Freshman Introductory Engineering Seminar Course: Coupled with Bridge Program Equals Academic Success and Retention

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ABSTRACT

Arizona State University's (ASU) Office of Minority Engineering Programs (OMEP) has hosted the Minority Engineering Program (MEP) Summer Bridge Program for the past two years. The purpose of the program is to promote greater awareness of and recruit potential candidates to the College of Engineering and Applied Sciences (CEAS) at ASU. The program content and curriculum were designed to prepare underrepresented ethnic minority students for success in the College at ASU. The program focused on building community and utilized undergraduate student role models as instructors, while the curriculum focused on engineering design, technical communications, and a design project. Academic scholarships were awarded to all participants based on a team design project competition.

The Summer '96 program participants were encouraged to participate in the MEP Academic Success Seminar course offered in the Fall '96. Twelve of the 43 participants chose to do so. Since the instructor for the course was also the director of the bridge program, the MEP used this as an opportunity to continue building community, reduce student isolation, and monitor student progress throughout the semester. In fact this is exactly what occurred with those who participated, however, continuing all these facets was difficult with the remaining 31. Therefore, the following year, the Summer '97 program participants were required to participate in the course as a stipulation to receive their scholarship. As a result, all 38 participants chose to register for the seminar course or the Foundation Coalition Match program at ASU.

The academic success of these students during their first semester is evaluated, compared, and correlated with several measures including 1) a comparative analysis of seminar course success between the students who participated in the bridge program and those who did not; 2) student's scores on the university mathematics placement examination and the student's class grade earned in their beginning mathematics class; and 3) the student's use of the MEP support system (i.e. Tutoring program, Academic Excellence Program).

INTRODUCTION

In Fall 1997, Arizona State University (ASU) enrollment figures including the East, West and Main campuses grew to over 47,000 students, placing it as the fourth largest university in the United States. The Main campus supports 44,255 students: 33,497 are undergraduate (75.7%) and 10,758 are graduate students (24.3%). The undergraduate underrepresented minority students included 2.2% Native American, 3.1% African American, and 10.5% Hispanic students. The graduate underrepresented minority students included 1.3% Native American, 2.4% African American, and 6.3% Hispanic students [1].

Within the College of Engineering and Applied Sciences (CEAS), the Fall 1997 enrollment of undergraduate engineering students increased by 5.9% (3,625) with an increase in graduate level students by 1.4% (1,791) constituting an overall 4.4% (5,416) growth in the college enrollment. During this same period, the minority undergraduate engineering enrollment grew by 15.8% (to 579 students, representing 16.0% of the undergraduate engineering students), while at the graduate level the minority enrollment decreased by 7.3% (to 89 minority graduate students, representing 5.0%) [2].

The Office of Minority Engineering Programs (OMEP) is a growing support system for underrepresented minority students (African American, Hispanic, and Native American) in the College. The goals of the program are to increase the number of underrepresented minority students who enroll in the CEAS and to increase the number of underrepresented minority students who successfully complete their undergraduate engineering degree at ASU. These goals are accomplished through programs such as the Peer/Tutor Program, Academic Excellence, skill workshops, MEP New Student Orientation, and ASE 194: MEP Academic Success Seminar.

These programs have been built on the existing literature for the retention of minority students, as well as the incorporation of unique techniques that have been found to be successful in our CEAS activities. Summer Bridge Programs and Orientation seminars have been used successfully for some time to assist in the retention of students. Hermond [3] includes them under the category of matriculation, a term defined by Glenn and Landis [4] as activities done with students between the time they are admitted and their first semester of enrollment, to assist their transition to college life.

Bridge Programs vary in length from a few days to one week, such as the Mathematics Bridge Program used at Purdue [5] to five weeks such as the Academic Enrichment Program at Hampton University [6]. Others are eight weeks [7] or 10 weeks with the participants taking two courses for credit [8]. Bridge programs may also concentrate on just mathematics [5], tutorials in several subjects [6], on survival skills [8], or other combinations of the above [8]. The programs often are offered free of charge and may include stipends or scholarships based on performance during the session.[6,7,8]. Reichert and Absher [8] identified 13 engineering schools that either graduate large classes of African Americans or that retain relatively high percentages of African American students in engineering. Six of the 13 schools offered minority students "survival skills" bridge programs and workshops. At the same time, coalition schools are interfacing their bridge programs with their coalition effort [9].

