

THE IMPACT OF SUPPORT PROGRAMS AND RESOURCES ON UNDERGRADUATE WOMEN'S PERSISTENCE IN ENGINEERING

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Abstract *¾ The Women's Experience in College Engineering (WECE) project is the first cross-institutional, longitudinal examination of the impact of Women in Engineering programs on undergraduate women's persistence in engineering. This paper provides an overview of the findings from the WECE study related to women's participation in support activities. These include women's participation in social enrichment activities, get help activities, give help activities, study groups, and internship/research experiences. Women's reasons for participating in these types of activities as well as the effect of such participation on their persistence in engineering are reported.*

Index Terms *¾ Evaluation, persistence, quantitative, longitudinal, undergraduate engineering*

THE WECE STUDY

In most colleges, the persistence of undergraduate women in engineering majors is still much lower than that of men. The Women's Experience in College Engineering (WECE) project is the first cross-institutional, longitudinal examination of the impact of Women in Engineering programs on undergraduate women's persistence in engineering. Carried out by Goodman Research Group, Inc. (GRG), the WECE project has been particularly interested in the roles that institutions, faculty, and the students themselves play in the persistence of women in engineering.

Fifty-three institutions with undergraduate engineering schools participated in the WECE project. Of these, 26 schools had formal Women in Engineering (WIE) programs

and were matched with a random sample of 27 schools that did not have such programs. These schools were selected to represent a range of geographic regions, sizes of engineering programs, Carnegie classifications, and levels of selectivity. The participating schools represent a wide range of public schools, private institutions, and technical schools, as well as those that offer liberal arts education. This paper reports findings based on analyses of data from all participating institutions.

The primary research data for this study are from a computer-adaptive, web-based survey of undergraduate women in engineering that was administered for three years (1999, 2000, 2001). The survey asked about students' backgrounds, their perceptions of and experiences in engineering, and their interactions with support programs and resources. The questionnaire asked approximately 220 questions and took 30-40 minutes to complete. Each year, about 23,000 undergraduate women at 53 institutions nationwide were invited to participate in the study--about 8,500 women completed the survey each year. Table 1 provides a summary of the survey response rate.

To situate student data in its larger institutional context, we also surveyed engineering faculty and administrators, and directors of WIE programs, and conducted site visits at a subsample of schools that included interviews with deans, faculty, WIE directors and other support program directors, and conducted focus groups with female engineering students.

TABLE I: WECE STUDENT SURVEY RESPONSE ACROSS THE THREE WAVES

Year	Invited	Responded	Response rate	Stayers	Leavers	Completed 2 of the 3 years	Completed all 3 years
1999	21,000	6,926	33%	96%	4%		
2000	22,516	9,231	41%	92%	8%	3,127*	
2001	24,809	8,999	36%	92%	8%	3,769**	1,302***

* 59% (3,127) of the women who were eligible to complete a second survey during the second round of data collection chose to participate for a second year.

** 57% of the women who completed the survey in 2000 and were eligible to complete the survey in 2001 chose to participate both times.

*** 66% of the women who were eligible for all three years and participated twice went on to participate all three times.

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Three types of statistical techniques were utilized to conduct the quantitative analyses of student data.

- **Cross-sectional analyses:** attention was focused on differences between those women who left engineering and those who persisted in engineering. In addition, differences across years of school on outcomes were analyzed. Using the multiple outcomes approach, it is possible to determine if and how groups differed on these measures³ analyzed. Using the multiple outcomes approach, it is possible to determine if and how groups differed on these measures.
- **Hierarchical linear modeling:** a means of modeling individual outcome variables (e.g., commitment to engineering) as they change over time as a function of individual and institutional predictor variables, each of which may be time-invariant (e.g., math SAT score) or time-varying (e.g., the proportion of students enrolled in engineering who are female).
- **Event history analysis:** (also referred to as “survival analysis”) was used to predict the probability of a particular event (in this case leaving engineering) occurring at a particular point in time.

This paper provides an overview of the findings from the WECE study related to women’s participation in support activities. A more detailed description of the study, its methods, and the findings is available at <http://www.grginc.com/wecesumm.htm>

TYPES OF SUPPORT ACTIVITIES

On the survey, women were asked to indicate whether or not they had participated in 18 different types of engineering support activities. For analytic purposes, we grouped related activities into scales that included:

- **Participation in Social Enrichment Activities:** A 16-point scale composed of survey items measuring the frequency of participation in engineering activities of a social and/or enrichment nature. Included in this scale are field trips, guest speakers, engineering social events, and engineering society events.
- **Participation in Get Help Activities:** A 16-point scale composed of survey items measuring frequency of participation in activities in which women received help from others through such programs as tutoring, peer mentoring, career mentoring, and email mentoring.
- **Participation in Give Help Activities:** An 8-point scale composed of two survey items measuring frequency of participation in programs in which students helped other students—in this case mentoring and tutoring.

- **Overall Participation:** A 40-point scale that is the sum of the Get Help, Give Help, and Social Enrichment participation scales: it includes all activities that compose the three scales.

