

## **WOMEN'S EXPERIENCES IN COLLEGE ENGINEERING AND SUPPORT PROGRAMS: FINDINGS FROM THE WECE PROJECT**

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The Women's Experiences in College Engineering Project (WECE) is the first controlled, cross-institutional study designed to identify which aspects of their educational experiences are critical to young women's retention and success in engineering and, most importantly, *why these aspects lead to success*. A total of 53 institutions nationwide are participating in the WECE study; these colleges and universities were chosen to represent a range of institutional size, region, engineering emphasis, Carnegie classification, funding source, and the presence or absence of a formal Women in Engineering (WIE) program.

At each institution, three rounds of surveys (spring 1999, 2000, and 2001) are being conducted of all women majoring or intending to major in engineering. Each year about 21,000 women are invited to participate in the survey. During the first year of the program (1998-99), 6934 women (33%) responded to the on-line questionnaire, which took 30-40 minutes to complete. The three sections of the survey focus on student perceptions of engineering, participation in engineering support programs, and background and demographic information.

To situate the student data in its larger institutional context, the WECE study also conducted a one-time survey of engineering faculty members at the 53 participating institutions (fall 1999), interviewed WIE directors, and is conducting site visits to a sub sample of schools.

Our session reports on three aspects of the first year of WECE study: college women's participation in engineering support activities, WIE director interviews, and faculty survey data. This paper provides a brief overview of some of the findings; a complete paper on each of these topics is available from the authors upon request.

## COLLEGE WOMEN'S PARTICIPATION IN ENGINEERING SUPPORT ACTIVITIES

### Program Participation

One of the aims of this study is to better understand which engineering support programs women utilize and when. In the survey, women are asked to identify the support activities they participated in during each year of their undergraduate career. Table 1 reports the percentage of students who participated in each activity broken down by college year and for all years. These data demonstrate that, in general, as women progress in their undergraduate engineering career, they become more likely to engage in support activities. For most of the activities, the percentage of women participating in an activity increases each year. For example, study groups, internships, career counseling, engineering society activities, speakers, and field trips are all utilized by an increasingly large percentage of students each year of college.

A few of the activities do not follow this trend. Not surprisingly, fewer students receive peer mentoring (and more act as peer mentors) as they move through their undergraduate engineering careers. The percentage of students who report receiving tutoring peaks in sophomore year (a notoriously difficult year) and then diminishes. Receiving academic advising remains fairly constant across the years.

Table 1: Percentage of Women Participating in Support Activities

Activity	All	Frosh	Soph.	Jr	Sr
Study or support group	85.6%	72.9	86.8	90.5	90.7
Internship/ Research experience	49.7	14.2	36.6	59.0	80.7
Received tutoring	55.6	57.4	60.3	56.2	49.8
Received academic advising	92.5	90.3	93.8	92.8	93.0
Received career counseling	46.8	34.4	44.8	48.3	57.0
Received peer mentoring	41.4	49.1	44.0	39.0	35.0
Participated in email mentoring	19.0	22.6	16.8	17.3	20.0
Been a mentor or "buddy"	28.6	16.1	26.5	31.9	37.6
Been a tutor	33.3	20.9	30.5	35.3	42.9
Read engineering newsletter or listserv	78.4	73.3	75.8	79.2	84.0
Engineering society activities (e.g., IEEE, SWE)	74.1	60.3	71.4	76.3	85.4
Engineering speaker	49.0	41.7	45.6	49.6	56.9
Field trip to industry site	46.2	25.5	37.1	50.9	66.0
Engineering social event	67.4	58.8	62.5	69.0	76.8
Participated in engineering orientation	56.8	69.1	56.6	51.1	52.1
Worked with outreach to high school students	24.7	14.7	22.0	26.3	33.8
Lived in engineering dorm	14.8	15.6	16.1	14.0	13.7
Engineering retreat	8.9	6.2	9.0	9.2	10.8

To assess students' interest in support activities, we asked "If it were available, would you participate or participate again in any of the following activities?" Dividing the responses into two populations—those who had previously participated in the activity and those who had not previously participated in the activity—permits one measure of student value of an activity.

Our data indicate that undergraduate women who had previously participated in an activity were much more likely than women who had not ever participated to indicate that they would "definitely" or "probably" participate again in that activity. For 11 of the 18 activities, over 90% of the participants responded that they would definitely or probably participate again! The remaining 7 activities were also viewed positively by their participants; for 5 activities 80-90% responded favorably, and the last two garnered support from 70-80% of students who had previously participated. Especially noteworthy was the extremely positive response to the internship/research experience.

### **Motivation for Participation**

In addition to knowing which activities women are utilizing, our study was also interested in why women chose to participate in support activities. For each activity that a respondent indicated she had been involved with, she was asked to select which reasons influenced her participation. To investigate whether students' reasons differ during their college engineering career, we also analyzed the reasons that were chosen by year of school.

A core group of reasons are most frequently cited by students. Learning about opportunities in engineering, and socializing with other women and men in engineering are the primary motivations for program participation throughout the college career. Being in a supportive atmosphere is another reason students frequently mention. However, the reasons for participation do vary across years; getting advice or mentoring about engineering is commonly cited during the first two years of schools, while learning more about specific fields of engineering is more commonly chosen by upperclasswomen.

## **LEARNING FROM WIE DIRECTORS**

To better understand structural and programmatic aspects of existing Women in Engineering programs, and understand what contributes to successful programs, the WECE staff conducted a 30-45 minute semi-structured interview with each of the 28 WIE (or WISE) directors participating in our study.

