

AN INNOVATIVE APPROACH TO RETENTION PROGRAMS FOR WOMEN

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Abstract – Since 1993, the Women in Applied Science and Engineering (WISE) Program at Arizona State University (ASU) has concentrated on designing and expanding programs that offer a universal approach to the retention of women in the College of Engineering and Applied Sciences (CEAS). In recent years, WISE retention programs have grown to include year-long academic programs for students; professional and peer mentoring programs; bridge programs for incoming students; seminars and technical workshops that aid in professional development; cross-curricular programs that explore the relationship between engineering and other disciplines; and programs that encourage student involvement in community service. These programs have proven to serve as the link between CEAS women students and academics and have strongly contributed to their retention in the college.

Since 1995, university first-year retention rates for CEAS women have increased averaging from 72% to 80%. In addition, ASU CEAS retention rates have increased from 53% to 63%. Innovative programming offered through WISE has aided in increasing college retention rates for women and assisted female students to surpass university goals for their retention. An overview of WISE Retention Programs is presented and includes a discussion of past and present retention rates for women in the college.

Introduction

Retention of engineering students is a major challenge for most universities, especially those with high acceptance rates. This selectivity is inversely proportional to the degree attainment of both minority and non-minority students [1,2]. Nationally, less than half of the students who begin engineering, graduate in engineering [3]. From 1993 – 1995, less than 59% of College of Engineering and Applied Science (CEAS) freshman engineering students (male and female) at Arizona State University (ASU) were retained in engineering beyond their first year [4]. ASU has an 80% acceptance rate. Many factors play a part in student attrition including difficulty in the transition from high school to college, lack of understanding about the demands of

attaining an engineering degree, financial problems, and problems with time management. Women are more likely to enter into engineering uninformed about the challenges associated with engineering academics and tend to face additional issues including lack of female role models, family problems, and social pressures [5]. Because of these factors, women are more prone than men to change their major or drop out of engineering without seeking support.

Among students who enter into engineering at the college level, researchers have discovered initial interest in engineering majors differs 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].

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 [7]. Other 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 and exhibited lower confidence in their engineering skills (problem solving, creative thinking, and design abilities) and basic engineering knowledge [9]. Many female students who pursued science or engineering degrees because of personal interest indicate feelings of loss in confidence, difficulty with poor teaching, and inability to function in a highly competitive environment [10].

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It is apparent that women face not only academic issues, but also loss of support structure in the college setting. Therefore, there is a need for retention programs that establish an early support network for female students and foster personal relationships. It is important to get the female freshmen students engaged early in supportive activities. Key actions for successful retention of minority students, which also apply to women, include special attention paid to the early success of freshmen and the delivery of special programs designed to help make the institution more supportive [1]. Studies at ASU have shown on-campus housing in itself is not effective in producing higher retention rates unless the students also engage in activities designed for retention.

Program Strategies

Since 1993, ASU Women in Applied Science and Engineering (WISE) retention programs have provided students with peer groups and support services to integrate female students within the college. These programs have included academic and professional development, networking, and community learning experiences that help female students to connect on a personal level with staff, faculty, female engineering professionals, the community, and other female students in the college [11]. Please note that in this paper, “engineering students” refers to all CEAS students, including engineering, computer science, and construction management majors.

WISE Program retention efforts have expanded dramatically since Fall 2000. Successful programs developed and implemented for the 2001-2002 academic year include:

- Student Success, a year-long program designed to meet individual needs of students having academic difficulties or students who wish to get a head-start on succeeding in their engineering curriculum
- Multi-Faceted Mentoring, which includes:
 - WISE Match, a peer mentoring program designed to pair lower-division engineering students with upper-division engineering students in their major
 - The WISE Industry Network (WIN), a collaboration between Intel professional mentors and female engineering students
 - The Big Sisters Program, a community service program that offers mentoring and tutoring to at-risk youth from low-income or single-parent families
- ArtVentures in Engineering (AVIE), a collaborative partnership that explores the interdependence of engineering and the arts
- Seminar Series, including seminars, workshops, and a Women’s Wellness series, designed to help students maintain their health and well-being

- Community Service Programs
- WISE Summer Bridge Program, a weeklong program designed to ease the transition from high school to college for incoming female freshman students
- Additional Programs, including WISE Study Groups, designed to aid students in calculus, physics, and chemistry

The main strategy in providing retention programs to students is to include diverse, comprehensive programming with universal appeal that encourages students to become involved. It is difficult to provide programming that appeals to everyone however, by providing many avenues and different approaches to retention, students are able to pick and choose which programs are better suited to fit their needs. Office of Minority Engineering Programs (OMEP) also provides support programs and activities. Many ethnic minority women attend activities in both WISE and OMEP. In expanding its services, WISE has included programming that caters to academic interests, professional development, networking activities, multi-disciplinary projects, good health, and community service. Programming of this nature ensures that more students will be interested, involved, and ultimately retained.

