleges. Studies in Higher Education, 11(1), 43-54.
3. Cabrera, A.F., & Nora, A. (1994). College students' perceptions of prejudice and discrimination and their feelings of alienation: A construct validation approach. Research in Education, XVI.
4. Belenky, M.F., Clinchy, B.M., Goldberger, N.R., & Tarule, J.M. (1986). Women's ways of knowing: The development of self, voice, and mind. New York: Basic Books, Inc., Publishers.

Table 1.
Number of Survey Items Statistically Significant for p<0.01

Dimension	Penn State University		University of Washington	
	Perception	Preference	Perception	Preference
Open-Endedness	0/7	1/7	0/7	0/7
Integration	0/7	2/7	1/7	1/7
Rule Clarity	0/7	2/7	0/7	1/7
Student Cohesiveness	0/7	3/7	0/7	0/7
Faculty Interaction	0/7	3/7	0/7	1/7
Material Environment	0/7	0/7	1/7	1/7
Awareness of Gender Discrimination	5/6	2/6	5/6	0/6

Table 2.
Statistically Significant Differences in Means by Sex, p<0.0001
University of Washington

Question Wording	Female Mean S.D. N	Male Mean S.D. N	Cochran Correction Used?
PERCEPTION ITEMS			
Students in this college are prejudiced against women.	2.04 0.81 70	1.54 0.74 166	No.
I believe this college is fair to female students.	3.99 0.76 72	4.51 0.80 169	No.
I have encountered sexism while attending classes in this college.	1.82 0.96 71	1.25 0.60 171	Yes.
PREFERENCE ITEMS			
My regular ENGR XX class work would be integrated with laboratory activities.	4.31 0.80 68	3.75 0.95 162	No.

Table 3.
Statistically Significant Differences in Means by Sex, $p<0.01$
University of Washington

Question Wording	Female Mean S.D. N	Male Mean S.D. N	Cochran Correction Used?
PERCEPTION ITEMS			
I have observed discriminatory words, behaviors, or gestures directed at female students.	1.45 0.79 71	1.17 0.50 170	Yes.
One hears negative comments about women while attending classes.	1.42 0.78 72	1.11 0.36 169	Yes.
The topics covered in regular ENGR XX class work are quite different from topics with which I deal in laboratory sessions.	2.42 1.12 67	2.85 1.05 168	No.
The laboratory is an attractive place for me to work in.	2.31 1.13 67	2.76 1.06 170	No.
PREFERENCE ITEMS			
I would find that the laboratory is crowded when I am doing experiments.	1.38 0.71 68	1.72 1.00 163	Yes.
The instructor would talk individually with students.	4.33 0.87 72	3.94 0.89 164	No.
The instructor would outline safety precautions to me before my design laboratory sessions commence.	4.25 0.88 56	3.80 1.17 147	Yes.

Table 4.
Statistically Significant Differences in Means by Sex, p<0.0001
The Pennsylvania State University

Question Wording	Female Mean S.D. N	Male Mean S.D. N	Cochran Correction Used?
PERCEPTION ITEMS			
Students in this college are prejudiced against women.	2.04 0.97 100	1.58 0.75 281	Yes.
I have observed discriminatory words, behaviors, or gestures directed at female students.	1.72 1.03 101	1.27 0.63 292	Yes.
One hears negative comments about women while attending classes.	1.53 0.83 101	1.14 0.40 293	Yes.
I believe this college is fair to female students.	4.03 0.84 101	4.54 0.78 290	No.
I have encountered sexism while attending classes in this college.	1.77 1.02 101	1.30 0.74 290	Yes.
PREFERENCE ITEMS			
What I do in laboratory sessions would help me to understand the theory covered in regular ENGR XX classes.	4.38 0.94 95	3.92 0.96 287	No.

Table 5.
Statistically Significant Differences in Means by Sex, p<0.001
The Pennsylvania State University

Question Wording	Female Mean S.D. N	Male Mean S.D. N	Cochran Correction Used?
PREFERENCE ITEMS			
In the design laboratory, I would be required to design my own experiments to solve a given problem.	3.06 1.03 98	3.48 1.05 287	No.
I would encounter sexism while attending classes in this college.	1.04 0.20 98	1.18 0.63 285	Yes.
I would work cooperatively in laboratory sessions.	4.67 0.66 97	4.37 0.78 287	No.

Note: No perception items had statistically significant differences.

Table 6.
Statistically Significant Differences in Means by Sex, $p<0.01$
The Pennsylvania State University

Question Wording	Female Mean S.D. N	Male Mean S.D. N	Cochran Correction Used?
PREFERENCE ITEMS			
My regular ENGR XX class work would be integrated with laboratory activities.	4.21 0.78 97	3.92 1.02 288	Yes.
One would hear negative comments about women while attending classes.	1.04 0.24 99	1.18 0.65 285	Yes.
I would get to know students in the design laboratory well.	4.66 0.70 99	4.39 0.75 289	No.
The instructor would help each student who is having trouble with the work.	4.73 0.58 98	4.51 0.68 289	No.
The instructor would seldom move around the classroom to talk with students.	1.34 0.99 99	1.75 1.27 287	Yes.
It would take me a long time to get to know everybody by her/his first name in the design laboratory.	1.41 0.76 98	1.72 1.02 287	Yes.
My design laboratory work would have clear rules to guide my activities.	3.91 0.94 96	3.54 1.07 288	No.
The instructor would be unfriendly and inconsiderate towards students.	1.04 0.25 98	1.17 0.62 287	Yes.
My design laboratory work would be run under clearer rules than my other classes.	3.55 1.03 97	3.19 1.02 285	No.

Note: No perception items had statistically significant differences.