

Bridging the Gender Gap: Six Years of Success

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Abstract

Since 1998, the Women in Applied Science and Engineering (WISE) Program in the Ira A. Fulton School of Engineering has held a WISE Summer Bridge Program for incoming freshman women. This program has averaged a one-year retention rate of 80% or higher for the past six years therefore, as a persistence tool, the effects of the program are significant. This paper will provide information on the Bridge Program, such as program components and activities, and examine overall retention rates for students participating since 2000.

During this four day residential program, students participate in academic reviews to prepare for their first year engineering curriculum including Calculus I & II, Physics I – Mechanics, Chemistry, and Introduction to Engineering courses. The WISE Summer Bridge Program also introduces students to MAPLE and Excel programming sessions, student engineering organizations, and provides evening activities geared toward students networking with WISE staff, other engineering students, and industry. The WISE Summer Bridge Program occurs each summer prior to the beginning of the Fall Semester and has evolved over the previous seven programs to provide students with a head-start on their engineering courses.

Data on persistence and graduation rates of WISE Bridge participants since 2000 will be presented. Possible explanations for former Bridge participants' persistence or consequent changes in major and their graduation/persistence rates after leaving engineering will be discussed.

I. Introduction

The interest in engineering as a choice for a major in colleges and universities is at a 30-year low. For all students regardless of gender and ethnicity, major issues that impact first-year retention include difficulty in the transition from high school to college, financial problems, and general misinformation about the engineering curriculum [1]. In addition, first-year engineering students generally have little exposure to engineering. Academically, the first-year curriculum consists primarily of fundamental courses (physics, mathematics, chemistry, English, etc.) that are essential prerequisites to upper divisions engineering courses. Often, these courses fail to motivate students and many potential engineers transfer out of their majors before they experience any engineering [2].

The situation becomes more serious when gender and ethnicity are primary factors. Although the number of women enrolled in engineering has increased each year since 1989, only 19.7% of the 353,118 students enrolled in engineering in Fall 2001 were women [3]. Minority women are the least represented in engineering, making up only 4.2% of the fall 2000 engineering enrollment [3] and receiving only 2.8% of Bachelor's degrees in engineering in 1999-2000 [4].

Over the past few decades, the Commission on Professionals in Science & Technology has studied reports on women in engineering career fields [5]. Many of these findings are still true today. In 1982, a relatively small percentage of women earned science and engineering degrees. Further, in science and engineering employment, women are concentrated in specific fields. Today, women are still employed in higher rates in part-time positions, with lower salaries, and only a small percentage of women hold tenured faculty positions [6].

II. WISE Bridge Program

The ASU WISE Summer Bridge Program offers a comprehensive orientation for incoming female students. The program prepares students for the rigorous engineering curricula and provides activities for networking with staff, student organizations, and industry. The Bridge Program has positively impacted overall female retention rates and serves as a national model.

The ASU WISE Summer Bridge Program was designed to prepare incoming female students for the transition from high school to the Ira A. Fulton School of Engineering. Since 1998, this program has offered academic reviews in courses such as mathematics, physics, and chemistry and has offered computer-based curricula to prepare students for introductory courses. Program participants are required to attend sessions including introduction to engineering, team training, time management and study skills to prepare them for first-year expectations. Each session is instructed by an academic expert including ASU Math Faculty, Engineering Faculty, engineering graduate students or WISE staff members.

According to recent surveys, students attending the WISE Summer Bridge Program are better able to acclimate to the campus by receiving general information concerning the university, financial aid, and departmental advising. In addition, students attending this program are able to become familiar with the ASU campus, gain a head start on engineering classes, and meet other female students. Finally, the participants become acquainted with the WISE staff and the Center for Engineering Diversity and Retention (CEDAR) available for their support.

ASU enrollment rates for women and minorities in engineering are consistently above national average. Currently, the enrollment rate for female students is 20.1% and for under-represented minority students, the rate is 17.7% as of Fall 2003 [7]. Recently, ASU was ranked 11th in the nation by the American Society of Engineering Education for graduation rates for women in engineering doctoral programs and for number of female faculty [8].

III. Program Components

The WISE Summer Bridge Program offers academic reviews in mathematics, physics, and chemistry to entering female freshman students. Each of these sessions are held in two-hour sessions with a 10 minute break. In addition, computer program tutorials in Maple and Excel are offered to better prepare students for their freshman engineering courses. Maple and Excel labs are generally two to three hours and contain information geared toward giving students exposure to computer programs utilized in Math (three semesters) and Intro. to Engineering courses, respectively. General information about ASU, financial aid, and advising is disseminated to help students become familiar with the campus. Evening activities are also planned that allow

participants to begin building a support system and network with “seasoned” engineering students and professional women engineers that they will continue to utilize throughout their freshman year and beyond.

