Developing Retention Strategies for Women that Promote Student Success in Engineering and the Applied Sciences

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Abstract

The Women in Applied Science and Engineering (WISE) Student Success Program was designed as a comprehensive approach to increase the retention of female undergraduate students in the College of Engineering and Applied Sciences (CEAS) at Arizona State University (ASU). Goals of the program include establishing contact with at-risk female engineering students, providing information on college and university resources, improving students' GPA for current and future semesters, and ensuring that the students achieve semester goals by maintaining personal contact.

Initially, sixteen female engineering students were involved in the Spring 1999 pilot program. The pilot cohort consisted of eight different engineering disciplines with Fall 1998 cumulative GPA ranging from 1.72 to 2.69. After individual interviews, students expressed three main concerns: financial aid/scholarships, tutoring resources, and the formation of effective contacts with other engineering students and professors. Overall program results indicate that 64% of the students showed an increase in their Spring 1999 semester GPA and 79% improved their cumulative GPA. Although results are preliminary, data received from the pilot program indicate that the student success program was effective.

An overview of the WISE Student Success Program will be presented and will include a discussion of the need for and impact of retention programs specifically geared toward female engineering students. In addition, future projections of implementation and direction of WISE student retention programs will be discussed.

I. Introduction

Nationally, less than half of all engineering freshman graduate with an engineering degree. According to statistics at Arizona State University (ASU), less than 66% of freshman engineering students (male and female) are retained in engineering beyond their first year [1]. For both men and women, issues concerning first-year retention include difficulty in the transition from high school to college, financial problems, and general misinformation about the engineering curriculum. However, studies have indicated that women are more prone than men to dropout due to ancillary issues concerning family, lack of female role models, and personal dissatisfaction with grades. In addition, women are more likely to enter into engineering uninformed of the challenges associated with their curricula as well as incurring these additional obstacles not experienced by their male counterparts [2]. Because of these factors, many female students dropout of engineering or choose to change their majors to other disciplines without

seeking academic support. Therefore, there is a need for retention programs that establish an early support network for female students and act to foster personal relationships.

Although women account for nearly 52% of high school graduates that enroll in four-year colleges [3], only 17% of all incoming freshman engineering students are women [4]. Fear-Feen and Kapostasy-Karako (1992) identified nine barriers to female enrollment in secondary level science, technology, and mathematics courses. According to their study, female students encounter such barriers as lack of self-confidence, ineffective learning environments, lack of female role models in science-related fields, and failure to recognize the relationship between science courses and societal expectations of women [5].

Among the students who enter into engineering at the college level, researchers have discovered that initial interest in engineering majors differ between men and women. Studies have indicated that males enter engineering because of previous mechanical experience, while females enter engineering because of achievements in math or science [6]. In addition, a recent study found that 74% of men and 91% of women who switched from science, mathematics, and engineering majors indicated their reasons for choosing one of these majors were inappropriate. While men stated clearer personal reasons for entering engineering majors, women were strongly influenced by significant adults including family members and high school teachers [7]. In either case, students are ultimately unaware of the academic demands associated with engineering and decide to transfer to other majors or drop out of college because they are unprepared for academic obstacles associated with these disciplines [8].

Although roughly 40% of Arizona State University engineering freshman leave engineering majors [9], Seymore and Hewitt found little difference in high-school preparation, academic ability, or effort expended in coursework between students who continue with engineering and those who change their majors [10]. Similar findings were attained in a recent study by universities in Colorado. Researchers deducted that initial attitudes held by the students regarding their perceived ability to succeed were key to understanding attrition. Students who left engineering in good standing tended to have lower general impressions of engineering, exhibited lower confidence in their engineering skills (problem solving, creative thinking, and design abilities), and lower confidence in basic engineering knowledge [11]. In addition, many female students who pursued science or engineering degrees because of personal interest also indicated feelings of being forced to leave due to loss in confidence, difficulty with poor teaching, and inability to function in a highly competitive environment [12]. Therefore, it is apparent that women face not only academic issues, but also issues concerning lack of information at elementary and secondary levels, lack of personal choice when entering engineering, and loss of support structure in the college setting.