The bridge program at ASU was primarily created to promote community and to ease the transition into the first introductory engineering class. This program and the academic success seminar also relied heavily on the theories and practice of Raymond B. Landis as described in his text Studying Engineering [10] and in his workshops. As a member of the Foundation Coalition, the bridge program was also designed to interface with the integrated curriculums developed through that program. A unique feature of the bridge program was that although a faculty member coached engineering students, the students themselves delivered the instruction and program [11].

MEP SUMMER BRIDGE PROGRAM

The OMEP has hosted the Minority Engineering Program (MEP) Summer Bridge Program for the past two years. The purpose of the program is to promote greater awareness of and recruit potential candidates to the College. The program content and curriculum were designed to prepare underrepresented ethnic minority students for success as an engineering student. The program focused on building community and utilized undergraduate student role models as instructors, while the curriculum focused on engineering design, technical communications, and a design project. Academic scholarships were awarded to all participants based on a team design project competition.

The curriculum focused on the introductory engineering course ECE 100: Introduction to Engineering Design. The catalog description of the course is the following:

> Introduction to engineering design philosophy and methodology: computer modeling of systems, processes, and components; design for customer satisfaction, profitability, quality and manufacturing; economic analysis; flow charting; sketching CAD; and teaming. A term design project is included [12].

ASU engineering students will usually take this course in their first year. It is a four-semester hour, open-ended design course with three components: laboratory, projects, and modeling.

During the summer of 1996, 44 students participated and completed the program. As a recruitment tool, the program was an overwhelming success with 43 of the 44 students completing the academic year (one chose not to because of the family's financial situation). During the summer of 1997, 39 students also completed the program. Currently, 38 of the 39 from the 1997 program have enrolled in the CEAS (one chose not to enroll because of problems with financial aid).

ASE 194: MEP ACADEMIC SUCCESS SEMINAR

In an effort to build community and increase academic success, the MEP offers a two-semester hour introductory course for new freshman/transfer students called ASE 194: MEP Academic Success Seminar. The purpose of the course is to assist and to prepare students to excel in their academic pursuit of a baccalaureate degree in engineering and the applied sciences. This course emphasizes academic success, leadership development, time management, the transition from high school/community college to the university, and professional development. The intent is to utilize a comprehensive approach to both academics and leadership development that will unilaterally prepare students for their academic career, as well as develop role models for future students.

The Summer '96 program participants were encouraged to participate in the MEP Academic Success Seminar course offered in the Fall '96. Twelve of the 43 participants chose to do so. Since the instructor for the course was also the director of the bridge program, the MEP saw this as an opportunity to continue building community, reduce student isolation, and monitor student progress throughout the semester. In fact this is exactly what occurred with the 12 that chose to participate. However, continuing all these facets was difficult with the remaining 31. Therefore, the following year, the Summer '97 program participants were required to participate in the course as a stipulation to receive their scholarship. These students were given the option to either participate in the Foundation Coalition Match program offered at
ASU or to register for the seminar course. The Foundation Coalition Match program, funded by the National Science Foundation, is a blocked curriculum that requires the students to take all their courses as a cohort. The program includes ECE 100, Calculus, Physics and English. The students take their classes in one classroom that is equipped with 40 computers. A team of instructors delivers the entire curriculum and the students are required to work in teams on all assignments. As a result of this requirement, all 30 participants chose to register for the seminar course and eight joined the Foundation Coalition Match program. However, of the 30 that registered for the seminar course, two of the youngest participants stopped attending classes and withdrew during the semester.

Overall, the 42 participants of the Summer '96 program performed well academically with an average semester GPA of 2.65 in their first semester (Fall 96). The average GPA for the twelve students who also took ASE 194 was 3.00 while the average GPA for those who did not take ASE 194 was 2.51 (p=0.067). The average GPA of the '96 ASE 194 students who were in the Bridge Program was 3.00. However, the average GPA for the students in the seminar class who had not participated in the bridge program was 1.85. These means were significantly different at p=0.013.