Two other variables were also used in the analyses:

- **Study Group:** The frequency with which a student participated in a study group.
- **Internship/Research Experience:** Whether or not a student participated in an internship or research experience.

Students participated in a variety of activities and support resources during their undergraduate years. The proportion of students participating in a particular kind of activity almost always varied by undergraduate year, with the exception of academic advising: slightly more than four-fifths of all students made use of this resource (possibly because it was required at many schools).

Students later in their engineering program were more likely to participate than freshmen and sophomore students in most engineering support activities:

- Study and support groups in engineering: though always frequented by a large majority of students, participation increased by about 4% each year through senior year
- Reading an engineering newsletter
- Internship/research, in which participation increased dramatically from freshman year (less than a fifth of respondents) to senior/fifth year (more than two-thirds of respondents)
- Engineering society, increasing from half of freshmen respondents to three-quarters of senior/fifth year students
- Social events: participation increased from two-fifths (freshwomen) to two-thirds (senior/fifth-year)
- Engineering speaker, increasing from a third to nearly two-thirds
- Career counseling
- Field trips to industry, tripling by senior year from a fifth in freshman year
- Being a tutor or a mentor to a younger student
- Working with high school students: more than doubling from a tenth to a quarter

A few programs were more likely to be used by women in engineering in the first years of college

- Nearly half of freshmen respondents received tutoring; the number decreased to a third by senior year
- A third of freshmen had peer mentors; a quarter of women did in other years.

³ Analyses of institutional characteristics (see <http://www.grginc.com/wecesumm.htm>) could find almost no institutional characteristics that were significantly related to women’s participation in support activities.

REASONS FOR PARTICIPATING

Women were asked why they participated in each activity in which they had participated. The most frequently cited reasons – those selected by 33% or more of student participants – are highlighted below.

The most common reasons cited for ‘Get Help’ activities were:

- ‘Learning about opportunities in engineering’ was chosen by nearly half of women as their reason to receive career counseling, and by more than a third of those receiving peer mentoring and participating in online mentoring with an engineer.
- More than a third of participants receiving peer mentoring and online mentoring with an engineer said they did so to socialize with other women in engineering.

Women who participated in ‘Give Help’ activities overwhelmingly said they did so to help others: two-thirds to three-quarters of students chose this reason. About two-fifths of students who acted as a mentor or ‘buddy’ to newer students also said they did so in order to socialize with other women in engineering.

Women participated in engineering society activities for many different reasons. This is not surprising, since the mission of such organizations is to serve a variety of needs of engineering undergraduates.

- Students participated in engineering social events in order to socialize with other women in engineering (two-thirds to three-quarters of students) and to socialize with men in engineering (almost half to two-thirds).
- ‘Learning about opportunities in engineering’ was an important reason for more than half of students participating in engineering society activities, listening to an engineering speaker, or taking a field trip to an industry site.
- Two-fifths of students indicated that they participated in engineering society activities in order to be in a supportive atmosphere.
- Women participated in society activities, went on field trips, and listened to engineering speakers so they could learn about an engineering topic of interest and also learn more about specific fields in engineering (two-fifths to three-fifths of survey participants).
- A third of participating students indicated that they attended talks by engineering speakers and went to engineering society activities in order to talk about issues of concern in engineering.

Reasons women participated in a study or support group (n=19,629) were:

- Getting help with engineering coursework (78.8%)
- Being in a supportive atmosphere (46.2%)
- Socializing with other women in engineering (39.3%)
- Helping others (38.1%)
- Socializing with men in engineering (36.0%)

Reasons for participating in Internship/ Research experience (n=14,034) were:

- Earning money (53.8%)
- Learning more about specific fields in engineering (51.5%)
- Learning about opportunities in engineering (48.1%)
- Learning about a topic of interest related to engineering (42.5%)

Reasons for ‘Read engineering newsletter’ or ‘listserv’ (n=13,191) were:

- Learning about opportunities in engineering (57.5%)
- Learning about a topic of interest related to engineering (55.8%)
- Learning more about specific fields in engineering (47.3%)

Categories for why students ‘received academic advising’ (n=19,541) were:

- Getting advice or mentoring about engineering (45.5%)
- Getting career counseling or information (35.7%)
- Learning about opportunities in engineering (35.6%)

Students who worked with outreach to high school students overwhelmingly said they did so in order to help others. Of 3,444 students, 78.6% cited this reason.

WIE AND SWE ACTIVITIES

Many students participated in SWE-sponsored programs, or in programs sponsored by the WIE program at their school, if one existed. About half of students who participated in an engineering society were participating in the Society for Women Engineers (SWE). About a third of students who read an engineering newsletter, heard an engineering speaker, went to a social event, or worked with outreach to high school students were participating in SWE-sponsored activities.

Students cited the school WIE program as a common sponsor of online mentoring with an engineer (25%). WIE programs were recognized by students as sponsoring between a tenth and a fifth of the peer mentoring opportunities (both for mentor and protege),

engineering newsletters, engineering society activities, engineering speakers, social events, and high school outreach. All of these programs were also often indicated by students to have been sponsored by SWE, at universities with or without a WIE program.

