

2006-779: CASE STUDY: STEPS TO REACH OUT TO HIDDEN UNDERREPRESENTED STUDENT CANDIDATES IN ENGINEERING

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Case Study: Steps to reach out to hidden underrepresented Student candidates in Engineering

Abstract

This article discusses the steps planned and implemented to reach out and increase participation and retention of minority students in our engineering programs at San Francisco State University (SFSU). These efforts began with SFSU's Partnership for Engineering Education (PFEE) program.

The goal of this program is to bring together alumni, faculty and student participants from various organizations such as high schools, community colleges, universities and industry. These participants are brought to the PFEE through SFSU chapters of the MESA Engineering Program (MEP), Women Engineering Program (WEP) and other similar programs or professional societies.

The article also briefly describes how the NASA Fellowship Program (NAFP) has provided opportunities to integrate faculty and NASA projects in the above efforts. Currently, average enrollment in the School of Engineering is about 750 students each semester. This student body is ethnically, culturally, academically and economically diverse. About 18% of the School's students are women and 54% are minority (28% Asian, 17% Hispanic, and 9% African American). The School of Engineering has a strong interest in maintaining and strengthening its reputation for attracting minority and underrepresented students. Its enrollment has steadily increased in the past five years, while national enrollments at other engineering schools have been declining. It is expected that this trend will continue. Nevertheless, our institution is continuing its minority recruiting efforts.

Introduction

With over 29,000 students, San Francisco State University (SFSU) is the third largest campus in the 22-campus California State University (CSU) System. SFSU ranks ninth in the nation in producing minority graduates. SFSU is an urban comprehensive university with the largest numbers of students of color among the northern CSU campuses (65% total undergraduate minority enrollment). By ethnicity, the student body is a formation of 37% White; 24% Asian; 14% Latino; 12% Filipino and Pacific Islander; 7% African American; 6% other and 0.8% Native American. Majority of these students work full time or part-time while studying for their degree at SFSU.

Average enrollment in the School of Engineering is about 750 students each semester. The student body is ethnically, culturally, academically and economically diverse. About 18% of the School's students are women and 54% are minority (28% Asian, 17% Hispanic, and 9% African American). Many of our students are the first in their families to attend college. Most are economically or socially disadvantaged and must work to support themselves financially while in college. Being confronted with these hardships helps the students develop a conviction and a determination to

achieve a brighter future. Most of these students persist in their studies, complete their engineering degrees and ultimately reap the benefits of significantly enhanced employment opportunities.

At the undergraduate level, the School of Engineering at SFSU offers bachelor of science degrees in civil, computer, electrical and mechanical engineering, all accredited by ABET. To assist in the recruitment and retention of minorities and women, the School supports MESA Engineering and Women in Engineering programs. The campus is only about 30-minute drive away from the Silicon Valley and most of our students work in the immediate S.F. Bay Area after graduation.

The School offers a graduate degree of Master of Science in Engineering with two areas of concentration, Structural/Earthquake Engineering (SEE) and Electrical and Computer Engineering (ECE). Currently, there are total of 80 graduate students enrolled in these programs, which feature curriculum and schedules designed with the convenience of working engineers in mind. About 70% of the graduate engineering students are domestic students and about 30% of the students are female.

Partnership for Engineering Education

In order to strengthen ties with its constituencies, the school of Engineering has established a Partnership for Engineering Education (PFEE) with engineering students, high schools, community colleges, and local industry. This PFEE encompasses the outreach programs to high schools and community colleges, industrial liaison board, with new efforts to establish dialog with our own students as well as students at high schools and community colleges. Under PFEE the School has created the Student Advisory Board (SAB) and convened general student meetings. The SAB serves as a liaison between the School and the general body. Both the SAB and general student meeting provide a formal means for obtaining students' input about our curriculum, facilities and other aspects relating to education and development of students in School of Engineering.

Under PFEE, round-table conferences have been held with high school faculty and administrators. Also high school students have been engaged in this activity through various contests and activity hosted for them on SFSU campus, engineering open houses, tutoring and mentoring. Through PFEE activities we hope that the high school students, many of whom come from underprivileged communities, will be introduced to the engineering profession, and realize that an engineering degree can lead them to excellent life long career opportunities in the future.

Another goal of the partnership with community colleges is to facilitate access to engineering education at SFSU for transfer students by streamlining transfer procedures, and giving technical presentations and demonstrations in their engineering courses to acquaint them with our programs.

