

## *A Supplemental Instruction Program for Enhanced Retention of Minority Engineering Students*

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### **Abstract**

The College of Engineering (CoE) at North Carolina A&T State University (A&T), along with the other schools on campus, has enjoyed surging enrollment increases over the last three years. This increased enrollment has benefited the campus in terms of increased faculty and staff positions to serve the students, but has given rise to an equal number of challenges – such as strains on physical resources such as classrooms and computing facilities. More importantly, there has been an imperceptible but very definite creeping up of class sizes in the lower-level critical core classes – the ones where one-to-one interaction is crucial for students to grasp the more complex and abstract concepts. This latter consideration has a direct and potentially negative impact on the retention of students especially in the science, mathematics, engineering and technology (SMET) areas.

The CoE has anticipated these problems in planning for its growth. A Supplemental Instruction (SI) Program has been instituted to enhance retention, particularly of minority students, by providing them with two or three opportunities every week to interact one-to-one with student SI facilitators to review and reinforce the fundamentals introduced by the instructor in a formal classroom setting. From its modest beginnings in Fall 2001, where two core courses were supported, the program has expanded coverage to as many as 18 core courses from the engineering and basic sciences. One or more SIs are assigned to a particular course. SI recruitment is selective, hiring students that have recently completed the same course with a B or better. This places them in a better situation to share both the fundamentals as well as successful test-taking and situation-handling techniques. Our results are very encouraging, and an unexpected additional benefit observed is the increased confidence of SIs in their own knowledge and communications skills and an increased interest in exploring academia as a career option.

### **Introduction**

The first year has been determined by many reports and studies to be the most critical time for a new student on any college campus. The first year lays the foundation for the undergraduate curriculum and determines whether the student will be successful in subsequent years. Further, it has been proven that the characteristic traits modeled during the first year will continue to influence the student in the sophomore, junior, and senior years. These traits are seen not only in academics, but also in the professional, personal, and social development areas.

A study of A&T's Electrical Engineering and Computer Science programs revealed that approximately 20% of the freshmen students drop out after the first year. This is due to the distractions that a freshman student is exposed to and the resulting difficulty in adjusting to them. However, providing students a head start during the freshmen year can lead to a 5 % or more improvement in the retention rate. The SI Program was one of the many unique strategies

adopted by the CoE to improve the first-year experience of students and improve the retention rate, especially for minority students. It is expected that as retention rates improve, graduation rates will also improve. Improved graduation rates will mean that the CoE will be able to provide a larger pool of qualified applicants for permanent hire. This project is serving as a model for the other programs in the college.

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### **Implementation**

A pilot program, focused on improving retention and graduation rates, was funded by industry (General Electric) in 2001. This program, monitored by Dr. Eric Cheek of the College of Engineering, limited itself to courses in Electrical Engineering. The SI program began to really gain momentum in the Fall 2002 with additional sources of funding in industry (Intel) and the government (National Science Foundation) being tapped by the second author of this paper. From a program managed and coordinated exclusively by the Dean's Office, the program is now coordinated by the five departments in the College of Engineering and coverage extends to 18 course sections.

The program provides its client students with two or three opportunities every week to interact one-to-one with SI leaders to review and reinforce the fundamentals introduced by the instructor in a formal classroom setting. The program has expanded coverage to as many as 18 core courses from the engineering and basic sciences. Each CoE department assigns a faculty SI coordinator. The responsibilities of the faculty SI are to: 1) identify the high failure courses rate within the department, 2) select SI leaders, and 3) be a champion for the SI program in the department. In addition to the faculty SI coordinator, a staff person in each department is identified to collect and ensure that all of the required paperwork is submitted. This includes payroll, attendance, timesheets, and evaluations. The dean's office staff monitors and promotes the SI program across the college and actively pursues extramural funding. Future plans include developing SI leader recruiting material and developing an informative website for the SI program.

One SI leader is assigned to each course section. For reasons of funding limitations, not all sections of a given course may be served. SI leader recruitment is selective, hiring students that have recently completed the same course with a B or better. This places them in a better situation to share both the fundamentals as well as successful test-taking and situation-handling techniques. Our results have been very encouraging, and an unexpected additional benefit observed is the increased confidence of SI leaders in their own knowledge and communications skills and an increased interest in exploring academia as a career option.

## Results

Figures 1 and 2 provide the ethnic and gender breakdown of the 10 course sections served by the program in the Fall 2002 semester. Ethnic minorities constitute a minimum of 80% of the classes and women a minimum of 20% of the classes. Table 1 and Figure 3 show the quantitative impact of the program on student performance.

