

Creating a Successful Model for Minority Students' Success in Engineering: The PREF Summer Bridge Program

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Abstract— In the College of Engineering, attrition tends to be highest for first and second year students. The PREF program's goal is to increase both retention and graduation rates for underrepresented minority students. This intensive residential academic preparation program focuses on social/cultural, academic and professional development. Based upon data from 14 years, participants demonstrate higher graduation rates when compare to both comparable underrepresented minority students as well as majority students from the College of Engineering. This highly successful program is a model in striving for diversity within the university and industry.

Introduction

Research shows that African-American and Hispanic/Latino American college students have higher attrition rates than Asian American and European-American students (Rendon, 1982; THECR, 1997). According to the National Institute of Education Report, when faculty, administrators, and students are involved in learning, there is greater student achievement and retention within that college environment (NIE, 1984; Pascarella & Terenzini, 1979; Persaud & Freeman; 2005; Tinto, 1975; Tinto, 1987; Tinto, 1999). In other words, students who make the effort to share their comments and questions during class are more likely to learn than those who are not actively involved and participate.

Arizona State University hosted a summer bridge program to recruit underrepresented students in engineering and applied sciences. The program's focus was on engineering design, technical communications and a final design project. In assessing the program's effectiveness, 80% of the participants were *very satisfied* and 20% were *moderately satisfied* with their summer experience and were more likely to pursue careers in engineering or applied sciences. Within one year of the program, there was an increase of 13.9% of incoming underrepresented minority undergraduate students into the colleges of engineering and applied sciences (Anderson-Rowland, Reyes, and McCartney, 1997). One year later, 81.8% of these students were still in these two colleges and earned between an A to a C in their fall math class ($p=0.0001$). Participants who attended a First-Year Seminar and tutoring received higher math course grades than those students who did not attend tutoring. Finally, after one year, students who

participated in the minority bridge program were retained at 88.40% as compared to all students who were retained only at 77.30%. Within the colleges of engineering and applied sciences, after one year, only 66.20% of all students (including majority students) were retained while 79.10% of minority bridge program participants were retained (Reyes, Anderson-Rowland, and McCartney, 1998). The results from the PREF program are similar to the summer bridge program at ASU.

Academic and student support services need to be front-loaded especially for first year students, since the research demonstrates a high attrition rate during the first year of college. In order for students to be retained, they need to develop their skill competencies and confidence in their ability to perform well academically. This can be done by: a) establishing mentoring programs and college-summer-bridge programs (Thomas, 1990; Tinto, 1982; Tinto, 1988; Tinto, 1999; Upcraft & Gardner, 1989). The summer bridge program, Pre-First Year Engineering & Science Program (PREF) has been designed to embrace these principles and has been remarkably successful in doing so over its 14 year history at the university (Persaud & Freeman, 2005).

PREF is a summer bridge program specially designed for underrepresented first-year students of color in engineering and science-based curriculums. It consists of intensive academic preparatory courses for entry-level Calculus, Physics, Chemistry and an English writing course. The overall objective of the PREF program is to maximize the retention and graduation rates of underrepresented minority students in engineering and science majors at The Pennsylvania State University (Persaud & Freeman, 2005).

Program Description

The PREF program is a residential, six-week, rigorous academic summer program that has taken place for the past 14 years. Accommodations for participants are made available through on-campus student residence and dining halls. PREF participants enroll in six-credit hours of course work that will prepare them for their first fall semester (Persaud & Freeman, 2005).

Selection Process

Both quantitative and qualitative data are considered in selection of PREF participants. Potential PREF students are identified from a group that meet these criteria:

- Taken high Calculus, Physics, & Chemistry in high school
- SAT Math score typically at 550 or higher
- High school GPA well above 3.0
- College science predicted gpa of 2.75 or above
- Identified Engineering or Science as an intended Major
- Essay discussing students' engineering aspirations
- Applied and accepted to Penn State's main campus (University Park)

A small group of students meeting these criteria is invited to apply to the program. Due to significant cost of the program, only 15-18 students are currently selected per summer (Persaud & Freeman, 2005).