Student Success Program

The Student Success Program was designed in Spring 1999 as a comprehensive approach to enhance the retention of female undergraduate students in the CEAS [12]. The 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’ GPAs in the current semester, to retain students in the college, and to ensure students are achieving semester goals by maintaining personal contact.

Student Success promotes mentoring relationships, encourages students to seek internship/co-op opportunities, provides the fundamentals of good study skills and time management to increase classroom success, and assists in other factors that may influence the ASU engineering experience. Since Fall 2001, Student Success participants are required to participate in the WISE Match mentoring program outlined below.

Components

At-risk female undergraduate students are identified from the ASU tracking system. At-risk students are defined as students with a Fall semester GPA of 2.7 or less or students with a cumulative GPA of 2.7 or less. Students are initially interviewed in one-hour sessions to assess current problems and to provide general information to encourage them to continue their pursuit of an engineering degree.

Students are required to submit a *Student Information Sheet* detailing personal information including name, student ID, address, phone, email, major, semester GPA, and cumulative GPA. In addition, this sheet queries them on immediate academic needs, trouble they may be experiencing with campus or college resources, and their long-term goals. Each student receives a *Student Information Packet* that provides information on ASU campus tutoring, student tutoring resources, engineering departmental advising, financial aid/scholarship information, and employment opportunities. Students are also given study skills/time management information and are required to complete a time management and assessment exercise.

After needs and goals are determined, a *Student Action Plan* is developed to direct the student. This plan is written by the student with guidance from the Program Coordinator, and details how they would obtain tutoring, academic advising, mentoring, and/or financial help. Both the student and the Program Coordinator sign this form. Students are also encouraged to become involved in the WISE Mentor Program and to utilize other mentoring resources. Students can choose to participate in extracurricular programs and activities only if they are sure it will not deter them from immediate academic improvement. Students agreeing to participate in mentoring are placed into a cluster based upon their engineering major and are given a primary upper-division contact.

All students taking lower-division math, chemistry, physics, and English classes are required to enroll with the *Student Affairs Academic Assistance Center* for free one-hour group tutoring sessions. Students are also referred to all on-campus tutoring centers, including engineering tutoring facilities and departmental advising. Throughout the program, students are encouraged to maintain weekly or bimonthly email contact with the WISE Program Coordinator to ensure program goals are being achieved and other problems are not arising. In addition, students are required to visit their engineering academic advisor and the WISE Program Coordinator a minimum of once per month by appointment.

Results

From Fall 1999 to Fall 2001, 68% of participating students showed an increase in their Spring semester GPA and 79% showed improvement in their cumulative GPA. After individual interviews, students appeared to express 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, addresses these concerns. Forty-four percent of the students who begin the program will maintain regular contact through unscheduled meetings, email, and phone calls.

Multi-Faceted Mentoring

Many university and women's programs include some type of mentoring program. The value of mentoring is that it provides a network of support and resources to students. Mentoring also offers valuable information and guidance to individual students and is a vehicle for mentors to relay their knowledge and experience. Mentoring provides a roadmap that helps students envision possibilities and options after graduation.

The WISE approach to mentoring is unique. Because the WISE program contains three different mentoring components, each program offers a different focus to serve the needs of individual students. WISE mentoring programs are a multi-faceted approach that includes peer mentoring between undergraduate students, industry mentoring, and mentoring by WISE students in the community. This approach appeals to a large number of undergraduate and graduate students, future engineering students, and industry professionals.

WISE Match

WISE Match is a program designed to connect lower-division engineering students with their peers and upper-division engineering students in the same engineering discipline. Since Fall 2000, this program has evolved to provide lower- and upper-division students with a network of resources. Clustered in groups based on their major, each cluster usually contains two to three upper-division students and three to four lower-division students.

Each Fall, interested students attend a WISE Match Orientation Dinner. During this event, students are provided with information on the program, are able to meet with their groups, and are required to sign a contract that ensures their participation and dedication to the program. Each group also receives training on working in groups and professionalism. Before students leave the orientation, they are also required to plan their first activity.