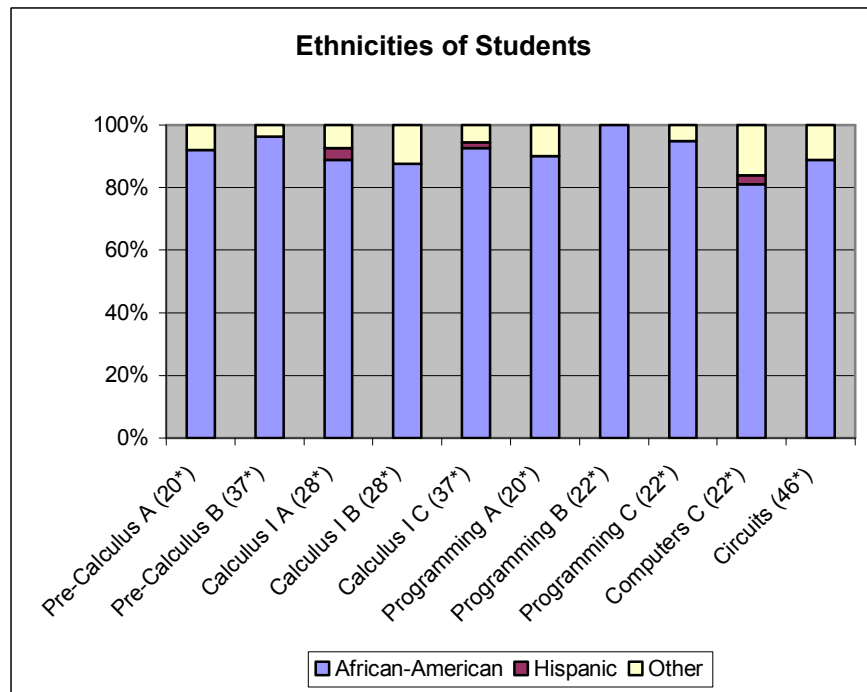
## Conclusions and Lessons Learned

The data showed that the average course grade of students that availed of the SI program was 38% higher than the average grade of the entire course section. The strong positive response has brought strong administrative support for adoption of this technique college wide. The following lessons learned from our initial experience are helping us to continuously improve the program:

- Recruitment of properly qualified and capable SI leaders is critical
- Faculty awareness and support for the SI program is essential
- SI leaders need proper training prior to beginning their duties
- Highest impact is achieved if the program starts along with the first week of classes

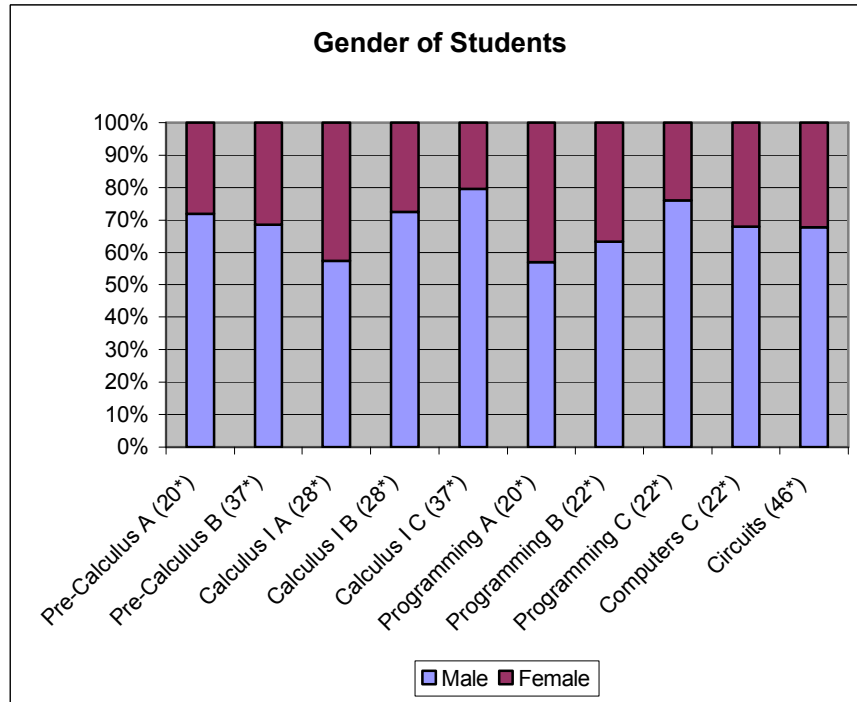
## Acknowledgments

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\*numbers in parentheses = number of students that attained D or better

Figure 1 Ethnicity of students in course sections provided with Supplemental Instructors



\*numbers in parentheses = number of students that attained D or better

Figure 2 Gender of students in course sections provided with Supplemental Instructors