Academic Review Sessions

Math Reviews: Students entering Calculus I are required to attend three math review sessions in Algebra, Trigonometry, and Calculus. Faculty from the Department of Mathematics facilitate these sessions. Participants attending these sessions are required to take a math placement test on the last day of review to indicate proper placement in their math class.

Physics & Chemistry Reviews: Students are required to attend two physics & chemistry review sessions. These sessions are facilitated by engineering graduate students or faculty. Students are given basic information and are introduced to problem solving techniques specifically geared toward the first physics mechanics and chemistry courses required of all engineering students.

Program Tutorials

Excel Tutorial: An Excel tutorial session is offered to introduce students to designing data spreadsheets. This tutorial is offered to expose students to programming, manipulating cells, and spreadsheet design required for the intro. to engineering course.

MAPLE Lab Session: A MAPLE laboratory session is offered to expose students to simple programming techniques needed to complete their calculus courses. The instructor for this session is typically an upper division engineering student who also helps to co-facilitate the Math Review Sessions. This session gives information on program language required to have MAPLE perform simple mathematical functions and graphing.

Seminars

Bridge Participants are required to attend the following sessions to give them a head-start on expectations during their first year. WISE staff members and/or student staff instruct each session. These sessions offer expert advice on ASU resources, departmental policies, where to go for advising, time management, and how to study.

ECE 100: Introduces students to engineering design projects and the Integrated Manufacturing Engineering Laboratory (IMEL) where semester projects are housed. All students taking ECE 100 are required to work with team members to solve problems for real-life situations.

Team Training: A team training session is offered on the first evening to ensure proper training to work in groups. Students are given information developed by Fulton faculty as well as expert advice from program counselors.

Time Management: Information for proper time management and suggestions are made to help students realize the importance of balancing academic demands, personal demands, and work demands. Printed materials are distributed to give advice on effective time management, time analysis, and how to prioritize activities. Students also are advised to use day planners and daily checklists to make the most effective use of their time and complete tasks.

Study Skills: Expert advice is given from WISE staff members to ensure students are aware of academic resources within the Fulton School and ASU. Strategies for learning information are discussed and students are given complete information on tutoring centers and resources located both on and off campus. Students also complete testing to indicate their learning style. Information on learning styles and strategies specifically geared toward engineering students are distributed.

Advisement: An advisement session is offered by the Office of Student Academic Affairs within the Fulton School to give students information on proper procedures for their specific departments. Students ask questions concerning drop-add, pre-registration, registration, and specific ASU & Fulton School policies.

Break-out Sessions

Math Placement Test: After math review sessions, students who had not previously taken their math placement test go to the Math Placement Center. On the first day of programming, all bridge students take a timed, practice math placement test to ensure proper placement in their math courses. During the math review sessions, students are able to clarify topics they had encountered on the practice test.

Computer Accounts: Students visit the Computer Accounts Office in the Computing Commons to register for their ASU email accounts. Students are able to familiarize themselves with computer resources on campus and pre-register for their accounts.

Activities

Networking: Networking activities are organized to foster relationships between students, staff members and engineering professionals involved in organizations. These activities encourage networking by introducing students to their peers and providing information on professional and student organizations. In addition to student Society of Women Engineers (SWE) members, members from all engineering minority societies; Society for Hispanic Professional Engineers (SHPE), National Society for Black Engineers (NSBE), and American Indian Science and Engineering Society (AISES) are invited to attend networking activities to get to know Bridge participants and inform them about their organizations.

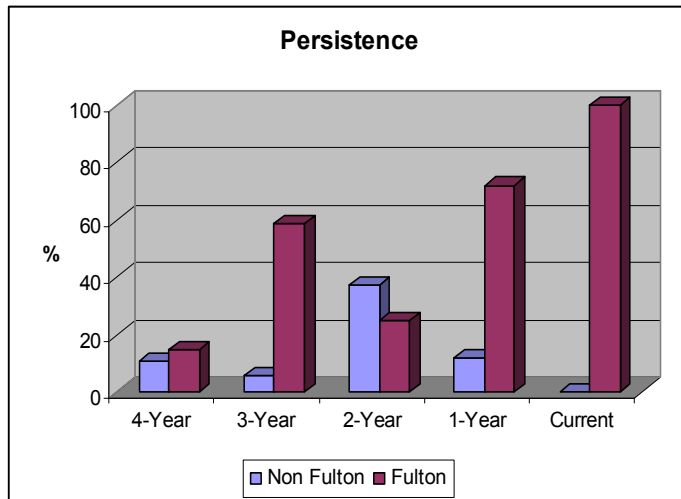
Industry Mentoring: To date, Motorola and other local industry have provided 35 mentors to be individually matched to WISE Summer Bridge participants offer support, guidance, and professional networking opportunities. Since 2003, industry mentors have diligently given their time and expertise to helping further the educational and professional ambitions of WISE Bridge students. Without their support, many of the students involved in this program would not have been retained their first year. Industry involvement in the WISE Summer Bridge Program began when Motorola recruited 30 professional mentors to attend an evening mentor activity and offer one-on-one advice. From the beginning of their experience at ASU, these freshman female students are able to see the level of commitment industry has in supporting them and are able to maintain their connections through the academic year by signing up to participate in the WISE Industry Mentor Program.

