THE WOMEN IN APPLIED SCIENCE AND ENGINEERING SUMMER BRIDGE PROGRAM: EASING THE TRANSITION FOR FIRST-TIME FEMALE ENGINEERING STUDENTS

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Abstract *- The Women in Applied Science and Engineering (WISE) Summer Bridge Program is designed to prepare incoming female students for the transition from high school to the College of Engineering and Applied Sciences (CEAS) at Arizona State University (ASU). This program offers academic reviews in courses such as mathematics, physics, and chemistry. Computer-programming tutorials are also offered in Excel and HTML to better prepare students for their freshman introductory engineering course. Participants acclimate to the campus by receiving general information concerning the university, financial aid, and departmental advising. Students attending the program become familiar with the campus, have a head start on their freshman engineering classes, and have a chance to meet other female students.*

An overview of the WISE Summer Bridge Program will be presented as well as retention data for 1998 and 1999 program participants. In addition, the paper will discuss the need for and impact of bridge programs specifically geared toward female students. Further, the paper will investigate other life circumstances, such as level of involvement in student activities, living situation, and employment that impact retention of these students. Finally, future projections of implementation and direction of student retention programs will be explored.

INTRODUCTION

Only 41.9% of women, who reach at least the threshold of the engineering curriculum in 4-year colleges, graduate in engineering, architecture, or engineering technologies. For the males, the graduation rate is 61.6% [1]. For both male and female students, issues concerning first-year retention include difficulty in the transition from high school to college, financial problems, and misinformation about the engineering curriculum. Attrition studies report that women enter into science, mathematics, and engineering with little information and consequently decide not to complete their curriculum or transfer to other majors.

Many female students who have pursued science or engineering degrees because of personal interest indicate feelings of being forced to leave due to loss in confidence, difficulty with poor teaching, and inability to function in a highly competitive environment [2]. Therefore, it is necessary that retention efforts begin with programs that serve to bridge the gap between high school and college with an emphasis on including curricula that introduce the student to basic engineering concepts and directly expose them to the expectations of the college-level curriculum.

Academic institutions indicate that summer bridge programs help to significantly increase student retention in engineering disciplines. Summer bridge programs specifically designed for female students not only serve to meet academic needs, but also serve to aid students in developing networking relationships and fostering community building. Studies have indicated that obstacles women face in attaining engineering degrees may be categorized as both societal/cultural barriers as well as institutional [3]. For many women, lack of information concerning the engineering curriculum and stereotypes that regard aptitude for math and science as masculine inevitably deter females from pursuing engineering or technical degrees [4]. According to recent studies, 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]. Therefore, the need for retention programs that establish an early support network for female students and act to foster personal relationships is crucial.

Academically, the first-year curriculum consists primarily of fundamental courses (physics, mathematics, chemistry, English, etc.) that are essential prerequisites to upper-division engineering courses. Often, these courses fail to motivate students and many potential engineers transfer out of their majors before experiencing any engineering [6].

In either case, students are ultimately unaware of 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

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these disciplines [6]. Thus, many female engineering students drop out of engineering before seeking academic support.

BRIDGE PROGRAM

The Women Applied Science and Engineering (WISE) Summer Bridge Program in the College of Engineering and Applied Sciences (CEAS) at Arizona State University (ASU) was designed to prepare incoming female students for the transition from high school to the CEAS. According to recent surveys and retention figures, students attending the WISE Summer Bridge are better able to acclimate to the campus by receiving general information concerning the university, financial aid, and departmental advising. Since 1998, this program has offered academic reviews in courses such as mathematics, physics, and chemistry.

Bridge participants have the opportunity to become acquainted with WISE staff and a WISE room available for their support located directly across the hall from the WISE Office. They become familiar with WISE staff by the end of the program and understand the WISE program office is available to support them. Finally, computer-based curricula have been offered in Maple, Excel, and HTML to better prepare students for their freshmen introductory engineering courses. Thus, students attending the program are able to become familiar with the campus, have a head start on all freshman engineering classes, and also have a chance to meet other female students.

