AC 2009-621: ENHANCEMENTS TO A RETENTION PROGRAM FOR WOMEN ENGINEERING TECHNOLOGY STUDENTS BY THE ADDITION OF A SOCIAL-SUPPORT NETWORK AND COMMUNITY-BUILDING ACTIVITIES

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Abstract

This paper describes a low-cost, successful program to help retain female Engineering Technology students with the ultimate goal of increasing the number of female graduates of our Engineering Technology programs. This program was started in 2003. The programming initially focused on academic support in the form of tutoring, formation of study groups and reimbursement for academic laboratory kits. This program did improve retention, but a survey of our students found that they also desired social support and opportunities to serve the community. Since the addition of programming involving social support and community building, retention of women students in the Engineering Technology programs has improved by an average of 6% per year. In addition to improved retention, the number of students receiving a D, F or Withdrawing from the core first- and second-year courses in these programs has dropped by over 75%.

Introduction

Unless the U.S. can attract more students to science and technical fields, there will be a shortage of qualified workers for our increasingly technology-oriented society. Women make up 46% of the available workforce, but only 9% of engineers are women.[1] Increasing the number of female engineering and engineering technology graduates is one way to increase the number of qualified workers for the future. Although our university is taking actions to increase the number of women enrolled in the freshman engineering technology (ET) programs, there is a need to improve the rate of retention in these programs.

A Woman in Technology (WIT) program was started in 2003 for first- and second-year female students in the Engineering Technology disciplines. The engineering technology programs include Civil, Manufacturing, Mechanical, Electrical-Mechanical, Electrical, Computer, Telecommunications and Undeclared Engineering Technology. For the first three years, programming consisted of four supportive activities: 1) study groups facilitated by adjunct faculty, 2) peer tutoring by juniors and seniors, 3) purchase of academic laboratory kits for first and second year students and 4) support for student attendance at the Society of Women Engineers (SWE) national conference. Retention of the targeted students was tracked. Most students who left Engineering Technology did so in the first two years. A study completed by the U.S. Department of Education found the first two years to be critical in ensuring degree completion.[2] It was found that retention of first-year female ET students improved 18%, from 35% in 2000 to 58% in 2002.[3] Even with successful efforts by WIT to improve retention, rates were still not at Institute averages. Overall Institute retention for the same year was 87.5%. The

Institute's goal is 92% retention of first year students by 2013. The directors of WIT researched other ways to improve retention.

A study by WGBH Educational Foundation for Extraordinary Women Engineers showed that females seek careers that are enjoyable, have a good working environment and where they feel they can make a difference.[4] Similarly, another study found that women look for careers that involve support, camaraderie, accomplishment and growth. Focus group data from these studies showed that women did not perceive technical careers to have these qualities.[5] It is important that educators convey to engineering students how a career in engineering can fit these descriptions. If in the first years of a program, women do not see that engineering can fulfill these types of career aspirations, they may leave the program. A study by the University of Washington showed that students left engineering programs in the first two years primarily due to a loss of interest in science and engineering.[6]

Social and academic support is also critical to persistence in Science, Technology, Engineering and Math (STEM) disciplines. Seniors in the Washington study reported that their persistence in engineering degree programs was related to support received from other students, faculty advisors and mentors. The self-confidence that they gained through the support network is a critical factor in degree completion.

In February 2007, an interest survey was developed and administered to find out what types of programming would be appealing to the Engineering Technology students. The survey was completed by 42% of the female students in the Engineering Technology departments. It was found they are most interested in participating in the following types of activities: having quarterly departmental luncheons or socials (88%), developing a Girl Scout Badge kit (72%), having a mentor in industry (69%) and touring local companies (66%). At the social where the survey was presented, a faculty member spoke to the students about developing a Girl Scout badge workshop. Because the Girl Scout program was discussed, a higher interest level in this outreach activity was indicated versus other outreach activities on the survey (tutoring and team projects with local schools). Through the survey, the students expressed the need for programs that reflect what women want in their careers: support, camaraderie and making a difference. See Figure 1.

Enhancements to Women in Technology Program

Based on the findings of the survey, new programming was implemented in Spring 2007. This programming included a mentoring network, quarterly socials for faculty and students, tours of local companies and a Girl Scout Badge workshop. This program was supported by the University of the State of New York State Education Department Perkins III (VTEA) Formula Funded Education for the 2007-2008 academic year.

