

**On the use of computer technology to teach
mathematics and computer science at a small black college**

by

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INTRODUCTION

Beating the odds is the story of the Mathematics and Computer Science Program at South Carolina State College. A profile of the institution in the 1987 edition of U.S. News and World Report's Guide to America's Best Colleges, describes a four year college with an enrollment of 4,037. Of this number, 95% are black, 4% white and 1% foreign. The combined SAT score of 670 is below the national norm and 85% of the undergraduate students receive some form of financial aid.

On the other hand, the South Carolina Higher Education Statistical Abstract, May 1987, indicates that 38% of the 140 Bachelor's degrees awarded during the 1985-86 academic year to blacks in South Carolina Colleges and Universities in the fields of Mathematics and Computer Science were awarded by South Carolina State College. The College, however, enrolled only 21% of all the blacks attending Colleges and Universities in the State. Students not only complete the programs but many go on to obtain advanced degrees at many of the prestigious institutions in this country such as the University of Illinois, Purdue, Michigan, Ohio State University and the University of South Carolina. Those not pursuing advanced studies are employed at top firms such as IBM, AT&T, Martin Marietta, State and Federal Government, and 10-15% of the graduates are commissioned into the Armed Forces.

What accounts for this phenomenal success?

The success is due to a large extent to a dedicated faculty, staff, and students. The other significant contributing factor is the curricula. The curricula is designed to overcome deficiencies which may exist in students' mathematical backgrounds while simultaneously responding to the recommendations of discipline organizations such as ACM and MAA.

THE CURRICULUM

The Mathematics and Computer Science curricula at South Carolina State College responds to the recommendations of ACM and MAA. The objectives of the first two years of the programs are two fold. First to provide the student with the prerequisite knowledge to undertake rigorous courses in calculus, modern algebra, geometry, and other higher mathematics. Secondly, to provide an introduction to the foundations of computer science, algorithms, data structures, and computer languages, software design and development, and properties of computer systems.

To achieve these objectives, students take seven courses in mathematics and four in computer science (29 credit hours). These courses are:

Mathematics 105-106	Pre-calculus I-II
Mathematics 203-204	Calculus I-II
Mathematics 112	Sets and Logic
Mathematics 212	Basic Proof Techniques
Mathematics 213	Discrete Mathematics
Computer Science 105	FORTRAN Programming
Computer Science 107	Computer Applications
Computer Science 201-202	Computer Programming I-II

Upon completing these courses, the student will have learned the elementary material of computer science, differential and integral calculus, and basic discrete mathematics; will be prepared for advanced courses in mathematics and computer science; and, most importantly, will be better able to decide on a chosen field. If the student wishes to switch majors after taking the courses of the first two years, he/she can do so with little or no loss of pace.

Relative to course requirements recommended by MAA, CSAB, or ACM, the South Carolina State College programs are not dissimilar from other mathematics or computer science programs at small four year colleges. The difference, we think, is in the novel way in which our curricula are designed to overcome deficiencies that may exist in the student's background. These deficiencies are identified through the college-wide testing of every freshman prior to placement in entry level courses. In mathematics, the test of the MAA are used. Reviews of tests results indicated specific weaknesses in the pre-calculus mathematics topics normally taught in a course equivalent to intermediate algebra. A formal study which investigated students' exit performance on the NTE further substantiated these initial findings.

The study correlated students performance in mathematics with their performance on the NTE. A multiple regression equation utilizing both the pre-college (SAT math score) and collegiate (course grades in calculus, statistics and linear algebra) variables for predicting NTE test performance, achieved an r squared of .6985 with the pre-college mathematics variable accounting for 55.76% of this total. The results of the study, as would be expected, indicated that the exit performance of students on the NTE may be improved by strengthening students' backgrounds in basic pre-calculus mathematics.

Based in part on the results of the study (not unlike many other colleges), students are offered a one year course in pre-calculus mathematics in an effort to overcome deficiencies which may exist. The structure and content of our pre-calculus sequence provide for an extensive review of intermediate algebra topics during the first semester. Emphasis is placed on the "algebra of calculus" with much drill and practice in exponents and radicals, solutions of quadratic equations, inequalities, etc. The first course concludes with a discussion of functions and their graphs. The second part of the course extends upon the notion of a function. In this course, attention is given to polynomial and rational functions, exponential and

logarithmic functions, and the trigonometric functions.

USE OF COMPUTER TECHNOLOGY

The college is currently implementing two major projects designed to incorporate computer technology into the curricula. The first project, a federally funded Title III activity, is aimed at providing computer literacy for all students during their first year of enrollment. Partially in response to the Criteria of our regional accrediting body (the Southern Association of Colleges and Schools) the College has included computer literacy as a general education requirement. Students in all disciplines satisfy this general education requirement by successfully passing Computer Science 107, Introduction to Computer Science with Applications. In brief, CS107 is a one semester, three (3) credit hour course which explores the nature and history of computers, their impact on society, and their use in various fields and careers, including selected popular applications, such as spreadsheets, word processors, file and database managers, and graphics. The emphasis in this course is not on computer programming, but is on learning about and using computers. However, the course will cover the fundamentals of BASIC programming.

A computer lab with 24 IBM PS-2 computers has been established and the course was offered for the first time this year, Fall '88, with an enrollment of 75 students.

The second project, funded by the Sloan Foundation, has two principal phases. Phase I is designed to incorporate computer technology into the teaching of elementary statistics. As is true at most institutions, elementary statistics courses are offered in the mathematics department as well as other discipline areas. Examination of these courses will reveal that there is considerable duplication of effort. Our Mathematics and Computer Science Department has revised our elementary statistics course (M208) to cover essential elements of statistics and data analysis found in these courses. The revised course uses the computer as a tool to remove the drudgery from long statistical calculations. The SPSS-X (Statistical Package for the Social Sciences) computer package is used in this course.

The IBM computers in use also have the capabilities to generate "electronic" transparencies. This allows the instructor to produce professional visual aids that can compliment a somewhat technical presentation. Any text or graphical material can be produced on a microcomputer screen and shown using an overhead projector. The system allows you to project computer screens "online" or use the built-in editor to develop organized, multiple-screen presentations. Using this software, problem solutions, computer output, and other teaching aids may be created for each topic to be taught. For example, in the teaching of computer science, programming steps and procedures can be developed and projected on the screen in the classroom or an online demonstration can be conducted to illustrate programming exercises.

Finally, the second phase of the Sloan Project is in the exploratory state. As a follow-up to CS105 and CS107, programming assignments have been

developed and will be introduced in freshman and sophomore level mathematics courses to improve programming skills and knowledge. When Phase II is completed, computer technology will be an integral part of all mathematics courses. Presently, review of available software to provide for computer assisted instruction in the following courses is being conducted:

M301	Introduction to Mathematical Logic
M401	Linear Algebra
M403	Differential Equations
M408	Introduction to Probability
M409	Mathematical Statistics

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