

Re-Engineering Engineering Education to Retain Women

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Abstract

In order to maintain and increase enrollment in engineering, engineering must, not only include, but actively recruit, women. However, engineering programs cannot stop there. Research indicates that more students leave than graduate with an engineering degree, and women are more likely to switch out of engineering than men.

The Women in Applied Science and Engineering (WISE) Program at Arizona State University was founded to improve the retention and recruitment of women in the College of Engineering and Applied Sciences (CEAS). Toward that end, the WISE Program has developed a systematic approach to retain women in CEAS. These programs are discussed in detail. The climate survey, which was conducted to determine students' needs, and upon which many of the programs were derived, is discussed. Pre and post retention figures, and other assessment information, are presented.

Introduction

In 1994, only 2.9% of the women entering college planned to major in engineering [1]. In 1995 that percentage dropped to 2% [2]. Women constituted only 17% of those awarded bachelor degrees in engineering in 1995 [3], a slight increase (16%) from the previous year [4]. In order to ensure that engineering problems are approached from a variety of angles, women need to be recruited to, retained in, and graduated from engineering programs in greater numbers.

The Higher Education Research Institute (HERI) has been conducting longitudinal studies of undergraduate students nation-wide for 27 years [5]. A portion of this research involves monitoring 25,000 students at 217 institutions, surveying entering freshmen and following them through their academic careers. The study has revealed that only 44% of the students majoring in engineering their freshman year were still in engineering their senior year. Women were more likely to switch out of engineering than men [6]. Data collected by the College of Engineering and Applied Sciences (CEAS) at Arizona State University show similar retention patterns. For the class entering in 1989, approximately 47% of the men, but only 31% of the women, remained or had graduated from the CEAS by 1994.

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Background Research

In developing a retention program, two important sources of information were consulted: research outside the CEAS, and research within the CEAS. "Outside research", such as the HERI study described above, consists of two basic types. First, there is a large body of research describing women's career development, including why they do not often chose engineering, why they may leave engineering, and what their careers in engineering are like. This is reviewed by Blaisdell [7]. The second type of outside research consists of program descriptions and evaluations of program effectiveness. A good source for this type of information are the annual meetings and resulting proceedings of the Women in Engineering Program Advocates Network (WEPAN). WEPAN can be contacted at (317) 494-5387 or at wiep@ecn.purdue.edu.

Consulting these studies provided WISE with a basic knowledge of the issues and some effective ways others have found to recruit and to retain women in engineering. For example, the HERI study found that the most important environmental factor for retention in engineering programs was the percentage of peers also majoring in the field [8]. This finding suggests that increasing the visibility of women students and helping them to network with each other so that they can find peers in engineering may help retain them in engineering.

Consulting outside research is only the first step, however. Each campus has its own strengths and weaknesses. Arizona State's CEAS is significantly different than other campuses that have a more residential student body, are a private institution, or differ in a variety of other significant ways. That lead to "inside research", which involved three steps: 1) examining our retention data; 2) surveying CEAS students to determine their needs; and 3) surveying students who left the CEAS to determine general patterns and reasons for attrition. We were able to utilize a university-wide system called "Data

Wherehouse" to put together some baseline statistics for retention of women in the CEAS. Next, we administered a climate survey and an exit survey.

Based on a similar survey used at Iowa State University [9], the climate survey contained items concerning reasons for attending the CEAS, reasons for selecting their major, academic preparation, satisfaction with the university and the CEAS, reasons they believe more women are not in engineering and how much each reason is an issue for them, what programs they believe would be valuable to women in the CEAS, and which programs they would be likely to attend. The climate survey was distributed to students who had contact with the WISE Program staff or facilities from August to October, 1993. Completed surveys were collected from 78 undergraduate and 30 graduate students. Information obtained in this survey helped us to understand our students better, and guided which programs we offered. Results of this survey are reported elsewhere [10]. Survey results were discussed further in three focus groups, held in November, 1993. The information obtained during the focus groups was important for program development, but also helped the students feel that they were guiding the program, an important key to getting students involved.

The exit survey, the third step in obtaining inside research, was developed to get a better understanding of why students leave the CEAS. The survey is mailed each semester to a sample of male and female students and contains items concerning the problems they faced while in the CEAS. To date, only a small sample of surveys have been returned, however, of these many students reported that they were overwhelmed, that it was difficult to communicate with faculty and advisors, and that they needed better study habits to succeed in the College. Some took issue with certain requirements within their former program, or when the required courses were offered. A few took issue with the quality of instruction they received within the College, while others complained of too little financial support. A number of the students left the College after finding out their interests lay elsewhere. However, some commented that they needed more information on what engineers do, and hands-on projects that would help them know if they wanted to pursue those careers. While nearly half (47.5%) of the surveys were returned by females, the sample size is too small to determine gender differences at this time.