V. Bridge Program Persistence & Graduation Rates

Table 1: WISE Summer Bridge Program Participant Persistence and Graduation Rates 2000 – 2004

Program Year	Total Enrollment	Persistence ASU Non-Engineering (as of F2004)	Persistence ASU Engineering (as of F2004)	Graduation ASU Non-Engineering	Graduation ASU Engineering	African American	Native American	Hispanic	Asian	Caucasian	Ethnicity Non-Reporting/Other
WISE Bridge 2000 (4 year)	27	3 (11%)	4 (15%)	4 (15%)	5 (19%)	1 (3.7%)	2 (7.4%)	1 (3.7%)	3 (11.1%)	15 (55.6%)	5 (18.5%)
WISE Bridge 2001 (3 year)	34	2 (5.8%)	20 (59%)	N/A	N/A	4 (11.8%)	1 (2.9%)	2 (5.8%)	5 (14.7%)	17 (50%)	5 (14.7%)
WISE Bridge 2002 (2 year)	24	9 (37.5%)	6 (25%)	N/A	N/A	2 (8.3%)	0	8 (33.3%)	3 (12.5%)	10 (41.7%)	1 (4.2%)
WISE Bridge 2003 (1 year)	33	4 (12.1%)	24 (72%)	N/A	N/A	2 (6%)	2 (6%)	8 (24.2%)	5 (15.2%)	13 (39.4%)	3 (9.1%)
WISE Bridge 2004 (current)	18	0 (0%)	18 (100%)	N/A	N/A	0	0	3 (16.7%)	1 (5.6%)	12 (66.7%)	2 (11.1%)

Graph 1: WISE Bridge Program Participant Persistence and Graduation Rates 2000 – 2004



n=136 *Legend: Non-Fulton = Non Engineering Major, Fulton = Engineering Major

Long-term data assessed from five programs, since 2000, indicate high one year persistence rates [9]. Since inception, Bridge students show an average one-year retention rate of 88%, 20 percentage points higher than the average engineering freshman student regardless of ethnicity or gender [10]. As of November 2004, all participants in the 2004 WISE Summer Bridge Program were in good standing. Students attending the 2003 Summer Bridge Program showed a 72% retention rate in engineering and an 84.1% retention at ASU (Engineering and Non-engineering combined), as shown in Table 1 and Graph 1.

The 2002 program data indicates slightly lower persistence rates however, the ASU overall persistence rate of these Bridge students is 62.5%. The three year persistence rate of Bridge 2001 students also indicates 64.8% ASU persistence with 59% persistence in engineering. Finally, four-year tracking of Bridge students indicates 19% of students have already graduated in engineering and 15% of students are currently persisting in engineering at ASU. An additional 11% of these students, though not persisting in engineering, are persisting in their education at ASU. Table 1 also summarizes the distribution of ethnicity of the participants of the WISE Summer Bridge Program. Quite notably, approximately 20% are African American, Hispanic or Native American with an additional 11% Asian.

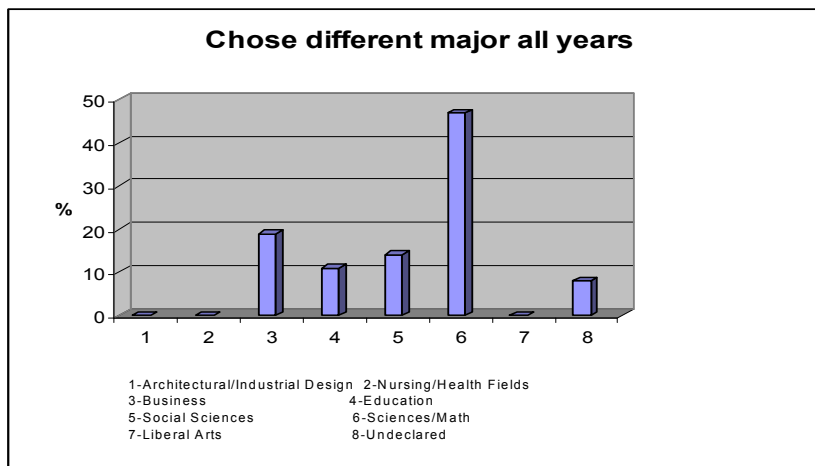
Table 2: WISE Bridge Program Participants' Overall GPA 2000 – 2004

