

BEYOND ANECDOTE: RESEARCH ON WOMEN IN ENGINEERING

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Developing successful programs to encourage women to seek and sustain careers in engineering requires a strong base of information on student needs and perceived needs, on faculty attitudes and perceived attitudes as well as on specific program evaluation. Too often, colleges and universities develop programs for women in engineering based on anecdote, myth, or tradition.

In this paper, we introduce a research plan in progress, and findings for research to date, and present a brief rationale of the importance of developing standard protocols for assessing institutional climate and praxis.

At Carnegie Mellon, a cross-college, cross-disciplinary committee has developed a research plan to survey and interview both undergraduates and graduate students and faculty about their experiences and expectations. The surveys are designed to be synergistic. Questions asked of students are parallel to those asked of faculty about their students. The student surveys were distributed in the spring semester 1992 and will be analyzed in the summer of 1992. The faculty survey will be pilot tested in summer 1992 for distribution in the fall. The questions used on both surveys are based on a review of related literature with the expressed intent of testing significant hypotheses raised in the literature. Several such hypotheses are suggested by anecdotal evidence and by the rather sparse survey data available; systematic data on choice of careers and retention are hard to come by for both men and women. Some of the hypotheses that can be generated are:

- Women with a father or brother in engineering are more likely to decide to study engineering (or perhaps it is encouragement that is important).
- Women are more likely than men to reject engineering because of certain prevalent attitudes toward work in the classroom and workplace (hierarchical organization, competition rather than cooperation, etc.).

- Lack of financial aid seriously hampers women from staying in engineering in college.
- A financially rewarding career is one of the primary reasons for women's decision to study engineering.
- The fear that it is hard to balance family and an engineering career turns women away from studying engineering.

We need to understand which of these factors are really important, and whether they are different for women than they are for men, whether institutions need to change for all people or only for women.

Student Survey

A student survey was mailed to undergraduate and graduate students early in the spring semester 1992. Of the 7,148 students at Carnegie Mellon, 1,800 received the survey and 413 responded.

Students were given two weeks to return their response. As mail surveys at Carnegie Mellon usually generate a very small response rate, students who completed the survey were given a chance to enter a lottery for three \$100 prizes. The response rate was surprisingly high for our community, (25%).

Students completing the survey were told that the University was "interested in understanding and improving the academic experiences of both undergraduates and graduate students." The survey included basic information about the student's major, college, year, race/ethnicity, or partner status, and work experience as well as general academic experiences and goals.

Questions ranged from the most significant factors for choosing the course of study, the nature of students' current academic experience in the classroom, relations with professors and advisors, various environmental factors (stress, workload stress, discrimination, harassment), significant encouragers (fathers, mothers, partners), future career expectations, and areas of improvement. The survey included five open-ended questions, answers to which -- not surprisingly -- have proved to be as interesting as the close-ended questions. It's also worth noting that of the 413 students (25%) who answered these questions, 216 (52%) offered to speak about their experiences to the research team in person.

We looked at 68 factors. Only 15 (22%) were different for men and women. While these student questionnaires are in the process of being analyzed, it is worth noting the following* :

- The women reported 3 factors as being more significant in their choice of field than men reported. These were:
 - 1) encouragement from parents (+.45)
 - 2) good grades in major or related subjects (+.37)
 - 3) availability of financial aid for study (+.49)
- In describing their current academic experience, women reported feeling
 - 1) less confident of their abilities (-.40)
 - 2) discriminated against (+.29), sexually harassed (+.29), and uncomfortable in approaching faculty to a greater extent than men reported (+.32).
- When asked about receiving support or encouragement for their academic work, women reported that their spouses or partners (+.52), other family members (+.46), friends outside the university (+.35) organized discussion groups (+.39), and Teaching Assistants (if undergraduate) (+.34) all were supportive to a greater extent than what men reported.
- Women reported they were much more likely to interrupt their careers to raise a family than men reported (+.83).
- Women indicated more interest in receiving help with practical matters (writing resume, job search) (+.29) and having handbooks or other materials related to academic programs or professional field (+.36).

The Faculty Survey

We will be pilot testing the faculty survey in summer 1992. The survey was developed to raise questions parallel to the student survey so that the resulting report could compare and contrast issues of similar concerns from the perspective of students and of faculty. In the faculty survey, we also test a number of hypotheses based on anecdotal evidence. For example, we are specifically interested in how parents of college-aged daughters answered the questions compared to others, and especially the way the responses of these college-aged women's fathers' responses compared to others.

* These numbers indicate the *difference* in average scores between women and men on a scale of 1 (least significant) to 5 (most significant). The +/- signs indicate how women scored relative to men.

However interesting the results of these surveys or the surveys we are conducting on program effectiveness (not covered here), we believe that individual institutional surveys are of limited usefulness until we develop ways of comparing experiences across institutions. Until we have a better understanding of different institutional climate, environment, and the nature of student and faculty populations at different institutions, it will be difficult to judge a potential for an effective program, and its application and especially for dissemination. We need to know more about which women (majority/minority, first generation college, low socio-economic income, or women with disabilities) do well in various environments. We need to know which programs have a positive impact on different kinds of communities. We need to know how a critical mass of women impacts male and female faculty attitudes, or whether attitudes are largely influenced by such personal experiences as having a college-aged daughter. We need to build a common set of hypotheses and design surveys which include some common open-ended and closed-ended questions. Then the use of a common method of analysis and discussion of interpretation can generate valid conclusions and recommendations to improve the retention of women, or indeed of all people in engineering.

Interdisciplinary, cross-university research is required to develop understanding of the impact of campus or department climate on women's attachment and retention; impact of a discipline's culture on faculty attitudes and behaviors, and how these factors interact in different institutional settings over time.