Program Components

The first WISE Summer Bridge program was held in 1998. It was funded by a National Science Foundation grant through the ASU Foundation Coalition Program. A letter of invitation was sent to 150 entering freshman women. Fifteen women chose to attend. The program was a one-week commuter program held before the beginning of the 1998 Fall semester. In an effort to give student participants tools to aid them in their first weeks, the Bridge program featured reviews of chemistry, physics, and mathematics. In addition, sessions on Excel and HTML were offered to better prepare the students for their freshmen introductory, ECE 100. Further information on ASU and other essential student services, such as financial aid, were also made available. Each day included social events and evening activities to foster community building and support systems prior to entering their freshman year. Tuition for the program was $150 and scholarships were available to those with financial need.

In 1999, Raytheon sponsored the WISE Summer Bridge Program. This five-day residential program was held one week before the Fall 1999 semester. Forty-three entering freshman women participated in team building activities and engineering projects. By the end of the week, students had created their own web page. A celebratory reception for the students, staff, industry representatives and faculty concluded the program. Because industry sponsored the program, tuition from the previous year was not increased even though the program was residential.

Raytheon also sponsored the 2000 WISE Summer Bridge program. Tuition remained at $150 even though participants were housed at a hotel near the ASU main campus. Review courses were taught and social activities occurred with the Society of Women Engineers (SWE) student chapter. Twenty-eight women attended. The program concluded with a luncheon for participants and their parents.

SURVEY ANALYSIS & RESULTS

In the Fall of 2000, the WISE staff surveyed participants from the three previous bridge programs in order to provide a more effective retention program. To date, only 17% of the 84 Bridge Program participants have responded however, these results show interesting trends. As assessments of the programs continue, results of the survey provide valuable insight into services successful in retaining freshman women in the CEAS [7]. The survey was divided into four sections: General Information, WISE Bridge, WISE Services, and Additional Information. Survey results and conclusions drawn are provided below for each section.

General Information

In the General Information section, the survey sought to evaluate background information on participants and their life situation prior to entering the CEAS. All of the respondents claimed to have made the decision to major in engineering between the ages of 13-17. The majority of respondents based their choice of engineering on the high demand for female engineers. Others cited their interest and aptitude in math and science as their reason for choosing engineering. Every one of the respondents indicated they were first introduced to engineering through a family member. This is consistent with the Cooper Union Survey of Women Engineers in which 52.6% of all women engineering students surveyed had a family member with a background in Engineering [8]. Less than 25% of the respondents attended middle school or high school engineering programs prior to entering the WISE Summer Bridge Program.

Bridge participants were afforded the opportunity to meet other females enrolled in CEAS prior to starting classes. All respondents reported that this made them feel more comfortable as the semester began. In addition to the Bridge program, respondents reported other services in the college of Engineering helped them through their first semester. Services such as academic advising, mentoring,

and tutoring provided by the WISE program, were cited as being significantly important in their first semester retention.

WISE Bridge

The WISE Bridge survey section was designed to assess effectiveness of the current residential program and additional services that might be added to better facilitate the transition from high school to college. All respondents claimed the Summer Bridge program was either "very helpful" or "somewhat helpful". Math and science course reviews, preliminary exposure to the college, and other CEAS services were listed as areas participants liked most about the program. When asked to make suggestions of additional services for future programs they listed a full campus tour, time management training, more time to interact socially with other CEAS students, and more specific information on individual majors and courses [9]. Overall, the program was rated as a "highly valuable" experience [9].

WISE Services

The WISE Services section of the survey aims to assess the most useful services provided to entering students outside of the Summer Bridge. All students reported having used at least one of the following WISE services: seminar series, peer advising, meeting space, computer labs, or the mentor program. One of the most valuable of those services was the Intel sponsored mentor program. This program, WISE Industry Network (WIN), meets once a month to discuss topics ranging from interviewing skills and internship opportunities to how to balance life, work, and family. Professional women from the Phoenix area come to campus and speak with small groups or individually with students about the challenges of being a female in engineering. When asked what additional services they would like to see provided, none of the respondents indicated the need for any additional services [9].

Student Involvement, Living Situation and Employment

Many factors contribute to the retention of any one student. Obstacles may be derived from employment, living situations, and lack of involvement in activities that foster support systems. Thus, this survey also aimed to create a general situational overview of each participant. The majority of the respondents were in-state students who lived on campus their first year. Many felt the program gave them the opportunity to get acquainted with dorm life, the campus, and each other prior to starting their coursework. Feedback from out-of-state students indicated that having the bridge program right before the beginning of the semester was "somewhat stressful".