Components of PREF

PREF is comprised of three program components: social/cultural, academic, and professional development. The social/cultural component addresses family interaction and the transition from high school to college and includes on-campus residential living and daily interaction with other students and staff. Students arrive with their families to an orientation that reviews the program expectations of the students and families. Participants receive access cards to their residence halls, student identification cards, computer lab and library access and every other privilege and responsibility of all Penn State college students (Persaud & Freeman, 2005). The academic component includes those elements that affect students' present and future academic performance. The academic component includes four introductory courses that participants are required to take. The courses required for PREF are an introduction to Calculus, Physics, Chemistry and English. Participants are also required to attend evening study sessions to complete homework and group assignments. Early encouragement of group-work is critical since their majors require an immense amount of time where it is necessary and assist each other. This early practice ensures that students will be more open to forming study groups in the fall (Persaud & Freeman, 2005). For professional development, participants complete a resume, a research paper and a presentation implementing library resources, and create an electronic portfolio showcasing their work. A corporate visit is included which has proven to be quite effective in helping the PREF participants to see the value of their classroom lessons and how learning math and science are directly used in their future careers (Persaud & Freeman, 2005).

Continued Retention Strategies

At the end of the summer program, students are not left on their own. Several retention strategies are in place to guide these students on to their continued journey of success. These include assignment into an engineering living option, a mentoring program, a first-year seminar, "cluster" course scheduling, and free tutoring. To assist in the social adjustment, all first-year students, including PREF participants, are assigned a mentor who contacts the students throughout their first year. In the fall, PREF participants are assigned to Freshmen In Science and Engineering (FISE) House, a residential hall specifically for first year students from the colleges of engineering and science. This special living option includes residential tutoring services for Calculus, Physics and Chemistry, and other resource workshops that residents are required to attend.

For academic continuity, PREF participants are scheduled in "clusters" of six to eight for designated sections of Math, Chemistry, and/or a first year engineering seminar taught by the Director of Multicultural Engineering Program. The purpose of this is to encourage students to continue the relationship building throughout the academic year. Finally, MEP offers free tutoring in core engineering courses such as Calculus, Chemistry, Physics, Engineering Design and Graphics, and Engineering Mechanics. The tutoring center, (Academic Excellence Center) is opened six days per week for approximately 50 hours per week. Students are encouraged to attend tutoring sessions with incentives such as the EATT card (Educational Advancement Through Tutoring) where students earn \$10 to their meal points for every five sessions of tutoring attended. Also, book scholarships are awarded to students based on improved grade point averages per semester (Persaud & Freeman, 2005). Students are reminded about the

services provided by the MEP on a bimonthly basis through e-mail as well as postcards in the mail.

A recent addition to the retention effort is a PREF Scholars' dinner meeting with the director, twice per semester. At these meetings, students are given updates about academic and financial policies and issues that may affect them. They also have either a faculty or corporate guest speaker at these meetings where they learn about graduate school or industry.

Data Collection

Data were meticulously collected by means of a university database as well as Microsoft Access to pool and track the PREF data over several years. Initially the admission semester, college, major, predicted first semester GPA, semester GPA, and cumulative GPA were entered in the spreadsheet at the completion of the first fall semester. Each spring and fall semester, attention is given to the current major, semester GPA and cumulative GPA of each participant. Attention is also give to students who have graduated from the University and degree awarded. Averages were calculated based on the updated information. Data for PREF participants were compared to underrepresented engineering students who did not participate in PREF as well as minority and non-minority engineering students who were not a part of the PREF program (Persaud & Freeman, 2005).