II. Student Success Program

The Student Success Program was designed as a comprehensive approach to enhance the retention of female undergraduate students in the CEAS. Goals of this program are to establish contact with at-risk female engineering students, provide information on college and university resources, and offer academic advisement to students. The primary purpose of the program is to improve students' GPA in the current semester, retain the student in engineering, and ensure students are achieving semester goals by maintaining personal contact.

III. Program Strategies

At-risk undergraduate students were identified by the acquisition of personal information from the university tracking system. At-risk students were defined as students with a Fall 1998 semester GPA of 2.7 or less or students with cumulative GPA of 2.7 or less. Students were recruited initially by mailing letters that introduced the WISE program and described opportunities with the Student Success Program. Initial interviews were scheduled for each respondent to assess the students' immediate needs, their academic problems, and their semester goals. Each interview lasted approximately one hour and served to establish a primary relationship between the student and the Program Coordinator. In addition, students were required to submit and to adhere to a strategic action plan for the Spring 1999 semester. Each student maintained at least bimonthly contact with the WISE Program Coordinator to help ensure the achievement of personal goals.

Program evaluation included results from the Spring 1999 semester/cumulative GPA compared to the Fall 1998 semester/cumulative GPA. Academic improvements were determined by assessing individual improvement in semester/cumulative GPA and overall improvement in semester/cumulative GPA. In addition, a log sheet was maintained to track personal contact between the student and the Program Coordinator.

IV. Program Components

Students were initially interviewed in one-hour sessions to assess problems they were experiencing and were provided with general information that encouraged their continuation in an engineering degree. The following are components of the program that were used to determine a course of action for the particular student and work to improve their semester GPA and cumulative GPA.

Students responding to the program were required to fill out a S*tudent Information Sheet* detailing personal information including name, student ID, address, phone, email, major, semester GPA and cumulative GPA. In addition, this sheet queried them regarding their immediate academic needs, other trouble they may be experiencing with campus or college resources, and their long-term goals.

Each student received a *Student Information Packet* that compiled all ASU, CEAS, and other resources. This packet provided information on ASU campus tutoring, student tutoring resources, engineering departmental advising, financial aid/scholarship information, and employment opportunities. Students were also given study skills/time management information and were required to complete a time management and assessment exercise.

After needs and goals were determined, a *Student Action Plan* was developed to direct the student. This plan was written by the student, with guidance from the Program Coordinator, to detail how they would obtain tutoring, academic advising, mentoring, and/or financial help. Both the student and the Program Coordinator signed this form.

Students were also encouraged to become involved in the WISE Mentor Program and utilize other mentoring resources, such as the Women in Engineering Program Advocates Network (WEPAN) affiliated Mentor-Net. However, students were not initially required to participate in extra-curricular programs that would deter from immediate academic improvement. Students agreeing to participate in mentoring were placed into a cluster based upon their engineering major and were also given a primary upper-division contact.

All students taking lower division math, chemistry, physics, and English classes were required to enroll with the *Student Affairs Academic Assistance Center* for free one-hour group tutoring sessions. Students were also referred to all on-campus tutoring centers, including engineering tutoring facilities and departmental advising. Students requiring assistance in the introduction to engineering course, ECE 100, were directed toward tutoring programs provided by the Office of Minority Engineering Program (OMEP) and Engineering Dorm Floors.

Throughout the program, students were encouraged to maintain weekly or bimonthly *Email Contact* with the WISE Program Coordinator to ensure program goals were being achieved and other problems were not arising. In addition, students were required to visit their engineering *Academic Advisor* and the WISE Program Coordinator a minimum of once per month by appointment.

V. Initial Results

The sixteen female engineering students involved in the pilot program represented eight different engineering disciplines with Fall 1998 cumulative GPA ranging from 1.72 to 2.69 (*See Table 1). Two of the sixteen students were first semester transfer students with cumulative transfer GPA's of 2.74 and 4.0. These students were not included in the final results of this program however, it should be noted that these transfer students both maintained exceptional GPA's (3.64 and 4.0, respectively) during their first semester. Although each student participating was at least a sophomore level student, a larger population appeared than was originally expected including six upper division students.

