

## SO IF THE SIX-WEEK ENGINEERING ACCLIMATION PROGRAM IS FREE, THEY'LL COME, RIGHT?

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**Abstract** – At NC State University, we have developed a student success model that is contributing towards our goal of increasing student diversity. We know we are on the right track because in 2000, we received our second Presidential Mentoring Award. For over five years, our Minority Engineering Programs have been evolving as a national model. A typical cycle for the students we target for recruitment begins when they are invited to participate in our Student Introduction to Engineering program. Following SITE, minority students are invited to participate in our six-week long recruiting and acclimation initiative, the Summer Transition Program. In 1997, we obtained funding from the NSF to expand STP participation from 50 to 75 students. We were excited to acquire the funds for program expansion, but since 1997, not once have we reached our goal of 75 participants. This paper discusses our Summer Transition Program.

*Index Terms* – bridge program, minority, recruiting, student success.

### NATIONAL MINORITY STUDENT ENROLLMENT, GRADUATION AND SUCCESS

According to the National Action Council for Minorities in Engineering [NACME], Inc., freshman enrollment, the gateway through which minorities enter the engineering profession, is considerably smaller today than it was five years ago. From a peak enrollment of 15,181 African-American, Latino and American Indian freshmen in 1992-93, minority freshman enrollment declined 8.2 percent, dropping to 13,929 in 1997-98. As a share of the class, minority students lost ground also, falling from 16.4 percent of all freshmen who enrolled in 1992-93, to 15.7 percent in 1997-98. Not surprisingly, for both African-Americans and Latinos, losses were concentrated among engineering institutions enrolling the largest numbers of, and providing the greatest access to, minorities [1].

While historically black colleges and universities (HBCUs) continue to enroll and graduate the largest share of African-American engineers [2], employment opportunities, aggressive recruiting and the comprehensive nature of major traditional white institutions (TWI) contribute to the

increased opportunities for African-Americans to earn engineering degrees at these institutions.

For decades several programs at the national and local levels have been developed and attempted to help meet the projected shortage anticipated in an ever-increasing high-technology work force. William Bowen and Derek Bok recently published results of a comprehensive longitudinal study of one specific, significant thrust at addressing minority student success: affirmative action. Their study [3] provides defensible, concrete proof of the positive impact affirmative action has had, not just on the minority participants, but also on society as a whole. While such results are notable from a historical perspective, anyone serious about minority student success will quickly acknowledge that there remains tremendous work to be done in reaching a point where access to education, and a diverse, well-prepared work force pool are assured.

### INTRODUCTION TO THE UNIVERSITY AND COLLEGE OF ENGINEERING

At NC State University, we have developed a student success model that is contributing towards our goal of increasing student diversity in the engineering and computer science professions. We know we are on the right track because our NC State University College of Engineering has been honored twice in the short, four-year history of a national mentoring awards program. In 2000, we received our second Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring [4]. One of our African American engineering professors won an individual Presidential Mentoring award in 1997 for his contribution to the success of under-represented minority students earning engineering graduate degrees [5].

For over five years, our Minority Engineering Programs (MEP) have been evolving as a national model for engineering student success. Refereed paper presentations on our model have been made in recent years at annual conferences of the American Society of Engineering Education [6], Frontiers in Education [7], and the International Conference on Engineering Education [8-10]. A typical cycle for the students we target for recruitment begins during their high school years when they are invited to participate in the NC State University College of

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Engineering Student Introduction to Engineering (SITE) program. SITE is a weeklong campus resident program designed to expose high school students to engineering and computer science.

Following SITE, minority students accepted for admission are invited to participate in our six-week long recruiting and acclimation initiative, the NC State College of Engineering Summer Transition Program (STP). STP is an annual intense campus activity and course-work submersion program designed to foster minority student acclimation and maturation as they make final decisions on which engineering college they plan to attend in the fall. We capture as entering freshmen 95 - 98% of the STP participants.

In 1997, we obtained funding from the National Science Foundation to expand STP participation from 50 to 75 minority students. In addition to the direct cost of \$1500 for each student supported, the program also pays successful STP graduates a \$500 stipend should they return to NC State as freshmen during the fall semester. We were excited to acquire the funds for program expansion, since with the new funds, we are now able to sponsor approximately ½ of all anticipated new minority freshmen. But since 1997, the largest STP class has been 64. Not once have we reached our goal of 75 participants.