Although student involvement has proved to be a crucial component in retention, less than 50% of the respondents reported they were involved in a student organization. Those who were involved were members of SWE however, all respondents stated they would be interested in volunteering with the WISE Program [9].

Employment is also another factor in whether or not a student is retained. During the Spring 2000 semester, the WISE staff conducted a special survey of WISE Summer Bridge participants to research the impact of employment on retention. Only 12% of the surveys were returned however, the results provide insight into these students' lives. Of those who responded, none were currently working for the WISE program. However, 66% of the respondents were working elsewhere, with 38% working on-campus and 62% working off-campus. The average on-campus salary reported was $9.75 per hour compared with an average $11.85 per hour for off-campus positions. The overall average wage was $10.59 per hour. The average hours worked per week was 14.38 while average course hours during Spring 2000 were 14.75. Out of all student respondents, only one was working more than 20 hours per week. This information, particularly the wage information, allows us to conclude that students who work off-campus make more money and may be more of a challenge for our retention efforts. It is interesting to note that the course hours are similar, on average, to CEAS standards for first and second year students. As a result of this survey, WISE will use this information to formulate financial/scholarship programs that meet the needs of all female students.

RETENTION RESULTS

For Fall 2000, 20.7% of the 4,259 undergraduate CEAS students were women. In 1992, before the WISE Program was initiated, only 544 women (17%) were enrolled in the CEAS. This increase in women's enrollment is due both to recruitment and retention programs such as the WISE Summer Bridge program.

The one-year retention rates of CEAS freshmen women entering in Fall of 1993-1995 averaged about 53% within the CEAS and 72% university wide.

TABLE I
ACADEMIC PROGRESS STATUS OF FRESHMEN CEAS FEMALE STUDENTS: BRIDGE VS. NON-BRIDGE
* FFF = FIRST -TIME, FULL-TIME FRESHMEN

Entering Fall	Academic Progress Status	% WISE Summer Bridge Fall 99	% CEAS FFF* Non-Bridge Fall 99	% WISE Summer Bridge Fall 00	% CEAS FFF* Non-Bridge Fall 00
98	Enrolled in CEAS	87% (n = 82)	60% (n = 13)	67% (n = 50)	36% (n = 10)
	Enrolled in Another ASU College	7% (n = 20)	15% (n = 1)	13% (n = 2)	28% (n = 38)
	Not Enrolled	7% (n = 1)	25% (n = 35)	20% (n = 3)	36% (n = 49)
99	Enrolled in CEAS			70% (n = 30)	60% (n = 96)
	Enrolled in Another ASU College			14% (n = 6)	19% (n = 30)
	Not Enrolled			16% (n = 7)	21% (n = 33)

The retention rates of CEAS freshmen women entering in Fall of 1996-1999 have been considerably higher both within the CEAS and within ASU. For the past three years, on average, the retention rate of freshmen women has been 64% in CEAS and 79.5% at ASU [10]. If retention rates of the WISE Summer Bridge Program participants are compared with freshmen CEAS women who did not attend the Bridge, the retention rate of Bridge participants is significantly higher and well over the ASU goal of 78% retention after one year. See Table 1.

CONCLUSION

Data received from the survey indicates that previous WISE Summer Bridge programs have been effective. The WISE staff is using the telling survey results in assessing program effectiveness, student retention, and attrition. It was observed that all of the respondents decided on engineering in middle school or high school. This strengthens findings that indicate current recruitment programs, including middle school and high school programs provided by WISE each summer, are necessary and effective. In addition, the residential program format proved to be a very valuable experience and helped to lessen the stress caused by transitioning from high school to college. Further, it was determined that the WISE Summer Bridge program is effective and useful to its participants. The academic progress of the WISE Summer Bridge students is very encouraging. The women who have participated in the Bridge Program have been retained at a level higher than the ASU goal of 78%. Even more importantly to the College, a higher percentage of these women are being retained within the CEAS.

Future plans address the suggested changes such as more social activities, time management training, individual major and coursework sessions, and a full campus tour. Raytheon has agreed to partner with WISE on this valuable program indefinitely. The Program will continue to research student needs and program effectiveness in an ongoing effort to provide the best Summer Bridge program possible.

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