Retention Programs

Through outside and inside research, it became clear that certain objectives needed to be met in our retention program: 1) Increase the number of women in the CEAS, and increase the visibility and networking of

female students already in the CEAS; 2) Help students make early connections between majors and potential careers; 3) Educate faculty and advisors about the needs of female students and the importance of their participation in engineering; 4) Help students develop study and time management skills; and 5) Offer programs directed at students' reported needs. To meet these objectives, WISE developed a systematic series of programs.

The first step of retention, then, is recruitment to help increase the number and visibility of women in the CEAS. WISE offers high school and middle school outreach programs during the summer. These programs are three and two days, respectively, consisting of hands-on engineering labs and discussions about opportunities in engineering. During the academic year, WISE coordinates with the Recruitment Office which arranges informational school visits. Sheer numbers of women entering the CEAS will combat complaints of alienation. However, until women enter the College in numbers relatively equal to the men, additional steps will be necessary to ensure we retain those few that enter.

First, in addition to the week long orientation program which includes seven special sessions held for all CEAS students the week before Fall classes begin, incoming women CEAS students are welcomed through an orientation program, WISE Start, held the Saturday prior to the Fall semester. All programs are held in the WISE Center, a room primarily for women students to study, meet each other, or just relax. During WISE Start, participants are welcomed by the Associate Dean, Mary Anderson-Rowland, and are introduced to other College faculty and staff. They participate in ice-breaker activities, such as "Comet in a Bag", where they work in teams to make a "comet" in a freezer baggie using dry ice and various materials. Participants receive a computer account and an introduction to the internet in the computer facilities. They eat lunch together in the WISE Center and hear about the resources WISE offers. Student officers of the Society of Women Engineers (SWE) welcome the women and inform them of what SWE offers. SWE members then give information about their majors and corresponding careers. In the future, WISE Start will also provide a time management and study skills session.

WISE offers an orientation program called "WISE Move" for community college students planning to transfer to a four-year engineering program. WISE Move is held in the Spring and follows a format similar to WISE Start, but additionally provides advising, time management and study skills sessions, and a panel of industry representatives to address potential career opportunities. Transfer students are invited to attend WISE Start the following Fall.

Once the semester begins, WISE hosts a Welcome Back Party to encourage new and continuing student cohesiveness and to inform students about WISE. In the past the party has been sponsored by a local consulting firm who provides career information during the event. In the Spring, WISE provides students in their first year at the CEAS a New Student Reception. This event was developed in response to data analysis which revealed that most of the students who leave the CEAS will do so at this point. During the reception students meet Dr. Anderson-Rowland, participate in ice breaker activities, learn time management and study skills, eat dinner, and discuss their concerns about continuing in the CEAS.

Throughout the semester WISE offers a series of professional development seminars including Writing an Effective Resume, How to Get an Internship, Going to Graduate School, a Panel of Women Engineers and a Faculty/Student Open House. WISE also offers a course, Professional Development for Women in EAS, to teach students about various EAS fields and job market strategies. The course was developed to address the complaint of many students that they do not really know what people with their degree do until their junior or senior year - and sometimes not until after graduation!

When the time approaches for students to register for next semester's classes, WISE coordinates a Peer Advisement Session for students to assist one another with the upcoming semester's registration process. The Peer Advisement Session also allows for informal clustering of women students to increase their visibility in classes.

Last Spring, WISE held a Careers in Science Seminar Series which brought renowned women engineers and scientists from around the country to speak to administrators, faculty and students about their struggles and achievements in male-dominated fields. The highly credible speakers were able to sensitize faculty and administrators to the perils of being a minority and how they overcame the barriers to succeed in their fields. Their stories were motivational for both undergraduate and graduate students.

WISE conducted a pilot faculty diversity training in Fall, 1994. The small group of faculty watched a video entitled "Equity in Education" produced by UC Berkley's Women in Engineering Program. The video was followed by a discussion and a current female student answered faculty's questions. Next year WISE will be embarking on a full-scale faculty diversity training, in cooperation with the NSF Foundation Coalition and the Minority Engineering Program at ASU. The training program is currently being designed,

utilizing feedback from the pilot training. A separate component of this training will focus teaching students about diversity in classroom or workplace teams.