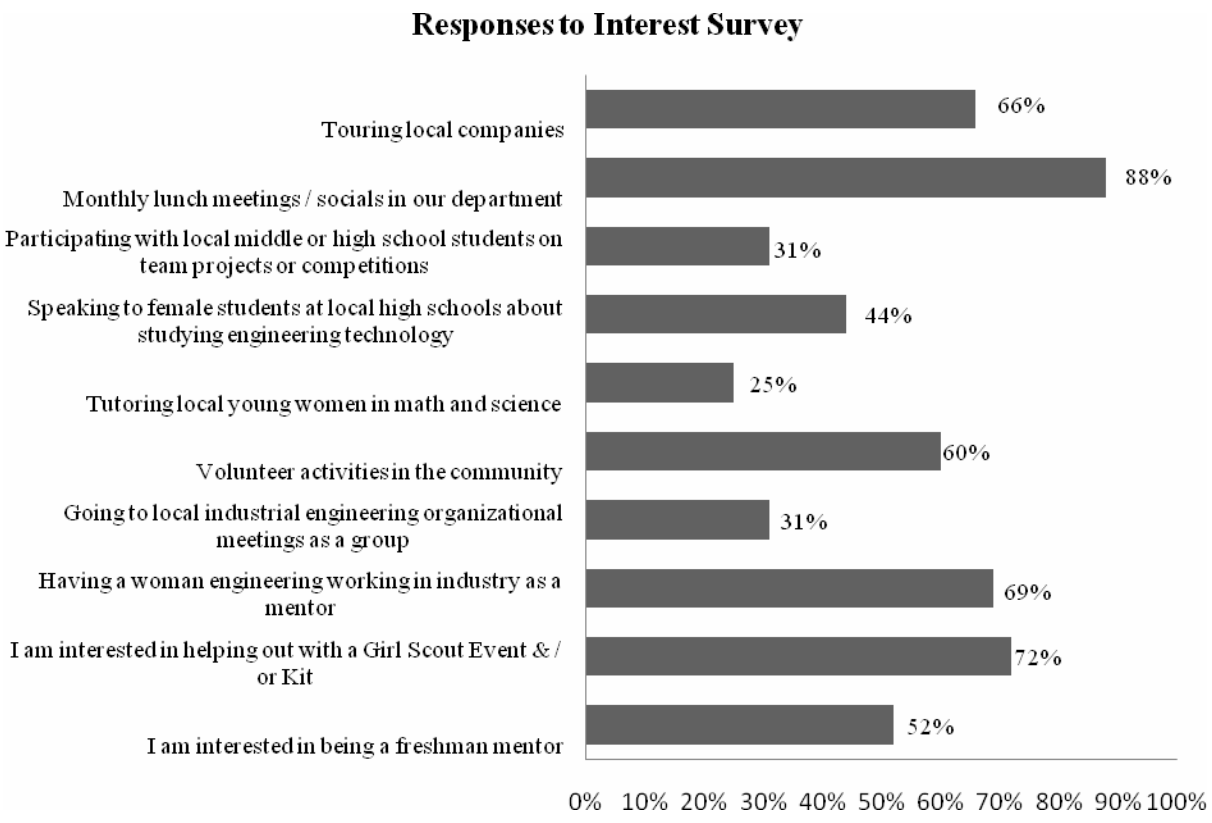

Figure 1: Women Engineering Technology Students Responses to Interest Survey

Mentoring Network

Research shows successful mentor activities at other Women in Engineering programs. [7,8,9] This evidence and interest in participating in such a program led us to develop a peer mentoring program. Incoming freshmen women were paired with an upperclassman from their department. The mentors contacted the freshman in the summer before she arrived on campus. This contact consisted of a welcome letter, a newsletter highlighting WIT activities in the past year and an invitation to a Welcome Social. Before the social, a mentor training session was held. Students were given a Mentor Handbook that included information about the importance of mentoring, contact information for all mentors and freshmen women and plans for WIT events for the academic year.

The Welcome Socials were developed to promote interaction between the mentors, mentees and faculty. In 2007, the social was a "Bunco" night. Bunco is an easy to learn dice game played in teams of two where partners change after every game. In 2008, a "Cooking in the Dorm" social was held. Students and faculty were divided into teams and had to develop and make a recipe with ramen noodles (a dorm food staple). Other available ingredients were items that could be purchased in the food market in the dorm. Both socials were successful in promoting interaction

amongst the students of all academic-year levels and the faculty. However, at both socials, only a few of the freshman actually attended. The poor attendance was despite efforts to encourage them to attend. Before the social, the freshmen have had very little face-to-face contact with their mentors. In the future, we plan to initiate programs to have the freshmen meet their mentors before arriving on campus. This spring, we will pair mentors with accepted students at our accepted-student open houses. We are also starting a WIT group on Facebook and will encourage the incoming freshmen to join this group.

