AC 2007-2439: RECRUITMENT AND RETENTION PROGRAMS FOR MINORITIES IN ENGINEERING PROGRAMS

James Northern, Prairie View A&M University

Recruitment and Retention Programs for Minorities in Engineering Programs

Abstract

The number of minority graduates with engineering degrees has declined during the past decade in comparison to those of non-minority and international students. This decline, coupled with the continued globalization of our economic markets, bears serious implications for the economic development and prosperity of the nation. For decades, one of the top priorities for America's higher education leaders is to get more students into college. The second priority is to graduate students that are competent in their field of study. In a recent national study, only two of five minority students who enroll in engineering programs graduate with a baccalaureate degree in engineering, as compared to two of three non-minority students. Another national study found that 54 percent of students entering four-year colleges in 1997 had a degree six years later, with even a lower percentage for Hispanics and Blacks. The barriers to minority student retention continue to be: the cost of education, isolating campus environments, a lack of peer and faculty engagement, and inadequate math and science preparation. To minimize the impact of this disturbing trend of students not pursuing an engineering degree, a priority must be set to generate student interest in the field of engineering. In this paper, we outline strategies to increase enrollment through five programs: (1) increase retention by creating a coaching and future leadership program for freshmen and sophomore students; (2) increase retention by hosting a design competition for engineering students; (3) recruit high school students into engineering programs by enhancing and expanding summer camp programs; (4) generate awareness of engineering programs through workshops for students and teachers at their respective high schools; (5) generate interest in engineering for 5th through 12th grade students by offering Lego Robotics programs in middle and high schools to be run by teachers.

From our five programs, mentoring and tutoring of students are known to improve retention. The mentoring and tutoring of students is best conducted in a form of coaching and future leadership. We illustrate a program to increase the retention rate of first and second year engineering students by providing them with academic and peer support to facilitate their transition into the College of Engineering. In addition, student recognition and academic competitions are provided as methods to increase esteem and competitive nature within students. In the area of recruitment, a method that has proven successful at some schools is the offering of engineering camps. Within these camps, students are introduced to and work with Lego Robotics in addition to preparatory skills from science, technology, engineering, and math. The use of these programs will create more opportunities to educate students about the fundamentals of engineering using innovative, fun and exciting projects.

1. HISTORICAL ENROLLMENT DATA

Electrical engineering undergraduate program at Prairie View A&M University (**PVAMU**) had an enrollment of over 500 students in 1991. In 2001, our enrollment had decreased to 250 students. By 2004, our enrollment had increased to 307, however the next year we were able to maintain above 300. The programs we have in place currently to recruit and retain more students are: (1) Increase retention by continuing with the Infinity Program and by providing tutorials and

mentoring to students at risk; (2) Recruit high school students into Electrical and Computer Engineering programs by offering summer camps; and (3) Increase community college students transfer.

The enrollment of the Electrical Engineering program from 2001 through 2005 is shown in Table 1. The enrollment has been broken down in terms of (a) Entering students, (b) Progressing students, (c) advanced student. Table 2 shows the gender and ethnic breakdown of students in the Electrical and Computer Engineering programs for the Fall 2004 semester.

Table 1 Enrollment of Electrical and Computer Engineering students

Year (Fall)	Entering Students		Progressing Students		Advanced Students		Total
	EE	CompE	EE	CompE	EE	CompE	
2005	65	35	98	21	80	5	304
2004	92	30	82	18	85	0	307
2003	87	10	99	5	60	0	261
2002	94	0	89	0	72	0	255
2001	90	0	90	0	70	0	250

EE and CompE stand for Electrical and Computer Engineering, respectively. The Computer Engineering program started in June 2003.

Table 2 Ethnic and Gender Breakdown of Students during Fall 2004 semester

Program	African Amer.	American Indian	Asian Amer.	Cauca-sian	Hispa-nic	Foreign	Male	Female
EE	228	1	5	5	6	14	200	59
CompE	45	0	1	0	2	0	40	8
Two Progs.	273	1	6	5	8	14	240	67
Percent 2 progs.	88.93%	0.32%	1.95%	1.63%	2.61%	4.56%	78.18%	21.82%

2. STRATEGIES FOR REACHING EXPANSION GOALS

2.1   Increase Retention Rate

The national retention rate for freshman engineering students is close to 48%. The strategies we want to employ to increase the retention rate are (a) mentoring and tutoring of students (b) design competitions and student recognition. Mentoring and tutoring of students are known to improve retention [2]. We intend to increase the retention rate of first and second year electrical and computer engineering students by providing them with academic and peer support to facilitate their transition into the College of Engineering. Additionally, we plan to provide student recognition and academic competitions, methods that have been used at other institutions and proven successful in retention.