Students unable to attend the orientation are required to obtain information and contracts individually. Approximately one week after the orientation, students are provided with email addresses and phone numbers for every member in their group and the entire WISE Match participant list. Groups are encouraged to meet with their members at least twice a month for individual activities and discussions. The WISE office also provides funding for all WISE Match students to take part in two activities a semester. Previous activities have included horseback riding, scuba diving, and pottery painting. Activities have proven to be very popular and provide students with new perspectives on networking and creating positive group environments.

WISE Industry Network (WIN)

WIN is a collaboration between WISE, female engineering mentors from Intel, and female engineering students. This program provides female engineering students with the opportunity to meet and network with engineers from local industry and to prepare for future careers. Launched in the fall of 1998, this program has continued due to the positive feedback from both the engineers and the students who have participated in the program.

WIN members meet for monthly networking meetings throughout the semester. Intel mentors provide information on various topics including resume writing, public speaking, interviewing techniques, and work/life balance. Students are given the opportunity to ask questions and to receive individual attention and direction on their career options. WIN Mentors are also available outside of the program for students to contact and consult with regarding specific questions. Many students from WIN have also gained internship experience and opportunities by attending and networking with these professional mentors. Female mentors involved in the program also gain experience and satisfaction in providing their expertise and in helping students.

Big Brothers Big Sisters of Central Arizona

The WISE program has recently developed a community service partnership program with Big Brothers Big Sisters (BBBS) of Central Arizona. This organization has become one of the largest Big Brother Big Sister agencies in the country. A majority of children served by this agency are underrepresented minorities from single-parent, low-income families. WISE has developed this partnership for the benefit of the community and our engineering students.

Both undergraduate and graduate female engineering students can participate in the program by either pairing with a young girl or by becoming involved in school-based programs. WISE is currently working with BBBS to develop a mentoring program at Laird Elementary School in Tempe, AZ. This program will provide tutoring and after-school activities to young underrepresented women involving engineering, math, and science.

This program was designed to involve engineering students in community service activities as well as to encourage middle- and high-school-aged students to attend summer WISE recruitment programs. These summer programs not only serve to introduce students to careers in engineering, but also help to foster personal support networks between women, build self-esteem, and possibly encourage first-generation or disadvantaged students to consider pursuing college degrees. Therefore, the BBBS program benefits its participants, industry, and the community.

ArtVentures in Engineering

ArtVentures in Engineering (AVIE) is a collaborative partnership between the WISE Program and the ASU Katherine K. Herberger College of Fine Arts (CFA). This program aims to express and to explore engineering concepts through the artistic media of music, dance, theatre, and visual arts. AVIE is designed to bring art and engineering to the community in an environment that appeals to multicultural and intergenerational learning. Though still in a pilot stage, there has been student interest and input in developing this program. The first event will be held in Spring 2002.

Project Description

AVIE is a series of workshops and educational K-12 projects designed to examine and to explore the interdependence of science and the arts. The primary goal of this collaboration is to educate and to bring community awareness to a diverse population through the exploration of interdisciplinary principles and to value the contributions of artists to science and scientists to the arts.

Traditionally, K-12 education has viewed science and the arts as separate. However, these areas are intimately interconnected, and many engineering students have a background and interest in the arts. By exploring their connection through seminars, hands-on activities, and K-12 projects, AVIE seeks to provoke audience members to actively question previous notions regarding these two disciplines.

Project Goals

The goals of this project are to incorporate scientific principles to explain artistic techniques and to initiate a dialogue between these two communities. Workshops, K-12 projects, and curricula materials produced will explore the relationship between these disciplines and how they inevitably depend upon one another. The product of these experiences will be a heightened awareness and an understanding for and appreciation of the arts and sciences. This project:

- Serves as a catalyst for further understanding of art and science;
- Creates community education and awareness of these disciplines;
- Promotes advertising to entice a diverse community;
- Obtains statewide, national, and international recognition through the materials produced;
- Develops curricula for teaching interdisciplinary subjects through printed materials that may be disseminated to K-12 schools; and
- Opens the door for collaborative work and research between two ASU colleges and community partners.

Activities

The first workshop in this series was held on April 4, 2002. *The Science of Painting* incorporated lectures facilitated by three artists: a local community artist, a CEAS engineering faculty member, and an ASU Herberger CFA faculty member. Each artist presented a 20-minute lecture on how they view the relationship between science and visual arts. After the lecture, participants were encouraged to explore six stations with hands-on activities, facilitated by female engineering students and fine arts volunteers. Over 60 K-12 students, parents, teachers, and community members attended this event.

