Design, Implementation and Evaluation of a Year Long Engineering School Acclimation Model for Enhancing Student Diversity

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Abstract: The College of Engineering at NC State University attracts some of the most talented high school students in the country. Each year, an entering freshman class of 1100 new engineering students includes 20% women and 20% under-represented minority students. The entire College of Engineering undergraduate and graduate enrollment of 7300 students comprises 22% women and 20% minority students. While our international reputation as a top-tier engineering university, coupled with academic scholarships, continue to attract a diverse set of entering freshmen, acclimating these students to engineering in general, and such a large, diverse campus in particular is a continuing challenge. At NC State University, we have a yearlong, concentrated effort to help insure student diversity and persistence. Following a successful recruiting cycle, we invite targeted students to enter our engineering programs during the summer session as participants in the NC State University Summer Transition Program (STP). (See conference companion paper on STP for details). These students begin the fall academic semester enrolled in Professional Student Development I, then follow in the spring with Professional Student Development II. The minority engineering programs staff teaches these two courses, which completes the yearlong student acclimation to engineering and NC State University. These courses are designed specifically for our first year minority engineering students, and serve to help enhance the opportunity for student success. Throughout the first academic year, these same students receive frequent mentoring, nurturing, academic and social support through Student Advancement and Retention Teams (START), our formal student mentoring program. Upper-division minority engineering students administers START.

Key Words: Diversity, engineering, freshman, model, acclimation

1. Introduction

Through its research as a land grant university the College of Engineering at North Carolina State University seeks to recruit the highest achievers while maintaining a diverse and inclusive campus community. Our enrollment rates of underrepresented students (African Americans, Hispanic Americans, American Indians), have increased steadily over the past twenty years. The NC State University Minority Engineering Programs Office was established in 1982 to address the needs of a growing number of students attending the university. As success was proven with this new model, it was replicated across campus in other schools and colleges. Research has shown that first year student success is highly dependent on support services and programs, particularly for minority students [1, 2].

This paper provides details on a plethora of freshman-oriented programs beginning with recruiting. Next, we discuss programs and activities that enhance our yield among accepted students. We then discuss four major first year programs that contribute to the acclimation and affirmation of academic career choices made by our freshmen engineering students. The paper concludes with concrete examples of our success and current national profile.

2. Recruiting Activities

Our Minority Engineering Programs staff begins recruiting early in the fall for the following academic year. Student organizations are very instrumental in the recruiting process for NC State. The National Society of Black Engineers (NSBE) Pre-college Initiative (PCI) attracts more than 10% of the attendees to regional and national conventions each year. On a local level, the American Indian Science & Engineering Society (AISES) visits North

Carolina high schools over fall break in their Native American communities to encourage high school students to attend NC State. AISES also co-sponsors a weekend visitation so high school students can attend class with students in their major and experience college life. The Society of Hispanic Professional Engineers (SHPE) has a mentoring program with a local high school for English as Second Language (ESL) students. In the spring, the admissions office hosts both African- and Native-American Visitation Days. African American students and parents also experience our African American Symposium each year as a supplemental orientation activity. The African-American Symposium is a summer educational and transitional experience for both students and their parents. Its purpose is to foster a sense of community for in-coming African-American first-year students and to provide them with information about campus resources, support personnel, coping strategies and African-American cultural heritage and contributions as a basis for helping ensure their academic success at NC State.

The Assistant Dean for Engineering Student Services and Director of Minority Engineering Programs has responsibility for the administration of all College of Engineering scholarships. By administering these funds in an integrated fashion, we have been able to increase both the quality and quantity of students in the College of Engineering. Personnel continue to visit schools and communities to help students understand NC State University engineering opportunities and environment. Minority engineering students active in NC State student chapters of the National Society of Black Engineers, American Indian Science and Engineering Society, and the Society of Hispanic Professional Engineers, recruit students and serve as judges in science-related contests at public schools.

2.1 Student Introduction to Engineering (SITE)

SITE is a weeklong campus residential summer program for rising high school juniors and seniors. Participants have the opportunity to spend a week on the NC State campus and participate in various hands-on engineering activities in several different departments. Students choose the specific departments in which they wish to spend a day, and all students participate in one day of multidisciplinary engineering experiences, involving either Product-Process Engineering Labs with an accompanying writing assignment, or a Control and Electromechanical Systems experience. The goal of SITE is to provide students an early introduction to engineering concepts as a means of encouraging them to pursue appropriate college preparatory courses while still in high school with a larger goal of attracting them to the NC State College of Engineering after graduation from high school.

2.2 Engineering Outreach Teams (EOTs)

The College of Engineering at NC State University has developed a group of Engineering Outreach Teams, which travel to K-12 learning institutions throughout the state of North Carolina (and, in some cases, to conferences outside of the state). The teams bring with them an enthusiastic approach to hands-on learning experiences designed to both inform and excite students about the discipline of engineering. The students and faculty comprising the teams are drawn heavily from our female and minority population as well. Once candidate schools have been identified as an EOT target, a program of visits to those schools is mapped out together with the school teachers and administrators. These visits go beyond the typical single career day visit and include participation of NC State students in tutoring and science fair workshop activities. A model for this program is currently working in conjunction with two elementary schools in the Raleigh area. NC State student tutors work with high achieving students in math at these schools on a weekly basis. We also make a number of visits to these schools to do hands-on demonstrations about various aspects of engineering.