## **Director and Program Demographics**

In our sample, 100% of the WIE directors are women. 33.3% of these women spent all of their time on WIE activities. For 28.6% of WIE directors, WIE activities comprised 50-80% of their responsibilities, and the remaining 38.1% spent less than 50% of their time on WIE programs. In general, WIE directors report either directly to the dean (39.3%) or to an assistant or associate dean (32.1%). A few report to either the provost, president, or a director of another university program.

Salary support for the majority of the directors (92.3%) is provided by the university; 7.7% are funded by corporations or foundations. However, WIE programming itself relies heavily on external sources of funding. Only seven of the 28 directors (25.9%) draw upon university funds to run their programs. More commonly, activities are supported by a combination of corporate monies (92.6% of programs cite this as a source of funding), governmental grants (48.1%), and alumnae (11.1%).

Four types of activities are mentioned as WIE directors' major responsibilities: 80.8% of directors cite retention, 53.5% recruiting, 46.2% fundraising, and 19.2% advising. Teaching a course and serving as the SWE advisor are also included in the purview of some directors' jobs.

## **Activities and Advice**

WIE programs encompass a wide range of activities. During the interview, WIE directors were asked to identify their most popular activity. They mentioned mentoring (25.0%), career day/conference (14.3%), orientation (14.3%), and speakers (10.7%). Other less frequently cited activities included SWE, scholarships, internships, outreach activities and living in an engineering-based residence hall.

The WIE directors in our study have a wealth of experience about how to craft and manage a program that succeeds. When asked for suggestions for new WIE directors, the most emphatic and prevalent piece of advice was that WIE directors should get support from their administration (63.0% cited this) and faculty (48.1%). Quite a few mentioned how helpful it was to network with other WIE directors (22.2%) for support and ideas. They also recommended that the director draw upon existing resources at the university (18.5%) and talk with students to stay informed about their needs (18.5%). Other advice included starting modestly when building a program from scratch, having a clear plan and vision for the future, and building connections with industry. Finally, the directors recognized the importance of communicating the results of their programs to faculty and administrators and providing a clear justification for the program.

At most institutions, the WIE staff is very small. Thus, communicating with other people who are working on similar programs can be very important. We learned that directors of WIE programs network on many levels, both nationally and locally. Responses clearly indicate that WEPAN is an important source of information and support. The WEPAN conference was cited by 77.8% of directors, and 51.9% mentioned the WEPAN listserv. WIE administrators also spoke about their communications with other directors (44.4%), their participation in the SWE conferences (22.2%), or other non-WEPAN conferences (25.9%).

### MALE AND FEMALE FACULTY PERCEPTIONS

One construct in our theoretical model is campus climate. In addition to surveying students, we also conducted a one-time questionnaire of male and female faculty members at the 53 institutions. This instrument serves both as another gauge of climate and to provide additional information about the participating institutions. The faculty survey, which took 10-15 minutes to complete, was administered via the Web. The questionnaire asked about teaching, advising, and perceptions of a variety of engineering related topics and issues. 6934 faculty members were invited to participate. We have data from 1387 faculty (20%). 85.7% of our sample is male and 14.3% female. Of particular interest in this paper was whether male and female faculty members' perceptions differed and how they differed. Mann-Whitney tests of significance were run to assess the differences between the sexes.

This survey asked faculty to compare the female and male undergraduate students' academic preparation and abilities. Faculty responded to this question in similar ways (only responses to the study skill variable were significant by sex (.014)). It is interesting to note that faculty perceive that female engineering undergraduates academic preparation and study skills are as good as, if not better, than their male peers. Table 2 summarizes faculty responses.

Table 2: Faculty comparisons of academic skills of male and female engineering students

Females are:	Better	No difference	Worse
Academic preparation	41.0%	56.0%	3.1%
Study habits	68.2	31.3	0.4
Laboratory skills	13.5	65.9	20.5
Engineering abilities	12.8	75.6	11.4
Mathematical abilities	20.6	71.3	7.7

Male and female faculty members' responses did vary on a number of other issues, however. In particular, they perceived university and departmental climate and support and workplace conditions differently, and report differences in how often they hear undergraduate women complain about unfair treatment. Table 3 reports Mann-Whitney levels of significance for a range of questions that faculty answered.

Table 3: Difference between male and female faculty perceptions

Perception	Significance
Whether conditions favor male or female undergraduates	.000**
Department is genuinely committed to helping undergraduate women complete their engineering degree	.000**
Department should do more to retain undergraduate women in engineering majors.	.020*
Department is supportive of undergraduate women	.000**
Engineering climate at their university favors undergraduate men	.000**
Should use gender-neutral language in class	.035*
Encourage students to do homework together	.005**
Encourage students to do projects together	.156
Grade on a curve	.094
Hear undergrads complain about teaching assistants treating women in engineering unfairly	.000**
Hear undergrads complain about undergrad men treating undergrad women in engineering unfairly	.000**
Hear undergrads complain about faculty treating undergrad women in engineering unfairly	.000**
University should make special efforts to recruit women for engineering	.072
University should have special programs for women in engineering	.001**
Whether conditions favor males or females in the engineering workplace	.000**
Easier for women to go into some fields of engineering than others	.002**
More difficult for a woman to balance career and family in engineering than most other fields	.000**
Women who are beginning their engineering career are generally offered higher paying jobs than men	.000**

\* p • .05

\*\* p • .005

That men and women faculty's perceptions significantly differed on such a number of issues relating to gender is noteworthy. Not surprisingly, in general, women perceived conditions in the workplace and the university to be less favorable for women than male faculty did. Also, women faculty report that they were much more likely to hear undergraduates complain about unfair treatment of women than male faculty. Such initial findings indicate that further analysis is warranted.

This paper provides only an overview of some of the research from the first year of the WECE project. Complete papers on each of the three topics outlined here are available from the authors.