In addition to programs, WISE distributes a quarterly newsletter to current and potential students, maintains a World Wide Web home page (<http://www.eas.asu.edu:80/~wise/>) and an e-mail network. WISE posts job, internship and scholarship information through these forums, and on a Career Board in the WISE Center. Additional professional development materials are also available in the WISE Center, including a small resource library and a notebook of names of individuals in industry who have volunteered to answer questions for our students.

WISE Staff are available on a walk-in basis to discuss students' problems and concerns. In an average week during 1995 WISE had personal contact with 87 CEAS students.

WISE works closely with SWE to assist their efforts toward retention and placement. SWE uses the WISE Center for their monthly meetings and as storage and advertising. WISE provides some staff time for student employees to work on SWE activities. In return, SWE members volunteer at various WISE functions such as WISE Start. Since this cooperative arrangement began, SWE has quadrupled its membership from a previous 30 members to a current 120. WISE also collaborates with the Minority Engineering Program on grant writing and other activities, and cooperates with the Recruitment Office, coordinating activities and sharing personnel at times.

Program Evaluation

There are many ways to examine how effective the WISE Program has been. First, has the percentage of female CEAS students increased? Second, has the percentage of women graduating from the CEAS increased? Third, do students attending WISE programs persist better than non-attendees? And fourth, how effective do the female students believe the WISE Program is, particularly in creating a woman-friendly environment in the CEAS?

Percentages of women in the CEAS increased from 18.3% in 1994 to 19% in 1995. For undergraduates, the change was more dramatic - from 18.3% in 1994 to 20% in 1995. This increase is despite the fact that nationally, women entering college in 1995 were significantly less likely to major in engineering than they were in 1994 (2.0% and 2.9%, respectively). Once enrolled, women tend to persist in the CEAS about as well as men, which is not very well. Retention for first year students improved from 63% in 1993 to 72% in

1994. (Retention data for 1995 is not yet available.) Still, the CEAS has a higher percentage of females graduating with a Bachelor of Science in engineering (22.2%) than the national average (17.4% in 1994-95). The percentage of women earning undergraduate degrees from the CEAS is up from 19.1% in 1993-94.

Perhaps the most impressive data, however, are those concerning students who participated in WISE programs. Of the 427 program participants, 83.4% are still enrolled and another 10.1% have graduated with a Bachelor's degree, resulting in a retention/graduation rate of 93.5% for WISE participants, a 30% difference from non-participants.

To measure the perceived impact of the WISE Program on the CEAS, a needs assessment was initiated in November, 1995. A random sample of 10% of the sophomores, juniors, seniors and graduate students, and 15% of the freshmen and transfer students were asked to complete a phone interview. Freshmen and transfer students were oversampled because data indicated that they are the most likely to attrit from the CEAS. While the needs assessment is not yet completed, 74 complete interviews have been conducted. Preliminary results indicate that 92% know about the WISE Program, and 82% have had personal contact with WISE. Of those who knew about WISE, 38% reported that they had been personally helped by WISE. Finally, 95% of those who knew about WISE believe WISE has been successful in creating a woman-friendly atmosphere in the CEAS.

Both data and public opinion indicate that WISE has been successful in it's mission: to recruit and to retain women in the CEAS.

References

1. Higher Education Research Institute, *The American Freshman: National Norms for Fall 1995*. Los Angeles: Higher Education Research Institute.
2. Higher Education Research Institute, *The American Freshman: National Norms for Fall 1994*. Los Angeles: Higher Education Research Institute.
3. Engineering Workforce Commission, *Engineering Degrees*, 1995.
4. LeBuffe, C, "Women in engineering", *Engineering Workforce Bulletin*, May, 1994, p. 133.
5. Astin, A.W, "Engineering outcomes", *ASEE Prism*, September, 27-30.
6. Ibid.
7. Blaisdell, S. *Factors in the Underrepresentation of Women in Engineering: A Review of the Literature*, 1996.
8. Astin, A.W, "Engineering outcomes", *ASEE Prism*, September, 27-30.
9. Evans, M.A. Undergraduate Survey for the Program for Women in Science and Engineering. 1993 Unpublished manuscript.
10. Cosgrove, C. Blaisdell S. & Anderson, M, "A Climate Survey and Needs Assessment" 1994 Women in Engineering Conference Proceedings, Women in Engineering Program Advocate Network.