2.3 Parents Weekend

During the university-wide event of Parents Weekend each fall, the Women in Engineering Program hosts a meeting for parents and their students. Representatives of the college discussing the freshman year also make interactive presentations. Then the meeting is turned over to a student panel that relates experiences that the members have had as female engineering students. These students are also asked to offer any advice that they have for the parents about good ways to support their daughters. In 1997 thirty parents attended and in 1998 twenty-five parents attended. The program is evaluated by collecting responses from attendees.

2.4 Spend a Day in Engineering

The College of Engineering Office of Academic Affairs invites admitted freshman engineering students to visit campus with their parents for one of five visitation days during the students' senior high school year. Care is taken

to ensure adequate representation of women and underrepresented minority students. When they arrive on campus they are paired with current engineering students to go with them to any classes, labs or seminars they have that day. Visiting students as well as host students are provided with an all campus card to cover lunch at any campus dining facility. Parents remain at our University Student Center for information on success in the freshman year, Cooperative Education and Career Services. They then have a choice of several departmental tours and demonstrations as well as a student-led campus tour and lunch with COE faculty and staff. The goal of this program is to provide early orientation for students and parents to achieve higher levels of familiarity and student networking prior to enrollment. Host students are encouraged to stay in communication with visiting students throughout the remainder of the spring and summer with the ultimate goal of acting as a resource and mentor to them in the freshman year. Freshman students who enroll are targeted as hosts for the following spring visitations.

3. Engineering Student Yield Activities

3.1 Engineering Scholarship Administration

This function works closely with university-level merit and need-based scholarship personnel to optimize use of scholarship funds available to recruit engineering student. The function also administers the engineering scholarship program that makes awards to entering freshmen and continuing engineering students. The function integrates all College of Engineering scholarships by managing restricted and unrestricted funds in a general pool. Awards decisions are made based on academic merit, and the funds are matched to optimize any constraints associated with those funds. Management and monitoring of each recipient continues until either the student graduates, is no longer in engineering, or becomes ineligible for renewal awards. Goal of this activity is to recruit and graduate the best qualified students possible so as to enhance our reputation as a national contributor to a high quality, diverse pool of engineers.

3.2 Summer Transition Program

After recruiting incoming minority engineering freshmen, the Minority Engineering Programs Office offers a summer bridge program. The Summer Transition Program (STP) is a six week comprehensive program held during the second academic summer session. A notice is sent out to all accepted underrepresented minority students announcing the program in mid-March. In April, applications are sent and these students are invited to apply for program participation. Fifty to 75 students are selected to participate in STP each year. STP allows students to take two university courses. The purpose of this program is to begin enhancing the academic and social maturation of incoming minority engineering freshmen prior to the start of the regular academic year. Participants receive instruction and where applicable, academic course credits in mathematics, English, and a science course. In addition, they gain early hands-on experience in engineering design, and an introduction to the College of Engineering computing environment. Weekly industry site visits introduce the students to opportunities available to them as they move through their undergraduate program, and seek permanent employment. This program is free to entering minority engineering student participants; cost approximately $2000/participant.

4. Acclimation and Affirmation Activities

4.1 Minority Freshmen Engineering Classes

In the fall semester of each academic year, all minority freshmen are enrolled in Academic and Professional Preparation for Engineers I. Student attrition is a significant problem in higher education, particularly in the field of engineering. This course offers early and intrusive support that promotes student persistence and academic achievement, while exposing students to goal setting, decision making and effective communication techniques. The course is designed specifically for minority students.

The fall class covers academic preparation such as time management skills, study skills, managing academics with extracurricular activities, graduate school and professional opportunities. Our fall course focuses on transition and academics. Another integral part of the fall class is the minority career fair. Each year the Black Student Board in conjunction with other student organizations such as the National Society of Black Engineers (NSBE) sponsors a career fair on campus. This is the premier recruiting fair for the university for the fall semester. NSBE sponsors a "Afternoon Affair" each year the day before the career fair so minority students will have an opportunity to meet

industry representatives and network. As part of a class assignment, students must attend the Afternoon Affair and the minority career fair.

In the spring semester, students may chose to enroll in Academic and Professional Preparation for Engineers II. The spring semester focuses more on the professional development of the student, such as preparing for a summer internship, co-operative education experience or full-time employment. The co-operative education program at NC State is the 2nd largest non-required program in the nation. Seventy per cent of the students who participate in the co-op program are engineering majors. The students also visit the University Career Center. The Career Center serves as a placement office for internships, co-op and full-time positions. The students meet the Career Center counselor assigned to the College of Engineering, learn about the interviewing process, and how to put resumes online. Industry representatives also speak to the spring class to discuss interviewing skills, goal setting, teamwork, understanding money, and professional development. Inviting industry representatives, many themselves minority, reinforces to the students the goals and mission of Minority Engineering Program: to produce successful minority engineers. The representatives tell the students how they need to get jobs, sell themselves and network to become successful engineers and productive and happy members of society. We also set up "mock" interviews for the students with industry Human Resources and Technical Managers so they can simulate what it will be like in a real interview.