This paper provides details on STP. We discuss our goals and objectives, provide details on the target student population, and share our selection criteria. The paper also includes information on incentives to student participants, and articulates the advantages gained over non-STP minority freshmen. We conclude with lessons learned about student priorities and engineering commitments. Finally, we share program philosophy changes resulting from our failure to achieve our stated objective of expanding the Summer Transition Program by 50% to 75 minority students.

### **Campus Engineering Environment and Demographics**

The College of Engineering comprises 10 departments offering 16 BS, 17 MS, and 14 Ph.D. degree programs and conducts the largest undergraduate and graduate engineering education and research programs in the State. The College continues to rank among the nation's leading colleges in the total number of degrees awarded, the number of degrees awarded to women and minorities, the quality of the graduate programs, and research and extension activities [1], [2], [11].

Of the 521 faculty and research staff members, 219 are tenured/tenure-track (rank of assistant professor or above) faculty members; 18 are lecturers/instructors; 44 are visiting; 119 are adjunct appointments; and 121 are other non-faculty and staff.

With a spring 2000 enrollment of 5,097 (1,017 freshmen, 1,172 sophomores, 1,214 juniors, 1,716 seniors, and 18 unclassified), the College of Engineering is the largest of the NC State campus units that make up the University

enrollment of about 27,000. Total undergraduate minority engineering enrollment for spring 2000 includes 548 African-Americans, 129 Hispanics, and 39 Native Americans. NC State University has the second largest African American engineering undergraduate enrollment of all non-Historically Black Colleges and Universities (HBCUs) in the nation. Among non-HBCUs, we award the second highest number of Bachelor of Science in engineering degrees to African-Americans.

## **DETAILS OF THE NC STATE UNIVERSITY COLLEGE OF ENGINEERING SUMMER TRANSITION PROGRAM**

### **Mission**

The mission of the Summer Transition Program is to strengthen incoming freshmen academically, socially, and professionally, prior to the start of the regular academic school year. This intensive six week residential program is designed to assist the students in making a smooth transition from high school to college by offering courses in mathematics, chemistry, engineering laboratory, study skills, and the College of Engineering computing environment.

In addition to academic success, the participants also discover additional rewards they can receive from college, including 1) how to form study groups; 2) how to network; and 3) what industry has to offer.

### **Recruitment and Selection**

Participants for the 2000 Summer Transition Program were selected from the pool of minority (African American, Native American, and Hispanic American) students accepted into the College of Engineering. Two hundred twenty six (226) potential participants were sent a program announcement called a "Ticket to Success." Several days later, the 226 students were mailed a summary of activities, a student profile survey, and an application. Also, their parents received information describing the program and outlining the information sent to their student.

We received 45 applications and based on our acceptance criteria and funding constraints accepted all 45. Of those, 35 actually participated in STP.

The criteria for the selection of participants was agreed upon by the Assistant Director and Director of Minority Engineering Programs. The SAT IIC Math placement scores were to be the primary criteria for selection. This is the instrument used by NC State University to determine math placement for incoming freshmen. Most of the students did not take the test until March or later and consequently, we did not receive their scores until after our deadlines.

In addition to providing room and board during the five-week program, the in-state portion of the tuition for each student's math class was covered. The math classes offered

were a 3 credit hour pre-calculus course, a 4 credit hour Calculus I course and a 4 credit hour Calculus II course. The cost of undergraduate tuition and fees for a North Carolina resident enrolled in a 3 or 4 credit hour summer session course was \$288 or \$379. The out-of-state portion of the tuition (paid by three participants), for a 3 or 4 credit hour course, was \$1040 or \$1440. Table I summarizes STP participant data.