Objective: Offer work study positions as mentors to make a difference as role models within the Department of Electrical Engineering.

Strategy 1: **First Year Initiative (FYI) – Transitioning High Students and Transfer Students through First Year; Year Two (Y2) program – Continuing with Engineering through Major-specific options**. *Timeframe: September through May (Orientations and information sessions in Fall)*

The goal of the First Year Initiative (FYI) is to increase the retention rate of first year electrical and computer engineering students after one year of engineering studies by providing them with academic and peer support to facilitate their transition into the College of Engineering. FYI includes workshops, design competitions and gatherings with industry mentors. The Year Two (Y2) program is designed to increase the retention rate of electrical and computer engineering students through two years of undergraduate engineering studies. The Y2 program provides academic and career support for second year electrical and computer engineering students and offers mentoring and exploration opportunities designed to connect students to their area of interest and career options.

Assessment: Number of work study positions taken and meetings attended.

Evaluation: The First Year Initiative and Year Two program was initiated with a meeting within the first few weeks of school. In this meeting FYI and Y2 students were introduced to Upperclassmen. The objective of the program was highlighted. The PI solicited help from upperclassmen to participate and encouraged them to fill out applications to be a Mentor. Feedback was received from those that were interested stating that they already had positions in other areas of the department and on campus. We continued to meet weekly and frequently discussed other alternatives to receiving financial compensation. Meetings were conducted with other professors within the department and others outside of the department for guidance. The best alternative was to implement a scholarship reward of $500 per student. The scholarship would give students the opportunity to pay back student loans and finance purchases needed for school, such as books and fees for joining professional organizations. During the meetings we stressed the importance of purpose of studying engineering, program requirements, and tools of success. We also engaged in discussions related to leadership development. The number of attendees were 16, including mentors. Throughout the semester those 16 students missed either 1 or no meetings. A survey will be disseminating at the end of the semester to the freshmen to better evaluate what steps should be taken for next semester.

In an effort to gain more interest, more attention was given to tutoring in the Spring semester. The tutors were hired as undergraduate teaching assistants. These undergraduate teaching assistants are conducting weekly tutorial sessions, at least twice per week. They also assist professors with grading of homeworks, quizzes and labs. The sophomore and junior level courses within the department were targeted. The rationale for selecting sophomore and junior level courses was the need to better prepare students for their advanced year and increase our graduation rate. We are currently in the process of evaluating this procedure.

Objective: Promote interaction between Freshmen, Sophomore, Junior and Seniors through a design competition between electrical and computer engineering students.

Strategy 2: **Electrical and Computer Engineering Design Competition (ECEDC) – Promoting interaction among students.** *Timeframe: September through March (Orientations and information sessions in Fall)*

The Electrical and Computer Engineering Design Competition (ECEDC) is designed to increase the retention rate and interaction among students within the Department of Electrical Engineering. Student design contests have been proven to be very good models for design projects within the classroom and promote special interest and creativity. Learning to work in groups is a key way to become prepared for later life, and of developing communication, citizenship, leadership, and social skills.

Assesment: Number of students and student teams participating in the competition.

Evaluation: In January 2007, we introduced the 1st College of Engineering Student Design Competition. Based on the idea given in the proposal, an invitation for other departments to participate was given. The design competition took place during Engineers Week and included participation from the Mechanical and Computer Science Departments. I thought that inter-departmental competition would increase participation and inspire students to be creative and competition. For the Department of Electrical and Computer Engineering we used the theme of Nanotechnology and Science for the theme of our competition and used Lego Robots to demonstrate design principles. For our first competition, we had three teams apply and one team successfully complete the project.

2.2   Recruitment of Students and Introduction to Engineering Concepts

The number of graduates with electrical engineering degrees has declined during the past decade. This decline, coupled with the continued globalization of our economic markets, bears serious implications for the economic development and prosperity of the nation. To minimize the impact of this disturbing trend, a priority must be set to generate student interest in the field of engineering. One method that has proven successful at some schools in the recruitment of engineering students is the offering of engineering camps [1,3]. Within these camps we intend to introduce and work with Lego Robotics to build a Lego Sensor City. It is our goal to enhance and expand these programs to allow greater participation from students around the state of Texas. The expansion of these programs will create more opportunities to educate students about the fundamentals of electrical and computer engineering using innovative, fun and exciting projects.