As part of the welcoming program, incoming students were given a welcome gift. The welcome gifts consisted of a tool related to the student's programs. For example, Mechanical Engineering technology students received a measuring tool kit with a micrometer, caliper and scale.

Socials

From the interest survey, 88 % of the students indicated an interest in attending socials with WIT. Socials were held quarterly. Each quarter of the 2007-2008 academic year, a different department would host the event. The hosting department was responsible for the program and invitations. Students, faculty and alumni from the department presented topics related to their department. Socials were scheduled at the convenience of the hosting department. Attendance at the events varied from event to event. Students often reported that they had class or had simply forgotten. In an effort to improve attendance at events, it was decided to run the socials at the same day and time each month. Beginning October 2008, socials have been run on a monthly basis. Socials are held the first Friday of each month.

Industry Tours

Industry tours were started in 2007. When arranging the tours, it was requested that the tour be led by women engineers, include a panel session and have a Human Resources representative present to accept resumes for possible internship opportunities. The industries targeted were those representatives of the department programs within the college. A wastewater treatment facility, packaging laboratory, an automotive component research and development facility and a nuclear power plant were toured. These tours provided students a chance to meet working women professionals and learn more about their major and career opportunities in their field, but they also had a chance to meet and get to know other students and faculty in the college. The quote below is from student feedback after attending one of the tours:

> *It was an adrenaline rush to know the importance of engineers and scientist play in the role of providing us with our everyday electricity….It is so nice to relate to something that as students, we only see on paper. …it brought me closer to my future and how important the decisions that I make today are for when one works on industry….various girls to chat with and great faculty.*

Outreach Activities

Women in Technology developed a Girl Scouts in Technology badge workshop. This workshop addresses the need to get girls interested in engineering early. The gender gap in math and science courses grows as students go from middle school to high school.[10] In fourth grade, girls report the same level of interest in math and science as boys. However, by the time they reach the eighth grade, boys are twice as likely to be interested in science, math, engineering or technology (STEM). Over 100 girl scouts have completed this workshop since its inception in February, 2008.

The faculty worked closely with female students to develop workshops in each of the Engineering Technology programs in the college. The workshop consists of hands-on lab activities that were specifically designed to be of interests to young girls. The workshops are run by the female engineering technology students. The day concludes with a panel session with the college students. Having the material presented by college students has a bigger impact on the young girls than if the same material was covered by a traditional teacher or professor. Surveys given to the Girl Scouts before and after the session have shown a positive change in attitudes towards science and engineering.

Quotes from girl scouts who have completed the workshop:

"My favorite part was programming the robot. I want to do that when I grow up."

"I want to go there again someday. I want to be just like you guys!"

There have been 32 Engineering Technology students involved in this program. This represents over one-third of enrolled female students. Involvement in this program builds communication skills, organization skills, knowledge of their major and a sense of community with their classmates and faculty. Although funds were available through a grant to pay students for developing and running the workshops, it was found that students were reluctant to request payment for their involvement. The grant from a local community foundation also covers the cost of workshop materials and supports faculty time for promoting and evaluating the workshop. The workshop is currently offered free of charge. Plans for sustaining the program include charging participants a fee, utilizing student volunteers and securing support from individual departments to cover costs of supplies. Continued funding also will be sought to expand the program.

Women in Technology students also participate in other engineering outreach programs through involvement in the Society of Women Engineers (SWE) chapter. These events include a SWE overnight for eleventh-grade girls, College and Careers Days for twelfth graders, and a Park and Ride Workshop for sixth- and seventh-grade girls.

Results

Since the Women in Technology program was started in 2003, there have been significant improvements in retention and performance in first- and second-year core courses. Since 2003, retention of first-year women students has increased from 84% to 96% (see Figure 2).

WIT programming in the 2003 and 2004 academic years consisted mainly of academic support in the form of tutoring and coordination of study groups. Since academic programming was started, retention of first-year students has improved an average of 2% per year. Second-year retention has improved an average of 6% per year (see Figure 3). In the 2006-2007 academic year, the social programming outlined in this paper was implemented. The combination of academic support and social programming together has shown an average improvement in first-year retention of 5% per year and an increase in second-year retention of 9%. Statistics from 2000-2003 are given to show improvement from historical levels. Data is for all women in the Engineering Technology programs and is not limited to those who participated in WIT programming.