**TABLE 1. 2000 STP DEMOGRAPHICS**

|          | African American |        | Native American |        | Hispanic American |        |
|----------|------------------|--------|-----------------|--------|-------------------|--------|
|          | Male             | Female | Male            | Female | Male              | Female |
| Pool     | 117              | 54     | 13              | 7      | 23                | 12     |
| Applied  | 27               | 15     | 0               | 1      | 1                 | 1      |
| Attended | 20               | 12     | 0               | 1      | 1                 | 1      |

### Orientation & Outward Bound

Orientation was held on Monday, July 3rd in the Witherspoon Student Center from 1:00 p.m. to 4:00 p.m. The participant's day began at 10:30 a.m. with check-in at Lee Residence Hall. Afternoon activities were the Outward Bound exercises. Outward Bound exercises build trust, while developing an understanding of teamwork and problem solving. Each of the eight counselors took their assigned group of students outside to start the activities. The parents remained inside and were instructed by the Assistant Director of Minority Engineering Programs, the STP Program Assistant, and a former STP Program Coordinator, who contributed throughout the program.

Over the course of the afternoon, the students and parents received the expectations of the program. They were given the opportunity to ask questions and interact with one another. The counselors addressed the student questions in the student session. The Assistant Director of Minority Engineering Programs, a former STP coordinator and Ph.D. student, and the STP Program Assistant addressed the parent questions. In both the parent and student sessions, the exercise "10 Weeks of Hell" was administered. "10 Weeks of Hell" was designed to simulate a fifteen-week academic semester. Students and parents were asked to solve addition and subtraction problems in an allocated time frame. As they attempted to solve the problems, which became more difficult as they went on, the staff interjected distractions and shortened the allotted time. The increasing difficulty of the problems and the distractions simulated adjustments students would have to make during the semester, while reinforcing their ability to handle the work. Parents were included to provide them with a better understanding of the college experience for new freshmen. However, the parents'

tests were distributed slightly differently. To demonstrate the importance of being prepared, only parents with writing utensils were allowed to take the test. This was not done for the students because we found it more critical for all of them to experience the actual test. We believe having the parents participate will help them to interact more effectively and encourage their student in the semesters to come.

### Academics

The academic component was designed to prepare the participants for the rigors of engineering studies. To achieve this, emphasis was placed on collaborative learning, in both the lecture and problem solving workshops. The 35 participants were distributed in the math courses as follows: 19 in Math 111 (Pre-Calculus with Algebra and Trigonometry), 12 in Math 141 (Calculus I), and 4 in Math 241 (Calculus II). Passing Math 111, Math 141 or Math 241, with a "C" or better, would allow the participant to advance to Math 141 (Calculus I), Math 241 (Calculus II) or Math 242 (Calculus III), respectively, in the fall. The respective departments designed all other courses with input from the MEP staff. Those courses were Chemistry Fundamentals and Introduction to EOS. With Introduction to EOS, the participants were given the opportunity to take a placement test as their final exam at the end of the program. They took the EOS placement test in an attempt to place out of the course all freshmen are required to take during the fall semester. Students also took Academic Enhancement Workshops in math, chemistry, and English.

### Program Schedule

Participants followed a daily schedule for the entire summer. Each evening, after tutorials, students had free time until their 12:00 a.m. curfew. Weekends were left open for the students. If a student chose to stay in the area, there were activities planned for their leisure. Unlike previous years, the students maintained the same schedule although they were in three different math classes. The students were divided into two groups depending on what math class they were in.

### Program Staff

The program staff consisted of course instructors, tutors, counselors, the Program Assistant, and the Program Coordinator. Some members of the staff had multiple assignments to decrease the number of people with which the participants had to familiarize themselves.

There were eight course instructors. University instructors taught the math courses. The instructor for Math 111 was a graduate student working on his doctorate in mathematics. The Math 141 instructor was also a graduate student in mathematics, working on his doctorate. The Math 241 instructor had worked with the program before. This

was his fourth time teaching the calculus course for the program. In each of the math classes, there were other students from the rest of the university population taking the math class as well. A part time doctoral chemistry faculty member taught the chemistry components, both the course and the academic workshop. A Ph.D. graduate student in Economics facilitated the Math Academic Workshop. The math tutors were engineering students (two graduate and three undergraduates). One of the undergraduate tutors was also a STP counselor. The two chemistry tutors were undergraduate students in Chemical Engineering. There was one Introduction to EOS instructor for each of the two sections. Both of the instructors were undergraduate students that came highly recommended by the computer science department.