4.2 Freshman Student Orientation (E497F)

In the fall 2000 semester the College of Engineering plans to offer the Introduction to Engineering class in a new format designed to increase student-faculty interaction. This change has occurred in response to student evaluations from previous offerings of the course. Although the content of the course had evolved from merely an orientation course (zero credit-hour) to a problem-solving and design-focused course (one credit hour), the format was retained to enable the College of Engineering Office of Academic Affairs staff to teach all 1100 students. Instructors and students did not find the format conducive to learning. Following the last offering of the course, the Associate Dean for Academic Affairs encouraged the staff to explore options for creating smaller class sizes while still accommodating the entire freshman engineering class. Departments within the College of Engineering agreed to provide instructors to help teach the 24 sections of the course, which will now be required. All sections will now be taught in computer-equipped classrooms. A multimedia text has been created for the class covering a number of topics: problem-solving, design, ethics, safety, spreadsheets, internet, and emerging technologies. The course has been designed to address many of the ABET 2000 criteria. Another innovation in the course has been to allow instructors to serve as advisers for the freshman until matriculation. This approach will allow students greater access to advisers.

4.3 Student Advancement and Retention Teams (START)

All freshmen underrepresented minority engineering students are automatically placed in the START Program. Often minority students feel isolated once they arrive on campus. This program is designed for students to receive support from their peers in a non-threatening environment. These select freshmen students receive frequent mentoring, nurturing academic and social support through a formal mentoring program. This is a student run program. Two upper class engineering students serve as coordinators and ten to thirteen other upper class engineering students serve as team leaders or mentors. Each mentor has at least five mentees. Students are paired according to academic interests. Each month one of the team leaders organizes a program for the entire START group. Each mentor contacts his/her mentees at least once every week through telephone, e-mail or face to face contact. Once a month the mentor may chose to meet as a large group and go out to lunch with all the mentees. The mentors then report progress biweekly with each mentee to the START program coordinators. All three minority groups participate in this mentoring program and this allows different ethnicities to meet each other that share common backgrounds. This program exemplifies how upper class students can lead by example and show freshmen how to be successful. This is a student run program with oversight by the MEPO.

4.4 Women in Engineering (WIN) Mentoring

This peer mentoring program for women engineering students started in the fall of 1998 with 130 voluntary participants. All but ten mentoring relationships are one-on-one, and matches are made according to discipline, interests and future plans. Pairs are suggested to communicate at least once a week with face to face contact at least twice a month. The program is assessed each semester, and participants given the opportunity to continue, be

reassigned or exit gracefully. The majority of the mentees are first year students, while the mentors are spread across sophomores, juniors and seniors. Our email mentoring program was pilot tested with five mentoring pairs in the spring of 1998 and will soon begin again at full scale. To date, ten large companies have indicated an interest in participating. Mentors are encouraged to communicate weekly via email with their mentees. During the pilot program, several of the local mentors invited their mentees to visit them at work. Because of the large industry interest, this program will be immediately open to female and male students.

4.5 Freshman Women Retreat

In 1998 Hewlett Packard sponsored a one-day retreat for freshman women. The participants were treated to a special tour of engineering departments, a round-table lunch discussion with industry representatives and an afternoon of games and brainteasers, which were engineering related. Every participant indicated via survey that she enjoyed the day tremendously and found it very helpful, but due to the small number of women who participated (seven), the program will probably be discontinued.

5. Examples of Engineering Student Success and Programs Enhancement

What follows is a brief summary of tangible results of our formal, dedicated efforts that target minority engineering student. This section concludes with a more comprehensive accounting of our aggressive program that targets students who are initially less than successful.

According to NACME, Inc., North Carolina State University awards the second highest number of engineering degrees to African-Americans of all traditionally white institutions in the nation [3]. This accomplishment is even more significant when one considers that the engineering program on our campus comprises approximately 28 percent of the total student population. At the number one university, nearly 66 percent of all students are majoring in engineering [3, 4].

At the graduate level, recent significant research contributions have been made by NC State College of Engineering African-American Ph.D. students in computer science [5], electrical engineering [6], and computer engineering [7]. The all-time national record of six Ph.D. degrees awarded in one year to African-American females by our engineering college resulted from a long-standing commitment to hiring, mentoring, promoting and celebrating a faculty that includes eight African-American professors. These faculty mentors and scholars provide additional credibility to campus-wide commitments through national recognition of their accomplishments. One of these African-American faculty members was recognized by President Clinton as a recipient of the 1998 Presidential Award for Excellence in Science, Engineering and Mathematics Mentoring [8]. Another is the first and only winner of the US Air Force Research and Development Award for research work done in support the International Space Station [9], [10].

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