The second workshop, entitled *Instrument Making and Acoustics*, will be held on November 9, 2002. This all-day workshop will explore scientific principles applied to making string instruments, pipe organs, and the design of performance halls. This workshop will also include three artists representing the community, the CEAS, and the Herberger College of Fine Arts. Interdisciplinary hands-on projects will also be incorporated for students, parents, and community members.

In its entirety, AVIE will include seven seminars on various topics until May 2004. The goals of the program are to publish K-12 curriculum materials in the form of ASU's Chain Reaction Magazine and to disseminate the edition statewide, nationally, and internationally.

Seminar Series

Each semester, WISE offers a seminar series on topics of special interest to female students. Since 1993, the WISE Seminar Series has expanded to include academic workshops, professional development workshops, and workshops geared toward providing students with alternative options for their stressful course schedules.

Seminars/Technical Workshops

Seminars held throughout the academic year include workshops on developing effective study skills, time management, resume writing, resume critiques, and panel discussions by female engineers from local industry. WISE also provides a variety of technical workshops to offer undergraduate and graduate students training on technical software, including topics such as Excel, Maple, and Matlab. Flexible programming of seminars allows students to request topics as needed. For example, in Fall 2001, WISE held two workshops in collaboration with ASU Counseling and Consultation office on how to effectively cope with the events of September 11, 2001. This workshop was attended not only by students, but staff and administrators as well, who were concerned about effectively managing and processing these events.

Women's Wellness Series

In Fall 2001, WISE established a Women's Wellness Program to encourage students to consider their health and well-being while attending school. This series consists of three workshops per semester with topics including yoga, meditation, and nutrition. Local individuals from the Southwest Institute of Healing Arts facilitated workshops and have indicated interest in providing resources next year.

Community Service Programs

In an effort to meet the mission of ASU to be Arizona's leading community university, WISE has developed a community service program for students and staff. This program allows engineering students and staff to use their skills and knowledge in Arizona communities to better the lives of low-income or disadvantaged populations. Our goal is to graduate a well-rounded engineer who has a sense of community and a willingness to give back to the community upon employment.

Walk for Hope

In October 2001, WISE was involved in coordinating a major fundraising effort for the fight against breast cancer. More than 25 students and staff participated in a five-mile Walk for Hope to raise money for cancer research. WISE raised over \$1,700 for the event and was one of twenty official sponsors for the event.

Big Brothers Big Sisters

This program, already described, doubles as a community service program as well as a mentoring program.

Summer Bridge Program

For female engineering students, bridge programs not only serve an academic need, but also serve to foster networking relationships between students prior to starting the semester. The WISE Summer Bridge Program was designed to prepare incoming female students for the transition from high school to the CEAS.

Since 1998, this program has offered academic reviews in courses such as mathematics, physics, and chemistry [13]. In addition, computer-based curricula have been offered in Maple and Excel to better prepare students for their freshmen introductory engineering courses. The Bridge Program is a four-day residential program that occurs one week prior to the fall semester. Raytheon has sponsored the program since 1998. Student tracking has shown that the one-year retention rate in the CEAS of bridge students from 2000 is 72% compared with the 61% retention in the CEAS of all freshmen women students from that cohort. Students

who participated in the 2001 summer program have been retained in the college at 88% after one semester.

Additional WISE Programs

The following are additional programs WISE provides to ensure a well-rounded approach to aid in student retention.

Study Groups

Each semester since the Fall of 2000, WISE organizes a select number of study groups to aid students in calculus, physics, and chemistry. Each group contains three to four female engineering students currently enrolled in core curriculum classes. This year, WISE has enlisted several volunteers to assist to tutor students in these subjects. Daily study sessions are scheduled, and students are encouraged to work with each other to finish homework and to prepare for exams.

WISE Center

The WISE Center is a centrally located room in the CEAS used for academic and social networking. Students can gather to study, take advantage of resources such as on-line computers, job and scholarship listings, and company profiles. WISE events and seminars are held in this room and all interested students are invited to attend. Each year, corporate sponsorship of the center provides funds for renovations or to purchase needed furniture or equipment.

WISE Engineering Residence Hall Events

Each fall semester since 2000, WISE connects with freshman female students who live on engineering dorm floors. During this event, students receive information on WISE Retention programs and are invited to attend SWE meetings and events to recruit new students. This event helps lower-division students get to know the WISE staff and program assistants.