This year, Minority Engineering Programs hired a Program Assistant rather than a Ph.D. student to help the Assistant Director of Minority Engineering Programs run the program. The Program Assistant had worked and participated in the program for four summers previously as a participant, counselor, head counselor and Introduction to EOS instructor. The Program Assistant's responsibility was to assist in the planning and organizing of the program throughout the spring and first summer session.

The eight counselors were selected from a pool of 19 applicants. Applicants were required to interview for the position. Each counselor was assigned a group of students for which they were responsible on trips and at curfew. These formulated groups were known as "posses". Each participant was required to sign a guideline form that outlined his or her expected behavior. The Program Assistant was responsible for supervising the counseling staff, coordinating all non-academic activities, recording the number of demerits accumulated by each participant, and reporting that information to the Program Coordinator and the respective posse leader.

### **Industrial Visits**

Five of the Friday afternoons during the program were set aside for industrial visits. The program offered two trips per Friday. Students were assigned to each location according to their intended major. We split the counselors and students into two groups. The first trip was to the DuPont facility in Fayetteville, NC or CISCO Systems in RTP, NC. The second Friday trip was to Eaton Corporation in Selma, NC or Alcatel in Raleigh, NC. The third Friday was a trip to Konica in Greensboro, NC or SAS Institute in Cary, NC. The fourth Friday was a visit to Procter & Gamble in Greensboro, NC or Nortel Networks in RTP, NC. The fifth Friday was a trip to IBM in RTP, NC or Underwriters Laboratories in RTP, NC. Each visit exposed the participants to the engineering profession. The students toured the facilities and listened to presentations about possible job opportunities with the various companies. Many of the company employees assisting with the

industrial visit also were minority professionals. Hence, additional minority role model interaction.

### **Housing and Meals**

All participants and counselors were housed in Lee Residence Hall. The male STP participants resided in four suites on the fourth floor and the female STP participants resided in three suites on the fourth floor. The residence hall was laid out in a long hallway structure with suites on one side that included four rooms. The STP students were housed two per room. Some of the male counselors resided two per room due to space constraints. The remaining counselors each had one room to themselves. Because of the even number of male and female counselors and students, none of the counselors had to share a room with a participant. The Program Assistant also lived in the dorm housing. This helped the program to address any issues that came up quickly and efficiently.

University Dining provided all weekday meals. Students were allowed to purchase a meal plan that gave them the option to use their student ID card to eat breakfast, lunch, and dinner in Fountain Dining Hall Monday - Friday. This meal plan also allowed students the option of eating lunch at one of the Student Center restaurants such as Chick-Fil-A, Taco Bell or Lil' Dinos. The meal plan included ten meals per week and \$100 Board Bucks. The students could use the Board Bucks at any of the convenience stores on campus or for meals at Chick-Fil-A, Taco Bell or Lil' Dinos. Students were financially responsible for their own meals, which was a change from previous years. However, they could subtract the cost of meals, \$275, from the scholarship they received at the end of the program.

The counselors were placed on the Board Bucks system. A total of \$500 was posted on their student ID card. They could use their card at any of the dining facilities on campus including purchases at the campus convenience stores. At the end of the program, any remaining Board Bucks were carried over to the fall semester. All housing and meal arrangements were made through Mr. Timothy Blair, Conference Coordinator of Housing and Residence Life.

### **Extra Activities**

Extra activities were planned throughout the program. None of the activities were mandatory, but those who were here on Saturdays and Sundays were given the opportunity to participate. The extra activities were designed to relieve stress and reduce some of the pressure from the previous week. The students found the extra activities as a time to bond with the counselors and each other.

### **Rap Sessions**

The participants were required to attend all Thursday evening two-hour rap sessions. These were held in the

Multipurpose Room of the Witherspoon Student Center. The rap sessions presented information to the participants as well as introduced them to people who could offer them advice or help during their future here at NC State. Rap session topics included 1) A day in the life of...; 2) Personal Finances; 3) So you want to be an engineer?; 4) Passive professors to rambunctious roommates; 5) and Health & sex: Alcohol, date rape and STD prevention.