Objective: Offer monthly workshops on basic engineering skills to middle and high school students and teachers within the neighboring Independent School Districts.

Strategy 3: **Lego Sensor City (LSC) Project – Promoting team building, problem solving, creativity, and analytical thinking**. *Timeframe: September 2006 through March 2007 and September 2007 through March 2008 (Orientations and information sessions in Fall)*

This project seeks to work with teachers to develop LEGO Robotics programs for 5th through 12th grade students in two Houston Independent Schools, as well as Waller area schools. The project's primary objective is to engage students in building and programming robots and

actively learning such things as team building, problem solving, creativity, and analytical thinking. During these exercises, the students will be exposed to key concepts of math, science, computer technology, social studies, communications and other areas, as directed by the State Content Standards and Objectives. Another project goal is to introduce computer engineering and other engineering related careers to these students so they may consider continuing their education in one of these many fields.

Objective: Continue the summer enrichment camps for sophomore, junior and senior high school students

Strategy 4: **Electrical and Computer Engineering Leadership Camp (Two weeks).**
Timeframe: June through August 2007 (Orientations and information sessions in Spring)

One method which some schools have tried and have been successful in recruitment of engineering students is by offering engineering camps [1, 3]. We intend to offer summer camps for sophomore, junior and senior high school students. Initially, we intend to recruit students from school districts within the state. The majority of the students that will attend the program will come from the local area. The camp will last for two weeks. About 20 students will be admitted into the camp each year. Some topics to be covered in the camp will include computer engineering, math, physics, english, electrical engineering, and laboratory exercises with LEGOs, plant visits, and engineering ethics. Table 3 shows a tentative schedule of activities for the camp.

By having the summer camp, we intend to get more students interested in the Engineering profession. The positive experience of the high school students due to the engineering camp may turn them on to study engineering. In addition, the summer camp will make the students understand that engineering can be fun, rewarding, and beneficial to society.

Table 3 Tentative Schedule of Activities for the Summer Camp

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Week 1	Welcome & Engineering Profession Talk	Math and English Skills Test Problem Solving Exercise Design Project #1 using Lego Robotic kits	Math History English Science Design Project #2 using Lego Robotic kits	Invited Talk/Plant Visit Design Project #3 using Lego Robotic kits	Math History English Science Design Project #4 using Lego Robotic kits	Math History English Science Career Strategies & meeting with Engineering students	Field Trip: Sea World San Antonio, TX
Week 2		Math History English Science Design Project #5 using Lego Robotic kits	Math History English Science Design Project #6 using Lego Robotics kits	Invited Talk/Plant Visit Design Project #7 using Lego Robotic kits	Math History English Science Design Project #8 using Lego Robotic kits	Presentation of Awards Departure	

3. SUMMARY

In an effort to gain more interest, more attention was given to tutoring in the Spring 2007 semester. The tutors were hired as undergraduate teaching assistants. These undergraduate teaching assistants are conducting weekly tutorial sessions, at least twice per week. They also assist professors with grading of homeworks, quizzes and labs. The sophomore and junior level courses within the department were targeted. The rationale for selecting sophomore and junior level courses was the need to better prepare students for their advanced year and increase our graduation rate. We are currently in the process of evaluating this procedure. The undergraduate TA's will be writing a mid-semester report, which will include the TA's assessment of students and the student's assessment of the TA. The assessment will also include proven methods of student's success based on in class examples and proposed solutions for making the program better. These evaluations will be used for implementation in further studies. Also in the future, we will also collaborate with the College of Engineering TA program and endeavor to mentor more Freshmen and Sophomores.

4. ACKNOWLEDGEMENT

5. REFERENCES
[1]   Texas Higher Education Coordinating Board, Technology Workforce Development Grants Program, *3rd Annual Report*, October 2004.

[2]   Ellie McGrath *"Welcome Freshmen!"* Time, Vol. 158, p. 64 –66, September 10, 2001.

[3]   Janet Hannan et al, "An Engineering Design Summer Camp for a Diverse Group of High School Students," Proc. of 27th IEEE Frontiers in Education Conference, p. 939 – 943, Nov. 1997.