Other programs like tutoring, internships and study groups, career counseling and academic advising – all activities that are often sponsored by the university, department, or classroom, or individually arranged – still had a number of students indicating that their participation was sponsored by the WIE program and/or by SWE.

LIKELIHOOD OF PARTICIPATING AGAIN

To assess the value that students place on the 18 various support activities, we asked “If it were available, would you participate or participate in any of the following activities?” Students who had participated in the activities previously were much more likely to indicate that they would “definitely” or “probably” participate again in the activity than those who had not participated.

For 11 of the 18 activities, over 90% of the prior participants responded that they would definitely or probably participate again. The remaining 7 activities were also viewed positively by their participants, with between 70% and 90% responding favorably. Especially worth noting is the extremely positive response to the internship/research experience (98% said they would participate again).

Even those who had never participated in support programs indicated that they were likely to participate if the program were available: especially in internships, career counseling, mentoring, and industry field trips; more than half showed at least some interest in participating in most of the programs we asked about.

Considering the many influences on students’ decision about which college to attend, a surprising number – nearly a third – of students who attended schools with WIE programs said they were influenced in their decision by the presence of support programs for women in engineering on campus.

PARTICIPATION IN SUPPORT ACTIVITIES RELATED TO PERSISTENCE

We measured whether participation in support activities and resources was related to undergraduate women’s persistence in an engineering major. In general, we found that students who ended up leaving engineering in a subsequent year participated in fewer support activities overall than those who remained in engineering. The difference between the means of these populations was significant. As stated earlier, upperclasswomen were more likely to participate than

were freshmen and sophomores in most engineering support activities.

Social Enrichment Activities

Most students participated in social enrichment activities in order to socialize with other women and men in engineering, be in a supportive environment, and learn about opportunities in engineering, and learn more about specific topics of interest

Stayer-leaver analysis suggests that students who became leavers in a later year participated in fewer social enrichment activities than those who subsequently stayed in engineering, and this difference was significant.

Survival analysis found that social enrichment participation remained significant after considering the effects of women’s self-confidence and the effect of their Perceptions of Department Environment. This suggests that there is a unique attribute to social enrichment participation that contributes to a woman’s decision to stay in engineering.

Giving Help

Students who participated in ‘Give Help’ activities overwhelmingly said they did so to help others or to socialize with other women in engineering.

Stayer-leaver analysis indicates that there were not significant differences between levels of participation in Give Help activities between students who will stay or leave engineering in a subsequent year.

Survival analysis found that Give Help participation was not related to leaving engineering.

Getting Help

Students participated in mentoring and tutoring to learn more about the opportunities in engineering and to socialize with other women in engineering.

Stayer-leaver analysis indicates that there were not significant differences between levels of participation in Get Help activities between students who will stay or leave engineering a subsequent year.

Survival analysis found that Get Help participation was not related to leaving engineering.

Study Group

Women participated in study groups primarily in order to get help with engineering coursework. They also said they participated in order to be in a supportive atmosphere, in order to socialize with other women and with men in engineering, and in order to help others.

Stayer-leaver analysis showed that from freshman year onward, students who stayed in engineering had

been participating in study groups more frequently than those who left the major. A Chi Square test indicates that the freshmen's frequency of participation was significantly related to their later persistence in engineering.

Internship/Research Experience

About half of students indicated that they chose to participate in an internship or research experience in order to earn money learn more about specific fields of or opportunities in engineering.

Stayer-leaver analysis indicated that a higher percentage of students who stay in engineering a subsequent year have held a research or internship position than those who leave engineering. However, Chi Square tests indicate that these differences were not significant.

SUMMARY AND CONCLUSIONS

Participation in support activities is vital to women undergraduates, who need to feel that they are part of a larger caring community in engineering. Being a part of that community allows students to build networks and to feel that their presence in engineering is valued. Networking can counteract the isolation that women feel – providing them with information and support, as well as knowledge that they're not alone in the challenges they face.

This sense of community and information sharing can be achieved through socializing with other students, being part of a study group, and through a variety of other support activities that can be offered by departments, by the WIE program, or by other support entities. The information can be gained from internships, in which women in the field work together and share their experiences.

It can also be gained from older students who talk about the challenges and offer the sentiment of "I've been there too; I understand what you're going through." Mentors, whether peer or older, can offer advice as well as listen. These kinds of supports are important throughout one's engineering college career. Moreover, the community optimally includes not only students' peers but faculty and advisors.

Because participation in social enrichment activities was found to have a large influence on persistence, such opportunities need to be sponsored by student support programs, deans, and faculty. Fostering a community is an important and viable step an institution can take to enhance rates of persistence among undergraduate women in engineering.

ACKNOWLEDGMENTS

The WECE project would like to acknowledge the support of the National Science Foundation (Award Rec 9725521) and the Alfred P. Sloan Foundation (Award # 96-10-16).

The authors would also like to thank several people whose work on the WECE project informed this paper, in particular, Cathy Lachapelle, former Research Associate at GRG, and Mario Delci and Robert T. Brennan, both statistical consultants to GRG. Meredith Thompson and Kate Bittinger also worked on the WECE project.

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