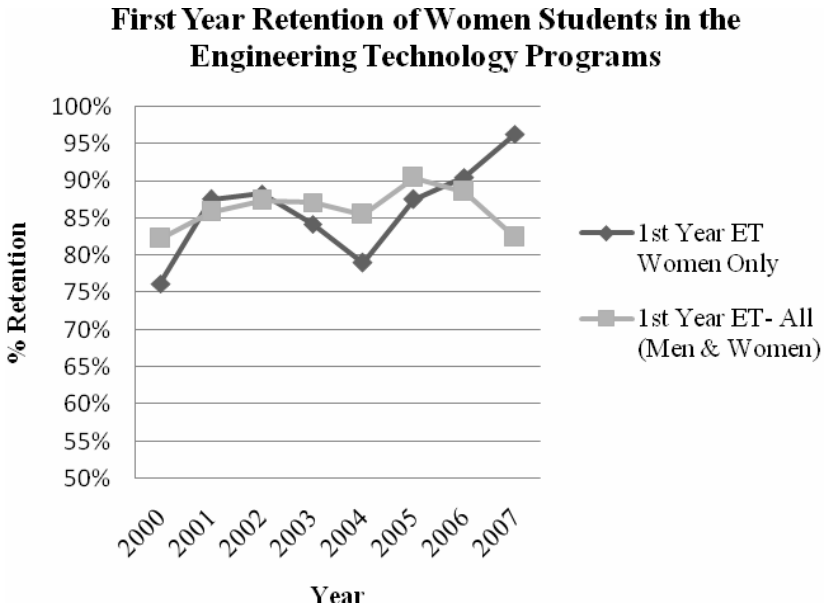

Figure 2: Retention Rates of First-Year Women Engineering Technology Students 2000-2007

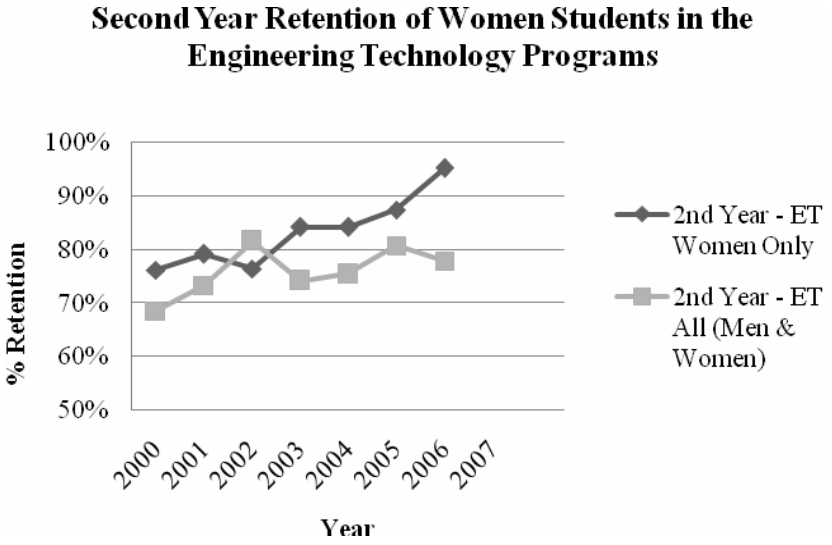

Figure 3: Retention Rates of Second-Year Women Engineering Technology Students 2000-2007

Studies have shown that students receiving a D, F or Withdrawing from a course during their first two years of college are more likely to leave before graduating. [11] [12] [13] Since WIT programming was implemented in 2003, the number of D's, F's and W's received in core courses in the first two years by female Engineering Technology students has decreased from an average of 1.5 per class to an average of 0.5 per class as shown in Figure 4. Statistics from 2000-2003 are shown to show improvement from historical levels. Comparable data for male students was not compiled.

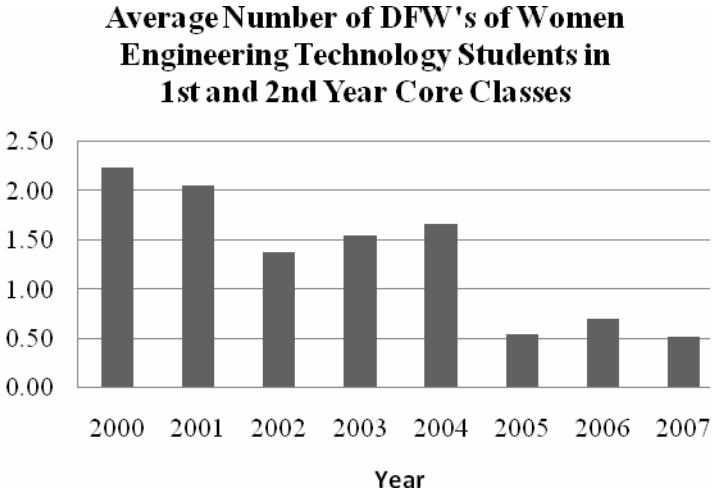

Figure 4: Average number of D's, F's and W's of Women Students Received in First- and Second-Year Core Courses per Course