	<u>Year 2000-2004</u>	<u>Year 2001-2004</u>	<u>Year 2002-2004</u>	<u>Year 2003-2004</u>
<u>Fulton</u>	<u>3.13</u>	<u>2.77</u>	<u>2.93</u>	<u>3.05</u>
<u>Non Fulton</u>	<u>2.66</u>	<u>2.89</u>	<u>2.89</u>	<u>2.7</u>

n=136

*-A statistical comparison between the two groups was conducted in terms of GPA. For four years, the GPA's of Engineering and Non-Engineering students were not significantly different.

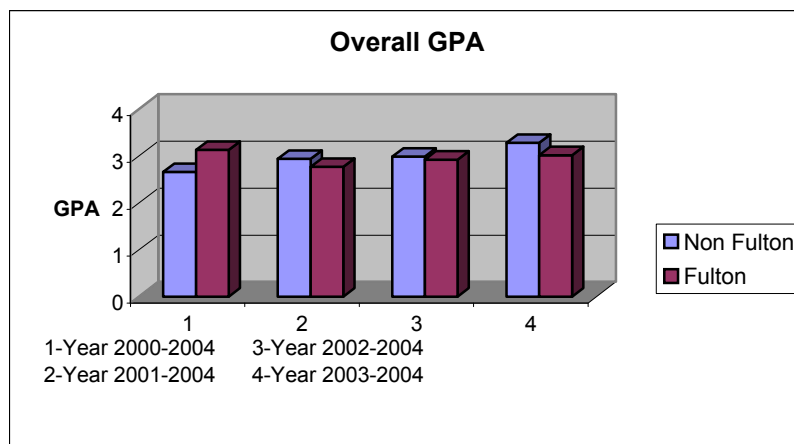
Graph 2: Change of Major of Bridge Program Participants 2000 - 2004



n=136

*Social Science includes majors in Anthropology, Political Science, Psychology, and Sociology

+Sciences/Math includes majors in Chemistry, Physics, Biology, Geology, Physiology, Integrated Studies, Economics, and Nutrition

Graph 3: WISE Bridge Overall GPA 2000 – 2004

*Legend: Non Fulton = Non Engineering Major, Fulton = Engineering Major

An examination of the information in Table 2 together with Graphs 2 and 3 reveal that WISE Bridge participants have good GPA's in both engineering and non-engineering majors. These results seem to indicate that changed majors are not due to low GPA achievement. Such a finding would be consistent with current literature on engineering persistence [11]. Also, Graph 2 indicates that students still at ASU are more likely to choose majors in math or science (47%) fields. In addition, students seeking non-science majors are likely to choose business (approximately 20%) or social science (14%) fields.

Although students are encouraged to persist in engineering, there are many factors that may influence their decision to stay in engineering or change their majors. There are also factors that influence their decision to stay at ASU. Many of the students that have left ASU are unaccounted for. It is possible that although these students are not at ASU, they are still pursuing an engineering degree at another institution. Financial pressures and lack of student support in other departments may also be contributing factors.

V. Conclusion

The Bridge Program is a key component in the successful growth of ASU WISE programming and a successful emerging model for improving female achievement. WISE has become a dynamic organization thanks to the foresight and support from faculty and industry who work in collaboration to support the needs of female students. The ASU Wise Bridge Program has been used as a model for other university Bridge Programs. With increased assessment and dedicated resources from the ASU Ira A. Fulton School of Engineering, this program will continue to grow and to provide the best possible services for female students to succeed in engineering in the future.

VI. References

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VII. Biographical Information

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DANA C. NEWELL, M.A.

Dana Newell is the Director of the Center for Engineering Diversity & Retention (CEDAR) Program. Her responsibilities include supervising staff that coordinate programs for recruitment and retention of women and minorities, fundraising and grant writing for program sustainability and expansion, creating new programs based on student need, and assessment & evaluation.

DR. SUSAN HAAG

Dr. Susan Haag is the Director of Assessment in the Fulton School of Engineering. She has conducted evaluation projects funded by NSF focusing on curricular integration, infusion of technology, teaming methods, e-learning contexts, institutional reform, and recruitment and retention of underrepresented populations in math & engineering.

DR. RONALD ROEDEL

Dr. Ron Roedel has served as the Associate Dean for Academic Affairs in the Ira A. Fulton School of Engineering for the past three years. Dr. Roedel holds a PhD in Electrical Engineering from Cornell University and has been a faculty member in electrical engineering for over 20 years. He oversees departments for scholarships, advising, student success initiatives, assessment and evaluation, diversity programs and internships programs.