Overall, the 36 participants of the Summer '97 program (two withdrew from their courses completely) also performed well academically with an average semester GPA of 2.39 in their first semester (Fall 97). All of the '97 participants were required to participate in the seminar course or the Foundation Coalition Match program. The 28 who participated in and completed ASE 194 seminar course had an average GPA of 2.34, while the eight who participated in the Foundation Coalition Match program had a GPA of 2.57 (p=0.429). Overall, the seminar course had 37 students who completed the semester (other students had registered for the course who had not participated in the bridge program). The 28 Bridge Program participants who were in the ASE 194 class had an average GPA of 2.34. The average GPA for the 9 students in this class who did not participate in the Bridge Program had an average GPA of 2.03. While the average GPA is lower for those who did not participate in the Bridge Program, it is not statistically significant (p=0.408).

MATHMATICS PLACEMENT EXAM

An additional concern was the welfare of the freshmen engineering students in their first mathematics class. It was well known that many of the engineering freshmen do not do well in their initial mathematics class. In a 1995 survey of freshman students enrolled in ECE 100, it was shown that the grades in the first mathematics class were very significantly different for the students who were retained to their sophomore year versus those who were not retained [13]. See Table 1. This particular concern of mathematics preparation is a common problem and special mathematics sessions are included in many summer bridge programs [5, 6, 7, 8, 9].

At ASU, math placement tests had not been used in some years [14]. When the Mathematics Department was approached by the CEAS about the possibility of reinstituting the math placement exam, they were most receptive. In response to the CEAS request, the Mathematics Department, in the summer of 1996, made available a pilot math placement exam for MAT 270, the first calculus class required by CEAS.

The pilot group, on which this exam was first tested, was the 43 participants of the 1996 program. No math review was given before the exam. The math placement scores ranged from 2 to 23. The Mathematics

Math Class Grade Earned Fall 95	**Still CEAS (n=99)**	**Left CEAS (n=31)**	**p**
A, B, or C	81.8%	41.9%	0.0001*
D, E, or W	18.2%	58.1%	

Table 1: Comparison of Math Grades earned in Fall 1995 by Students Enrolled in ECE 100 Between Those Who Were Retained for Fall 1996 and Those Who Were Not.
* *with Yates' correction*

Department conservatively suggested, based on past history, that a student had a high chance of obtaining a grade less than a C in MAT 270 if their math placement score was less than 13.

Of the Summer '96 participants, fifteen students took MAT 270. Their math placement scores ranged from 10-22. For those with placement scores of 15 or higher, over 83% of the students received a C or better. Three scores were below 15 and these students received a B (score 10), an E (score 11), and a W (score 14).

Twenty of the students chose to enroll in MAT 170 (pre-Calculus). Their placement scores ranged from 5 to 15. Over 91% of the students received a C or better if their placement score was 8 or higher. The math placement scores were lower (13.0 average) for the students who took the ASE 194 course, than for those (13.68 average) who did not. However, the difference was not significant (p=0.0731). All of the students who were enrolled in the ASE 194 received a C or higher in their math class except for one student who withdrew from Calculus I (he had been advised to take Pre-Calculus). Over 32% (n=31) of the students who did not enroll in the ASE 194 course received a D, E, or W in their math course.

During the 1997 MEP Summer Bridge Program, some math review was given before the math placement test was administered. Perhaps, due to this review, the '97 students scored an average of 13.64, slightly higher than the '96 students who scored an average of 13.50. However, this difference was not statistically significant (p=0.908). The math placement exam was revised slightly for use in Fall 1997 and specific advisement recommendations were made. If a student scored less than 15, they were strongly recommended by the Math Department, to take MAT 170. If a student scores less than 10, an academic advisor must approve enrollment to MAT 270. All of the '97 Bridge Program students were counseled and advised on which math class they should take. Only one student took MAT 270 who was advised to take MAT 170. The student withdrew from school during the semester.