After individual interviews, students appeared to be expressing three main concerns: financial aid/scholarships, tutoring resources, and forming effective contacts with other engineering students and professors. The resource information provided to the students as well as encouragement to maintain regular contact with the program, addressed these obstacles. Of the sixteen students originally interviewed, 44% maintained regular contact through unscheduled meetings, email and phone calls. Several students are continuing to maintain regular contact for the Fall 1999 semester and inform the program about achievement in their classes.

Table 1: Student Semester and Cumulative GPA

Student	F98 Semester GPA	F98 Cumulative GPA	Sp99 Semester GPA	Sp99 Cumulative GPA
1	1.71	1.94	2.79	2.32
2	2.55	2.23	2.79	2.38
3	2.50	2.44	3.00	2.52
4	1.27	2.24	3.00	2.35
5	2.25	2.39	2.62	2.52
6	2.31	2.26	0.00	2.10
7	1.85	1.85	2.60	2.52
8	1.72	1.72	2.00	2.12
9	1.92	2.25	1.67	2.03
10	3.00	1.89	3.00	1.93
11	4.00	2.69	3.00	2.78
12	2.69	2.50	0.00	2.50
13	2.78	2.60	3.31	2.79
14	2.00	2.36	2.46	2.37

Overall, 64% of the students showed an increase in their Spring semester GPA and 79% improved their cumulative GPA. The highest difference in semester GPA was observed in student #4 with a 58% increase. Although most students improved, student #9 and student #12 received lower semester GPA's in Spring than in Fall. Student #12 had the most difference with a 33% decrease in semester GPA. However, this same student managed a 3% increase in cumulative GPA based on grades and number of credit hours received in Spring vs. Fall. Of the initial student cohort, only two students (14%) obtained lower semester grades and only 14% received lower cumulative GPA. Although several factors may have influenced this result, it was determined that student #12 was unable to complete the semester due to personal concerns and completely withdrew from the university. In addition, it appeared that another student (#6) failed to withdraw prior to finals and as a result, received two failing grades.

VI. Future Projections

Due to the initial success of participants, at-risk students will be contacted every semester with the continuation of this program. In order to increase its effectiveness, program advertisement will incorporate classroom recruiting in all introductory engineering classes (ECE 100) as well as entry level calculus and physics classes. In addition, freshman students entering the college will be introduced to the program during ASU Orientation, and students living on-campus in engineering dorm facilities will also be heavily recruited. Since financial issues were found to be a primary source leading to attrition and academic difficulties, industry funding will be sought to offer small scholarships or possible financial resources to students with monetary needs. Incoming job opportunities and internship information will continue to be forwarded to all participating students. In addition, students established in the program and maintaining above average GPA will be encouraged to participate in student organizations or participate in extra-curricular activities within the CEAS.

VII. Conclusion

Although results are preliminary, data received from the pilot program indicate that the student success program was effective. A previous participant recently wrote, "I am very excited about school and feeling really good about it all, instead of overwhelmed!" Several of the Spring 1999 pilot program participants continue to maintain regular contact and drop-in with informal meetings to let our program know how they are faring in their engineering classes. One student involved in the program was a senior in her last semester and became a participant because she was worried that she would not graduate. After checking her semester grades, it was apparent that she received her BSE degree in Civil Engineering after taking several summer courses. In addition, this student successfully graduated with a 2.41 GPA.

Another student was experiencing family troubles and was overwhelmed by her fathers terminal illness. This student managed to overcome the death of her father and the responsibility of being the primary caregiver to her younger brother. Today, she is still enrolled in the college and determined to finish her degree.

Regardless of financial issues, family pressure, and academic troubles, all students have problems while they are attending school. It is interesting that some students are able to gain the resources they need to help them complete their degree. Engineering is one of the most demanding majors and entering students, whether freshman or transfer, need to recognize that engineering degrees will demand their time, finances, and their mental abilities. University retention programs must encourage students to seek out resources and learn to help themselves.

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