Participation and Retention Results

The enrollment of women in the CEAS has steadily increased from 532 (16.8%) in Fall 1991 to 940 (20.2%) in Fall 2001. ASU's one-year retention goal for first-time freshman students is 78% by Fall 2003. Freshmen CEAS women have been retained for one year at ASU at over 80% for four of the last five years. Since 1995, university first-year retention rates for CEAS women have increased, averaging from 72% to 80%. Average ASU retention over the last four years for CEAS women is 8% higher than the average retention from 1993–1995. The 1997–2000 freshmen women were retained in the CEAS on average at 63%, an increase of 10% over the 1993–1995 freshmen

cohorts. Since programs described in this paper were developed over the past nine years, it is believed that innovative retention programs developed by WISE have contributed to these increases in CEAS retention. Fall 2001 program participation increased sharply (over 250%) from Fall 2000 and included over 400 women students.

Currently, WISE is in the process of developing and entering a new comprehensive data tracking system to accurately record and evaluate program results. This will allow long-term tracking of students and pertinent retention information to give a better understanding of student difficulties and how WISE can better serve and accommodate its students.

Regardless of financial issues, family pressure, and academic troubles, all students have problems while they are attending school. Though some students are able to gain the resources they need to complete their degree, others may have difficulty. 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 mental abilities. University retention programs must encourage students to seek out resources and learn to help themselves.

In providing diversified and innovative programs, WISE has found that the variety of programming has created a well-rounded service center, more well-rounded students, and more social and academic interaction between all students and staff. Moreover, diversity in retention programs has solidified the WISE program as one of the most dedicated and organized programs in the CEAS and has excelled in offering support for women in engineering.

References

1. Morrison, Catherine, Griffin, Kenneth, and Marcotullio, Peter, "Retention of Minority Students in Engineering," NACME Research Letter, December 1995, Volume 5, Number 2.
2. "Colleges with the lowest acceptance rates, Colleges with the highest graduation rates," <http://www.usnews.com/edu/college/rankings/>
3. Landis, Raymond, "Studying Engineering," Discovery Press, Los Angeles, California, 2000.
4. Office of Institutional Analysis, Arizona State University Main Enrollment Summary, Fall Semester, 1993-2001, Tempe, AZ.
5. Felder, R., Felder, G., & Associates. "A Longitudinal Study of Engineering Student Performance and Retention: Gender Differences in Student Performance and Attitudes," Journal of Engineering Education, April, 1995, pp. 151-163.
6. Barley, Z., & Phillips, C. "Closing the Gap for Girls: Gender Differences in Teachers' Technological Attitudes and Proficiency". Journal of Women and Minorities in Science and Engineering. Volume 4, pp 249-267, 1998.

7. Seymore, E., & Hewitt, N. "Talking about Leaving: Factors Contributing to High Attrition Rates Among Science, Mathematics, and Engineering Undergraduate Majors," Bureau of Sociological Research, University of Colorado, Boulder, CO, 1994.
8. Moller-Wong, C., & Eide, A. "An Engineering Student Retention Study," Journal of Engineering Education, January, 1997, pp. 7-15.
9. Besterfield-Sacre, M., Atman, C., & Shuman, L. "Characteristics of Freshman Engineering Students: Models for Determining Student Attrition in Engineering," Journal of Engineering Education, April 1997, pp. 139-149.
10. Brainard, S., & Carlin, L. "A Longitudinal Study of Undergraduate Women in Engineering and Science," Proceedings, Frontiers in Education Conference, Pittsburgh, PA, November, 1997.
11. Anderson-Rowland, M.R. & Blaisdell, S., "A Comprehensive Approach to the Recruitment and Retention of Women in Engineering," Shaping a National Agenda for Women in Higher Education, Conference Proceedings, University of Minnesota, Minneapolis, Minnesota, March 2000, Women in Science and Engineering, 8 pages.
12. Fletcher, S., & Anderson-Rowland, M.R. "Developing Retention Strategies and Preventative Measures for Women in Engineering and the Applied Sciences," WEPAN 2000 Conference Proceedings, Washington, D.C., June 2000, pp. 163-169.
13. Fletcher, S., Newell, D., Anderson-Rowland, M.R., & Newton, L. "The Women in Applied Science and Engineering Summer Bridge Program: Easing the Transition for First-Time Female Engineering Students," Frontiers in Education 2001 Conference Proceedings, Reno, Nevada, October 2001, CD-ROM, Session SIF, pp. SIF 5-SIF 9.