An attitude survey regarding women students' perceptions of the educational climate in our programs was administered. The survey used was developed by the Women in Technology group at Purdue University. Purdue's survey was based on the Women in Engineering Programs Advocates Network (WEPAN) Pilot Climate survey.[14] One of the open-ended questions on this survey was, "How can Engineering Technology best support its women students?" Although the question did not directly ask about any of the Women in Technology programming, many students commented on the effectiveness of this program. Selected student quotes are given below:

I think the ET program has gone above and beyond in supporting its female students and would encourage them to continue because it is a great way to meet other women going though the same things, and a way to get to know the female professors on a more personal level

I think that by having women in technology club and gathering all different types of engineering students together on campus is really helpful. And just being able to have that support system is a really good feeling.

I have participated in both Women in Technology events as well as the Women Engineers events. Each group has enriched my experience here at RIT. The best way to support the women students is to continue these activities as well as reaching out to future women students.

Budget and Funding

From 2003-2007, Women in Technology was supported by a grant from the University of the State of New York State Education Department Perkins III (VTEA) program. The funds ranged from $10,000-$12,000 per year. Eighty percent (80%) of the funds were used towards professional salaries. Adjunct professors and lecturers were hired to develop programming, set up study groups and analyze year-end retention data. Students were hired as peer tutors and to help develop and run the Girl Scout Badge Workshop. Student salaries accounted for about 10% of the budget. Supplies for the Girl Scout workshop accounted for less than $50 per session. The remaining funds were used to buy welcome gifts for incoming students. Food expenditures were not allowed by the funding agency. Food-related expenses were paid for through the budget of an endowed chair. This endowed chair is charged with matching university intellectual and educational resources with the needs of students and the community.

In 2008, the only programming for the WIT activities supported by external funding is the Girl Scout Badge Workshop. For the 2008-2009 year, this program is being funded by a grant from a local community foundation's program for supporting educational opportunities for women and girls. Student salaries and social expenses are funded through the budget of the endowed chair. Individual departments within the college also supported WIT activities by providing funding for food and supplies.

Lessons Learned and Future Plans

- Participation in a one-on-one mentoring program by incoming freshman has been low. To overcome this, we plan to implement new strategies for contact between current students and incoming students. Strategies include utilizing a Facebook group and having WIT students serve as guides during tours for accepted student Open Houses. Plans also involve moving from a one-on-one mentoring program to a group mentoring program. Success with these programs has been reported.[15]

- Students are willing to volunteer their time towards outreach programs. When requesting funds to run outreach programming, initially 10% of the funds were allocated towards student salaries for working on outreach programming. Only a small percentage of funds were used because of the student's reluctance to request payment. Funds were reallocated towards other programming efforts.

- Attendance at social events fluctuated from event to event. Plans have been implemented to run this programming at the same date and time each month so students will know when events are.

- To build networking opportunities with professional women, an alumni event is being planned this Spring. It will be held the same weekend as a college wide festival. Alumni from all engineering technology majors are being invited to participate in this event. The event will include the monthly WIT social on Friday afternoon where students in all academic years will be able to meet and make connections with females in their chosen field. Referring to Figure 1, it is seen that one of the top interests for the students was having a mentor from industry. This social event will allow the opportunity for some of those mentoring relationships to form. In the evening, there will be another social event for just the alumni and our senior students. This will be an opportunity for the seniors to make connections that could possibly lead to job opportunities. On the invitation to the alumni weekend, the women will be asked, if not able to attend the event, if they would still be willing to be a mentor. Interested respondents will be matched with students who are looking for a mentor in that field.
- A new seminar is being offered Spring 2009 for female freshmen Engineering Technology students. The goal of the seminar is to present engineering topics using techniques that encourage group interaction. Group interaction will support the goal of building a community of women in our programs. Topics will highlight the impact women have made and can make on society through a career in engineering.
- Based on the success of the Girl Scout badge workshop, plans are underway to turn that effort into portable modules or kits that can be used by educators who work with middle

school aged girls. WIT students will be involved in the effort by developing, refining and marketing these kits.

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