### Rules and Regulations

The program guidelines were designed to maintain and provide a rewarding experience for all. Participants were expected to adhere to high standards of academic and personal conduct. Each student and their parent(s) were required to sign the guidelines and return them with their acceptance form.

The program staff enforced the rules and took appropriate actions for each situation independently. Depending on the severity of the participant's misconduct, discipline may range from removal of privileges to immediate dismissal from the program. The governing of the action taken was conducted through the use of a point system. All violations were documented on an incident report form. Each member of the counseling staff and academic staff were given a set of blank incident reports. The completed form was given to the Program Assistant who kept an accurate account of the number of points each participant incurred. The incident report form was also used to document academic difficulties and medical emergencies. This assisted the Program Coordinator with understanding the nature and outcome of any academic difficulty or medical situation.

### PROGRAM OUTCOMES

The participants' academic performance was closely monitored. All 35 participants completed the program. Eighteen of 19 Pre-calculus, and 11 of 12 Calculus I students earned a "C" or better (required to move to the next math course). The two students will retake Pre-calculus and Calculus in the fall. A grade of "C" or better was earned by all 4 of the students who took Calculus II. So these students will move on to Calculus III in the fall. These four students will be ahead of most of the entering freshman class of 1100+ students. Of the 35 participants, 15 earned a "C" or better in the Chemistry Fundamentals course. This course was designed to prepare the STP participants for Chemistry 101, which they will take this fall. Introduction to EOS was another very successful course. All engineering students must have an account on EOS, the computing system. E115 is the course that is required for all freshmen engineering students. STP's Introduction to EOS was a modified version of E115, which offered the participants the opportunity to place out of E115. The placement exam was given as the

final exam. All 35 students passed the exam with a score of 85% or better which placed them out of E115.

### TRACKING

The Minority Engineering Programs Office will track each student who participated in the program. The academic progress of each participant will be monitored each semester. This will be accomplished through surveys, study group progress, and academic performance.

### FACTORS IMPACTING PROGRAM PARTICIPATION OBJECTIVES

The following reasons are major explanations for why we have never achieved our goal of 75 STP participants:

- a) We have become victims of our success. When STP first began, the students only took MA 111 (Pre-calculus, a remedial course), because most came to NC State with a weak mathematics background. Each year, the academic records (SAT, HS GPA, HS Rank), have steadily increased. So now, most minority students feel they are already on par or where they need to be to start in the fall. Since more students are coming in with AP credits, the program is not quite as attractive as it once was to those students who were trying to play "catch up". These students feel they can use their summer before they go away to fulfill other personal obligations such as paying for school, spending more time with their family & friends, etc.
- b) STP is a large time investment. Some students cannot afford to vest that much of their summer into a program when they need to be working, taking care of family members (maybe younger siblings), etc. Students often have to work over the summer to help with college costs. Some of the non-STP students did decide to take classes, but at a local community college or university so they could work and go to school simultaneously.
- c) We found that many students attend the program because their parents insisted. The parents recognized the value of our program, even if the students did not.
- d) Students also just do not want to spend their summer in another classroom. They just graduated after spending 13 years in class. At the start of STP, some have not been out of high school for more than a few weeks.

### SUMMARY OF RESULTS

An analysis of the degrees awarded to minority engineering students in 1997-98 reveals the following national rankings for the North Carolina State University College of Engineering: 1) First among all engineering programs in Ph.D. degrees awarded to African-American women; 2) Second in engineering BS degrees awarded to African-American students (excluding HBCUs); 3) Second among

all engineering programs in Ph.D. degrees awarded to African-Americans; 4) Sixth among all engineering programs awarding engineering degrees to Native-Americans; and 5) Tenth among major engineering programs in MS degrees awarded to African-American students (excluding HBCUs) [1], [2], [11].

North Carolina State University awards the second highest number of engineering degrees to African-Americans of all traditionally white institutions in the nation [1]. 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 [1], [2].

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 [12], electrical engineering [13], and computer engineering [14]. 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. President Clinton recognized one of these African-American faculty members as a recipient of the 1998 Presidential Award for Excellence in Science, Engineering and Mathematics Mentoring [5]. 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 [15], [16].

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