

ENGINEERING EARLY OUTREACH TO COMMUNITY COLLEGE WOMEN

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Abstract

Using self-efficacy theory to develop an intervention, we developed a program to reach out to community college women. All four sources of self-efficacy information were provided to potential transfer women during the one-day program. Pre-and post intervention assessments indicated a distinct increase in participants' self-efficacy for engineering, as well as smaller increases in self-efficacy for scientific careers and mathematics.

Introduction

Women enter engineering majors in very small numbers. Programs that encourage women to enter engineering typically focus on high school and younger students, since college students have traditionally come from these sources. However, today many women enter or return to college via a community college. In fact, more and more "traditional" students begin their higher education at community colleges to take advantage of smaller classes and less expensive tuition. This group of potential transfer students is a largely untapped resource for increasing the number of women entering university engineering programs.

The transition from the community college to a major university often frightens students. They aren't sure they know how to act, how to get answers, or how to succeed academically at a university. Many have low self-efficacy for successfully completing a university engineering program. Self-efficacy is defined as "one's belief about his or her ability to successfully perform a given task or behavior."

Self-efficacy is derived from performance accomplishments, vicarious learning, encouragement and support for achievement-related behaviors, and emotional or physiological arousal.¹ The extent to which an individual will change his or her self-efficacy based on performance accomplishments will depend on the difficulty of the task, the amount of effort expended, the amount of external aid received, the circumstances under which the task was performed, the individual's emotional and physical state at the time of performance, and the nature and strength of the pre-existing self-efficacy.² Performance accomplishments are presumed to be the most powerful influence on self-efficacy. Vicarious learning appears to be the second most powerful, and is influenced by the perceived similarity between the model and the observer, the number and variety of models, and the perceived power of the models.

Encouragement and support are influenced by the perceived expertness, trustworthiness, and attractiveness of the source of encouragement.³

Perceived self-efficacy causes an individual to approach that particular behavior or task with anxiety. This emotional arousal may perpetuate a sense of self-efficacy. The degree to which self-efficacy is affected by emotional arousal depends on the individual's appraisal of the source of arousal, the circumstances under which the arousal is elicited, and personal experience of how arousal affects the individual's performance. Social cognitive theory posits that it is a perceived self-inefficacy for coping with these aversive events that leads to fearful expectations and avoidance behavior.¹

Bandura's self-efficacy theory⁴ was first applied to women's career decisions by Betz and Hackett.⁵ Self-efficacy expectations are viewed as particularly useful to the understanding of women's career development because the sex-role socialization of females is less likely than males to facilitate development of strong career-related self-efficacy expectations. They note that women and girls today are often not encouraged, or are actively discouraged, from engaging in a variety of activities that serve to increase and strengthen their expectations of personal efficacy. A large body of research indicates that a low self-efficacy for engineering is responsible for keeping many women from entering this field, primarily because women have less access to the four sources of information that build self-efficacy for math, science and engineering careers. This may be especially true for women returning to school, or for women who opt to attend a community college for other reasons.

Community college transfers are a significant component of Arizona State University's student population. ASU's large urban main campus had Fall, 1994 enrollments of more than 42,000 students, of which approximately 60% had transferred from another institution. Last fall, we discovered that 5% of newly enrolled women in the College of Engineering and Applied Sciences (CEAS) withdrew from the university during the first three weeks of classes. In the same time period, less than 2.5% of men withdrew. In addition, a recent survey of CEAS exiting students indicated that 50 of 107 respondents were older than 25. Although they left for a variety of reasons, the older students expressed much frustration with the "system."

This theory-based intervention was designed to help women students become familiar with the campus and support services available, to provide an opportunity to successfully perform engineering activities, to provide role models and opportunities for vicarious learning, to encourage participants to remain on the pre-engineering track, to encourage enrollment at ASU when the right time for the student arrived, and to provide initial transition services.

Method

We sent personal letters to each of 200 community college women enrolled in transferable math or science courses at two community colleges, inviting each woman to participate in the day's activity. Participants paid a \$10 fee to cover the cost of

lunch, and to encourage their investment in attendance. The program was scheduled on a weekday during winter break for all the schools (January 10). Low-cost child care was available.

Participants completed a pre-intervention instrument. After a short welcome and orientation, they moved to a computer lab for the first of the interventions. Bandura's model of self-efficacy indicates that past performance accomplishments provide much self-efficacy information. The women were placed in small teams, given an engineering design problem, and basic software instruction. Using a spreadsheet to develop mathematical models, they were encouraged to develop an optimal solution. Later in the day we again addressed performance when they built a model to tough specifications using only marshmallows, flexible straws and toothpicks. Each small team accomplished both tasks.

The women's sense of finding friends in a new place helped us address vicarious learning. Participants met in small groups with current ASU students (prior transfers from their community college) to talk about the transfer process and problems the ASU students encountered. The ASU students had been trained to present themselves as coping models ("I tried this first, then that") rather than as mastery models ("I've never had trouble"). Later during the day, women alumni returned to discuss their transition from college to work, and to present coping models for employment issues.

This group of women, as expected because of their self selection for the program, all responded to the third source of self-efficacy information, encouragement and support. To provide some of that encouragement, participants attended a luncheon with more than half of our engineering faculty women, and Renee Diehl, NSF Visiting Woman Professor from Penn State University. Throughout each activity the women were encouraged to investigate their options, seek support when necessary, and talk to others.

The fourth source of information, physiological arousal, was addressed in several ways. Successfully finding parking and locating the engineering complex, the campus tour, and their experience in the computer commons helped orient students to the physical layout of the campus, and reduce their anxiety about attending ASU. In addition, their interactions with faculty and other women students raised their excitement levels while reducing their anxiety about the coming changes.

Participants completed a post-intervention instrument that allowed us to measure the change in their situational self-efficacy.

Evaluation

The pre- and post-intervention self-efficacy inventories for each individual were compared to determine any change in each participant's attitudes. Then the women's scores were averaged to facilitate comparison with the scale published by Betz and Hackett.⁶

As expected, all the women began with higher than average mathematics self-efficacy. Despite that, average math self-efficacy increased by 3.1%. The career self-

efficacy of these women was also above average before intervention. Their average increase of 5.3% was an indication the women were positively impacted by the program. However, the largest change in participants' post-intervention attitudes was a 10.3% increase in engineering self-efficacy.

To determine if this increased self-efficacy for engineering will translate into engineering enrollments, we will monitor ASU enrollments and academic majors of these students. We believe this initial positive experience with the CEAS will increase their participation in WISE programs and will improve the likelihood of retention to graduation.

We anticipate the WISE Move program will be an annual event, and plan to expand recruitment to all community colleges in the state. In addition, we will begin using this intervention model with new traditional and transfer students during fall orientation programs.

In addition to the quantitative self-efficacy measures, participants were asked to provide qualitative comments about their reactions to the program. One said, "I'm more confident about my career than I was when I got up this morning." Another said, "I feel much more comfortable knowing some people here, now. Thank you for this great gift!"

Besides reaching a group of potential students, WISE Move provided considerable value to other groups. The ASU students who served as role models, without exception, said they wished they'd had the opportunity to collect information and "get comfortable" before they transferred. The faculty women who attended the luncheon were radiant about the opportunity to get together (they had not met as a group for more than a year), and asked the WISE Director to develop more such opportunities. The alumni women were very positive about the opportunity to participate in the program and have pledged to continue their support of WISE Programs.

References

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