Our main industry partner in PFEE is our long-established Engineering Advisory Board (EAB) consisting of respected local practicing engineers, and our alumni . The EAB advises us on how to shape our curriculum, assists us in providing summer jobs and internships for our students, provides us with a good pool of technical speakers for our bi-weekly seminars and presentations and helps us improve the infrastructure by donating equipment as well as funds.

MESA Engineering Program

Among the strength of the School of Engineering at SFSU is the supportive environment it has created for our diverse and multicultural student body. For many years, SFSU MESA Engineering Program (MEP) has provided support services to our students. These support services include academic and career advising, counseling, tutoring, academic excellence workshops, assistance with scholarships, resume writing workshops, internships and job placement. MEP also performs outreach programs to local high schools and community colleges. The funding for this program has been provided in the past from University of California (UC) Math, Engineering and Science Achievement (MESA) program, SFSU President's Office and other sources.

Supplementing the MESA program is the Women in Engineering Program (WEP). This program, managed by women students, offers support services to women engineering students.

Retention of Freshman students

Next few sections explain the steps that we have been taking to increase our retention rates through an introductory engineering course, advising and mentoring programs.

In an internal study of enrollment patterns, we found that only 61% of the students who took our first semester engineering course (ENGR 101) continued as an engineering major in the subsequent year. We believe that many of those who left engineering after the first year would have continued in engineering if they had a more encouraging, helpful, personal, and stimulating first year experience. Many other universities have recognized the importance of the first year experience as well and have revamped their first year introductory engineering course(s) [1-5]. The goals of this introductory course are to provide students with basic skills for success, to enhance their interest in engineering and to cultivate their sense of belonging. Because of the recent decline in engineering enrollments [6], this has become a much more critical course for engineering schools. Since high school graduates generally do not have much knowledge about or contact with the engineering profession, the first course in engineering should prepare them for future challenges. After an extensive research of many different approaches to the introductory engineering course [1-4,7-13], we decided on an approach that is best fitted to our students, institution and community.

Introduction to engineering courses have been taught in many institutions in ways that students are given opportunities to tackle real engineering problems [14,15]. The centerpiece of our course is hands-on projects that inspire student interests in engineering and offer positive experience in teamwork. They will learn how to be successful engineering students as well as creative, adaptive and innovative engineers. This course gives them the first taste of engineering concepts and design. It also teaches them survival skills that will benefit them throughout their university education.

In addition, more than half of our upper division students are transfer students and, as a part of the articulation agreement, community colleges and we teach the same lower division courses. We have been helping community colleges to develop their first semester engineering courses to attract and stimulate more students to engineering programs later on, and at the same time stay within the

articulation agreement. The impact of this interaction, we believe, will go far beyond the boundaries of our campus.

Retention through Mentoring and Advising

An engaging engineering educator can be an effective advisor and mentor for students. According to Bjorklund's study on the effect of faculty interaction and feedback on the gains in student skills, he provides insight into the relationship between faculty-student interaction and students' perceptions of selected skills and attitudes [16]. The study was based on data gathered over a period of two years from more than 1500 students taking the first-year design course offered at 19 Penn State campuses. The results strongly indicated that there was a correlation between students' gains in design and professional skills and faculty interaction with students through constructive feedback.

Engineering educators should be open to the student perspectives. Student creativity should be fostered and encouraged. Educators should also encourage two-way dialogue and discussion of real-world issues with students. Faculty should serve as mentoring role models and offer valuable academic and professional advice to students. Indeed, mandatory advising has become part of faculty teaching assignments at San Francisco State University (SFSU). Our engineering students are required to seek curriculum advice on specific advising days, during each semester, and no classes are held on advising days to give ample time to faculty and students to interact. Mentoring and advising have been recognized as important mechanism for effective learning. The School of Engineering considers advising as an integral part of teaching and learning. Our advising program has been implemented to achieve the following five major objectives:

- disseminate accurate information to students regarding university and departmental policies, procedures, requirements, and resources.
- To assist students in developing their interest in engineering, and in setting their goals and objectives.
- To review students' course selection and monitor their progress toward their academic goals; and, if they have academic difficulties, to assist them in taking corrective action.
- To obtain informal feedback from students about policies, procedures, resources, and curriculum for future improvements.
- To provide students with information, guidance, and assistance in job search and advanced studies.

