

RECRUITING WOMEN INTO ENGINEERING GRADUATE SCHOOL

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INTRODUCTION

Despite progress during the past few decades, women continue to be severely underrepresented in engineering fields. The pipeline through which women travel toward engineering becomes increasingly leaky, so that very few women emerge as professional engineers or professors in academia. At each transition point, the number of women decreases significantly more than the number of men.¹ The transition for undergraduate to graduate school represents a point toward the end of the pipeline that most women do not cross. In the Fall, 1996, women accounted for only 19.2% of the masters students and 16.2% of the doctoral students enrolled in engineering programs.²

These numbers are particularly disturbing when one considers the shifting demographics in the workforce. Economic expansion due to technological advancements is predicted to create up to 18 million new jobs in the future.³ Women of all racial and ethnic groups will be the major source of new entrants into the labor force.

Increasing the number of women entering the pipeline is unproductive if so few women emerge as professionals. While increasing the numbers of women in engineering is paramount to fulfilling the labor market demands, increasing the numbers of women in the higher echelons of the field may be viewed as a critical factor in changing the institutional culture to reflect a "relational female model." Changing the engineering culture at an institutional level is critical to retain more women in academia.^{1, 4} In addition, given that engineers with graduate degrees tend to exert more power and influence in industry and academia, increasing the number of women with such degrees will increase the number of role-models available to those considering engineering. Thus, recruiting women into engineering graduate school may be viewed as a step toward three goals: recruiting and retaining women in engineering, altering the engineering culture, and increasing the numbers of women in engineering academia.

THEORETICAL BASIS AND PROGRAM COMPONENTS

The Women in Engineering Scholars Program has been implemented as Arizona State University to encourage more women to pursue graduate school in engineering. The

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program is based on Bandura's theory of self-efficacy that has been empirically supported to explain why women tend not to enter non-traditional fields such as engineering. Bandura defines self-efficacy as one's belief about how well she or he can perform a given task or behavior.⁵ The Scholars Program aims to encourage women to pursue graduate school through four sources of efficacy information: encouragement and support, vicarious learning, performance accomplishment, and freedom from anxiety associated with physiological arousal.

The Scholars Program consists of both Professional Development and Community Building components. As part of Professional Development, the Scholars participate in a series of workshops about how to apply to graduate school, what to expect, and the benefits of a graduate degree. In addition, each participant is given the opportunity to participate in a summer research project in the lab of an ASU faculty member. At the end of the summer, a Research Forum provides the participants with the opportunity to present their research projects to faculty, mentors, industry sponsors, women engineers from the community, and peers. The Professional Development component includes all four sources of efficacy information.

The Community Building component gives each Scholar the opportunity to interact with other women in engineering and faculty members. A mentoring relationship is established with each Scholar and a female graduate student or a woman working in industry with a graduate degree. In addition, throughout the year, the scholars are given the opportunity to network with faculty, other graduate students, and women in industry. At the end of the academic year, an Awards Banquet is held for all participants and their family, friends, mentors, supporting faculty, and industry sponsors. At the banquet, those participants who have successfully completed the academic year portion of the program are awarded the title "Women in Engineering Scholar" by the Dean of the College of Engineering and Applied Science (CEAS).

The community surrounding ASU has collaborated with the Scholars Program in numerous ways. Women engineers working in local industry have volunteered to serve as mentors for the Scholars. Others have volunteered to present at the workshops, sharing their success stories in graduate school and in the work environment. Local industry has provided many of the Scholars with internships. Four of the largest technological corporations in the area have also financially sponsored the Awards Banquet and the Research Forum.

PRELIMINARY EVALUATION

Preliminary evaluations of the 1997-98 inaugural year have shown beneficial effects. In a qualitative assessment, program participants described the program as an "educational, enlightening, motivating, and a positive" experience. When compared with pre- and post-test measurements of a matched control group, the program participants showed a significant

($p = .01$) increase in their self-efficacy for attending graduate school. So far, five of the twenty participants in the 1997-98 program have applied and been accepted to graduate school. Eight others have demonstrated a high commitment to continue and excel in the field by procuring internships or attending engineering-related conferences.

For the 1998-99 year, ten participants have completed the academic portion of the program. All ten Scholars have elected to continue with the summer research experience. One Scholar will be accompanying an ASU faculty member for a two-week training session at a university out-of-state, and another will be attending a research internship out-of-state. The other eight Scholars will be working with faculty here at ASU. Based on a mid-year survey, the program seems to be having an encouraging effect. Post-test measures of self-efficacy will be collected in August and compared with pre-test measures for a quantitative evaluation.

BEYOND THE PROGRAM COMPONENTS

Programs such as this one that aim to encourage women to pursue or continue in non-traditional fields rely extensively on support from a variety of sources. In many cases, the program may be working against deeply ingrained notions about what is or is not appropriate for women. Providing role models and sources of encouragement across various contexts is considered paramount to challenging these notions.

The Scholars Program involves individuals from a variety of contexts that can provide encouragement for attending graduate school. Individuals from across the campus community support the program by presenting at the various workshops. These include representatives from the Graduate College, the Financial Aid Office, the Career Center, Counseling and Consultation, the Women's Studies Department, and the Affirmative Action Office. Two faculty members from the Cancer Research Institute on campus have also hosted Scholars in their labs. In addition, guest speakers from off-campus who are knowledgeable in gender issues or engineering also support the program. For example, a woman who owns her own communication consulting business agreed to speak to the Scholars about issues related to gender communication.

The Scholars Program also receives support from a variety of contexts within the College of Engineering as well. Mary Anderson-Rowland, Associate Dean for Special Programs and Student Affairs, offers her support to the program by attending events, speaking, and providing individual encouragement. Faculty members from across all engineering disciplines also support the program. Seven faculty members have served as panel members for a workshop entitled "Choosing a Graduate Program," and fifteen have hosted a Scholar in their lab for the summer. One faculty member has actively recruited and mentored a Scholar who accompanied her to an out-of-state graduate training session. Each of the faculty members who agree to host a Scholar for the summer are required to attend a gender diversity training seminar, which is an additional indicator of their commitment to increasing the presence of women in the college.

As mentioned, support from within the College also comes from the graduate students who serve as mentors. Over 30 female engineering graduate students have served as mentors and offered encouragement for the Scholars to attend graduate school. Many of these graduate students also have served as panel members for the various workshops.

Another critical source of support for the Scholars Program comes from local industry partners. In addition to financially sponsoring the program and providing internships, local industry has been especially supportive in providing mentors and attending workshops. Efforts to encourage women in engineering to continue on to graduate school often have to compete with the financial gains industry can offer those with an undergraduate degree. Hearing first-hand from women in industry about the benefits of a graduate degree has proven to be an important source of encouragement.

In sum, increasing the numbers of women in engineering has proven to be a challenge but not an impossible endeavor. In addition to recruiting and retaining females at the undergraduate level, more women are needed in academia and upper management. The presence of women in powerful positions is apt to help increase the numbers of women entering the field and progressing forward toward a successful career in industry or academia. Recruiting women into engineering graduate school is a crucial step in increasing the influence women have on the field of engineering. In order to accomplish this, encouragement is needed from a variety of contexts, including industry, community, campus, and departmental support.

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