Table 1 Student performance data

Course No	Title	# Completed	M/F		Ethnicity			Class Grade	Participant Grades	% Change
			M	F	Afr-Amer	Hisp.	Other			
MATH 110.06	Pre-Calc A (20*)	20	72	28	92	0	8	2.2	2.5	13.6%
MATH 110.09	Pre-Calc B (37*)	37	68.5	31.5	96.3	0	3.7	1.56	2.33	49.4%
MATH 131.02	Calculus I A (28*)	28	57.4	42.6	88.9	3.7	7.4	1.24	2.33	87.9%
MATH 131.06	Calculus I B (28*)	28	72.5	27.5	87.5	0	12.5	1.175	2.125	80.9%
MATH 131.10	Calculus I C (37*)	37	79.6	20.4	92.6	1.8	5.6	1.48	1.67	12.8%
GEEN 102.02	Progrmng A (20*)	20	57	43	90	0	10	1.6	2.67	66.9%
GEEN 102.03	Progrmng B (22*)	22	63.3	36.7	100	0	0	2	2.71	35.5%
GEEN 102.05	Progrmng C (22*)	27	76	24	95	0	5	3.05	2.94	-3.6%
GEEN 103.01	Computers C (22*)	22	68	32	81	3	16	2.35	3	27.7%
ELEN 200.01	Circuits (46*)	46	67.7	32.3	88.7	0	11.3	1.7	1.85	8.8%

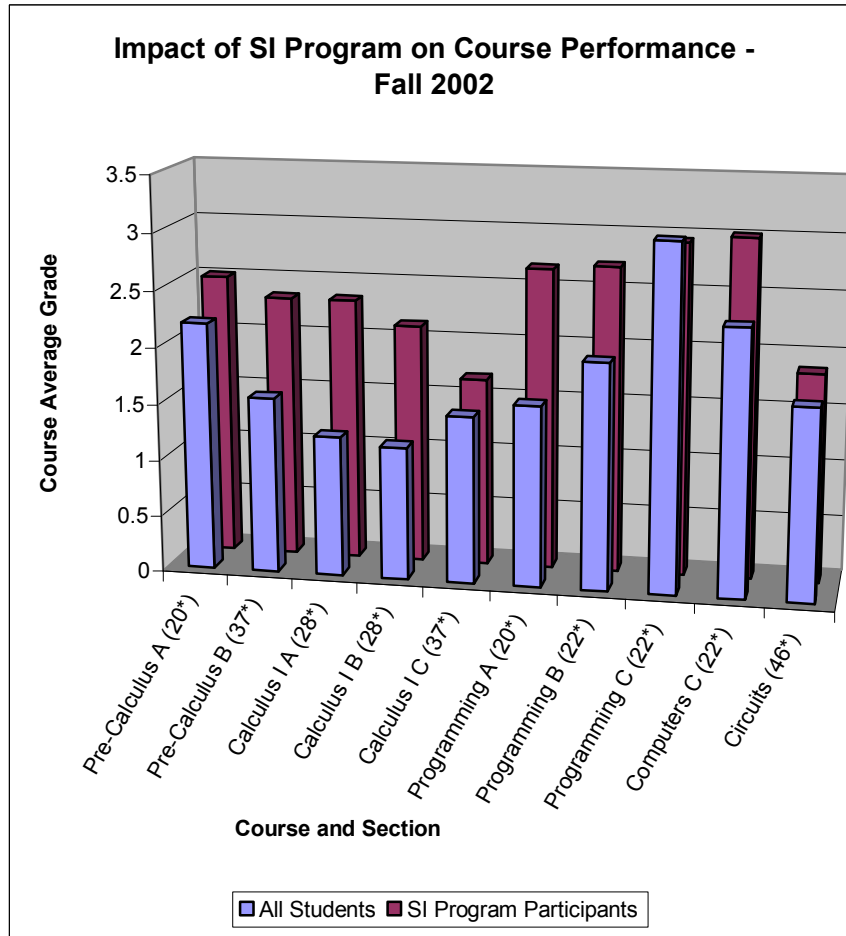


Figure 3 Impact of supplemental instruction on student performance

**Biographies**

**Devdas M. Pai** is a Professor of Mechanical Engineering at NC A&T State University and Associate Director (Operations) of the Center for Advanced Materials and Smart Structures. He received his M.S. and Ph.D. from Arizona State University. He teaches manufacturing processes and tribology related courses. A registered Professional Engineer in North Carolina, he serves on the Mechanical PE Exam Committee of the National Council of Examiners for Engineers and Surveyors and is active in several divisions of ASEE.

**Leotis L. Parrish** is Assistant Dean in the College of Engineering. He received his B. S. and M. S. in Civil Engineering from NC A&T State University. He was formerly instructor and department chair for the Department of Civil Engineering and Surveying Technology at Guilford Technical Community College, where he taught courses in soils, project management, project planning, construction management, concrete and some other courses. At NC A&T State University, he has focused on student development for undergraduates and graduates. He has fostered the germination and development of the Supplemental Instruction Program in the College of Engineering, that has impacted all the seven undergraduate engineering programs.