Recruiting

The PFEE program has been the basis for our recruitment efforts. The recruitment activities is carried out by regular visits by faculty and staff to high schools and community colleges to introduce our Engineering program and encourage students to consider engineering as one of their career options. We actively invite high school students to participate in our yearly Robotics contest, and the response has been extremely well. In addition we have open houses specifically arranged for some high schools and community colleges. We follow the objectives below in our recruiting and retaining of students:

- Actively engage in institutional and community programs that recruit under represented

- and economically disadvantaged students.
- Stimulate students pursuing an engineering profession through mentoring, advising, and engineering success programs
- Mentor students undertaking projects and research.

These objectives are firmly supported by both the School of Engineering and top-level administrators at San Francisco State University. Faculty in the School of Engineering believe strongly that an active hands on applied research program provides students with the opportunity to gain first-hand experience in what engineering design is, as well as in how engineering concepts apply, and gives them skills not attainable in a traditional classroom setting. This encourages students to join engineering and stay in the program. In addition, the University at large is committed to the education of the ethnically diverse Bay Area population. SFSU has won praise from regional accrediting agency, WASC, as “an institution that cares deeply about its students, a campus committed to multiculturalism, and to opportunity for a wide range of students.” In fact, our University President, Robert Corrigan, in his recent address said that “Diversity is to us a mission, a source of pride, a fountain of strength.” The fact that SFSU is ninth in the nation as a producer of ethnic-minority university graduates is due to this leadership and the willingness of the faculty to embrace these viewpoints. We believe our efforts are paying back and as the following tables 1 and 2 indicate we have been able to increase our enrollment both at undergraduate and granulate levels. In addition we have been able to significantly increase the number of our female graduate students.

| Year | S'01 | F'01 | S'02 | F'02 | S'03 | F'03 | S'04 | F04 | S05 | F05 | S06 |
|-------------------|------|------|------|------|------|------|------|-----|-----|-----|-----|
| Enrollment | 220* | 261 | 272 | 270 | 288 | 309 | 323 | 335 | 310 | 299 | 295 |

Table 1: Engineering Undergraduate Enrollment Figures from 2001 to 2005

* Enrollment before 2001 was hovering around 220

| Year | Number of Graduate Students on Record | | |
|-------------|--|-------------|--------------|
| | Female | Male | Total |
| S01* | 7 | 30 | 37 |
| F01 | 11 | 27 | 38 |
| S02 | 11 | 31 | 42 |
| F02 | 17 | 43 | 60 |
| S03 | 20 | 56 | 76 |
| F03 | 29 | 66 | 95 |
| S04 | 34 | 73 | 107 |
| F04** | 34 | 62 | 96 |
| S05 | 23 | 49 | 72 |
| F05 | 16 | 49 | 65 |

Table 2: Graduate Enrollment Figures from 2001 to 2005

*Enrollment before 2001 was fluctuating between 30 to 40

**In F04 the graduate admission was put on hold for a year by university, hence the dip in enrolment

NASA Fellowship Program

The NASA Administrator's Fellowship Program (NAFP) is designed to enhance the professional development of NASA employees and the Science, Technology, Engineering, and Mathematics (STEM) faculty of Historically Black Colleges and Universities (HBCUs) and Other Minority Universities. The program also seeks to increase the ability of these Minority Universities to respond to NASA's overall research and development mission. [17] NAFP strongly encourages the fellows to participate in recruiting of student candidates to join the engineering programs. In addition, by forming a large pool of researchers and scientists from its present and past fellows, NAFP is carrying out an excellent mentoring program for engineering students.

NAFP also exposes science and engineering students to NASA projects and activities through NASA employees and STEM faculty research projects. This will result in more students becoming interested and attracted to science and engineering programs. These students may find employment with NASA in the future, and will form the ideal liaisons between the agency and universities and keep the technology transfer link alive.

Conclusions and Future Plans

We have set in place a Partnership for Engineering Education that includes the engineering faculty and students, high schools and community colleges in San Francisco Bay Area to increase participation and retention of underrepresented students in our engineering program. We have observed an increase in the number freshman and transfer students in our program and we intend to carry out a closer monitoring and correlation of our mentoring and recruiting efforts with the increases in our enrollment in the past few years. We also plan to get our alumni more involved in these efforts to interact more with our engineering candidates to provide them first hand information as how an engineering degree has helped them improve their lives generally and economically in particular.

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