Twenty-two of the thirty-eight '97 participants took MAT 270 their first semester at ASU. Their placement scores ranged from 8-22. For those with placement scores of 15 or higher, all received a C or better. Ten of 22 students took MAT 270 with a placement score of less than 15. None of these students earned a grade better than a C and six earned a grade below C. Six of their scores were less than 13 (actually less than 10) and all earned a grade of D, E, or W. Eleven students chose to enroll in MAT 170. Their placement scores ranged from 6-15. Only two of the students earned less than a C: a student with a placement score of 13 earned a D and a student with a placement score of 6 earned an E [14]. Of the students enrolled in ASE 194, only 20% (n=25) received a D, E, or W. Of the students not enrolled in ASE 194, 25% (n=8) received a D, E, or W.

Although the 97 students had a higher average math placement score, on average their grades in their first math class was 2.09, lower than the 2.23 average of the '96 class. However, this difference was not significant (p=0.621). The average GPA of the '96 students after one semester was 2.65. The average GPA of the '97 students after one semester was 2.39 (p=0.202).

MEP SUPPORT SYSTEM

Supported by the Foundation Coalition, the MEP has begun an Academic Excellence Program that clusters underrepresented minority students enrolled in calculus, chemistry, physics, and the introductory engineering design course. The students develop their own community of peers and collectively come to conclusions on how to process information. The workshop helps to move away from traditional tutoring that is often a short term fix. These sessions enhance the mastery of engineering concepts as opposed to isolated problems by collaborative learning between the students and an upper-division undergraduate student who acts as the session facilitator. It is the intent of the process to prepare students for potential curriculum integration in the future, as well as for team participation in industry.

The MEP Peer/Tutor/Mentor Program provides tutorial services to minority students based on their needs and requests. The program includes one-on-one or group-tutoring sessions in a variety of required courses such as mathematics, chemistry, physics and the engineering core courses. The program offers flexible hours because tutoring sessions are scheduled between the tutor and students. The program also serves as a mentor program in that students who are in their junior and senior level curriculum or graduate program serve as tutors. In addition, the program allows for those tutors who work with the incoming freshman and transfer students to work one-on-one in areas that may concern the new student.

The students who participated in both summer programs were strongly encourage to also participate in either the Peer/Tutor/Mentor Program, the Academic Excellence Program or both depending on their courses. The 1997 MEP Summer Bridge students were given two additional support systems for retention during their fall semester. As discussed before, the first was required participation in the MEP Academic Success Seminar or a program that clustered students. The second was

clustered tutoring sessions offered by the MEP. The overall effect of these additional support programs is shown in Table 2.

Math Grade	Seminar & Tutoring		Seminar & No Tutoring	
	MAT 270	MAT 170	MAT 270	MAT 170,106
A, B, C	8 (88.9%)	6 (85.7%)	8 (61.5%)	4 (66.7%)
D, E, W	1 (11.1%)	1 (14.3%)	5 (38.5%)	2 (33.3%)

Table 2: Comparison of Math Grades depending on Use of Seminar and Tutoring

These numbers are small, but if we contrast the students that made use of the tutoring services as well as the seminar, with those that did not use the tutoring services, there is a significant difference at p=0.2101 (with Yates'correction).

CONCLUSIONS

In spite of the lack of strong grade prediction due to the math placement exam, over 88% (n=43) of the 1996 MEP
Summer Bridge Program students enrolled at ASU in Fall 1997 for their sophomore year. Over 77% of these were retained in the CEAS for Fall 1997. (Only 76.2% of the Fall 95 students returned to the CEAS for the 1996 Fall.) The overall comparable retention rate in the CEAS for the Fall 1996 class was over 66.2%, a significant increase over the 54% that were retained from Fall 1995. In addition, entering students were retained at a 77.3% rate in the University, a dramatic increase from 68.5% of the year before. This increase is believed to be due, at least in part to the increased retention activities of the College in general, and the MEP, in particular.

Students	Category	ASU: Retained after one year	CEAS: Retained after one year
F 95	All	68.80%	54.00%
	Minority	68.10%	
F 96	All	77.30%	66.20%
	Minority Bridge Program (n = 43)	88.40%	79.10%

Table 3: Retention of CEAS First-Time Freshman

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