Results

Data suggest that PREF students' fall gpa is higher on average than non-participants. In other words, they have proven to be better prepared for success in engineering and have higher academic performance rates than underrepresented minority engineering first-year students without such a summer bridge preparation program (see Table I). Although the average first-semester GPA is not significantly different for PREF participants compared to non-PREF participants (2.89 vs. 2.57) the 5-year graduation rate is explicitly different (see Tables I & II).

Table I
Comparison of Average GPA for First Year PREF Students (EN) and all First Year Engineering Student (All EN) After their First Semester in College

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Avg.
*EN	2.92	2.73	3.06	2.80	3.19	2.82	3.17	2.99	2.83	3.09	2.44	2.74	2.76	2.89
**All EN	2.53	2.60	2.77	2.55	2.32	2.64	2.51	2.64	2.77	2.64	2.46	2.48	2.44	2.57

*Engineering PREF participants

**All underrepresented first years engineering students.

Table II

14-Year Comparison of PREF (Engr) Students' Average Science Predicted GPA to their Average Cumulative GPA for their First Semester in College & their 5-Year Graduation Rate

Cohort Year	Ave Sci. Predicted GPA	Average 1st Fall Sem. GPA(ENGR)	5-Year Graduation Rate
1991	2.91	2.92	80%
1992	2.92	2.73	63%
1993	2.96	3.06	75%
1994	2.89	2.80	68%
1995	2.91	3.19	65%
1996	2.81	2.82	67%
1997	2.86	3.17	71%
1998	2.90	2.99	87%
1999	2.94	2.83	82%
2000	2.91	3.09	NA
2001	2.71	2.44	NA
2002	2.98	2.74	NA
2003	2.91	2.76	NA
2004	2.90	NA	NA
TOTAL	2.89	2.89	73%

Note: Average 1st fall semester GPA for 2004 PREF engineering students and five year graduation rate for the years 2000 to 2004 were not available at the time of this submission.

Clearly, participants performed better academically after the PREF program. We can safely say that the program was successful in preparing these students for the academic intensity of their first academic semester.

Over the years, the five year graduation rate has ranged from a low of 63% to a high of 87%. Incredibly, even the low end of this range is extremely higher than the 5-year graduation rate for majority students (55.7%). There has been 151 Baccalaureate degrees awarded to underrepresented minority students from the college of engineering over the past 14 years. These extremely high graduation rates indicate that the PREF program is successful in attaining its goal of retaining and graduating underrepresented minority engineering students.

In the college of engineering, attrition tends to be high, especially for underrepresented minority students. The 5-year attrition rate for underrepresented minority students is 56.5% compared to 42.7% for the non-minority engineering student population (College of Engineering Retention Rates by Race/Ethnic Status for University Park Campus from 1991-1999 (Persaud & Freeman, 2005)).

Based on this data, it is clear that the PREF program has strong long term benefits. PREF participants demonstrate a higher 5-year graduation rate (73%) when compared to non-PREF engineering students. The 5-year graduation rate for majority (White, Asian and International students) engineering students is 55.7% compared to the 5-year graduate rate of minority (American Indian, Black and Hispanic) engineering students of 38.4%.

Conclusion

The PREF program was established as a retention program at The Pennsylvania State University within the College of Engineering through the Multicultural Engineering Program. In its 14 year history at The Pennsylvania State University, 269 students (170 students from engineering) have completed the PREF program. This support service, created to improve the retention and graduation of underrepresented minority engineering students, continues to diversify the university and the field of engineering by helping to ensure success of these students. PREF serves as a strong retention mechanism which safeguards students' first semester transition and leads to ultimate success. Its extremely high five-year graduation rate of 73% is the highest within the college. The PREF program may be the key to successfully retaining and graduating all underrepresented groups and implementing it for all engineering students can only secure their future academic and career success (Persaud & Freeman, 2005). Such successful programs as PREF are proof that universities and colleges need to continue their commitment to supporting diversity programs such as Multicultural and Women Engineering programs on campus.

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