A EXAMINATION OF PRE-COLLEGE
PROGRAMS IN MATHEMATICS AND THE SCIENCES
FOR YOUTH OF COLOR
by
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AN EXAMINATION OF PRE-COLLEGE PROGRAMS
IN MATHEMATICS AND THE SCIENCES FOR
BLACK YOUTH

by
BARBARA GOMES-BEACH

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ABSTRACT

The first pre-college preparatory program for black students
was established in 1973 in Philadelphia. The pre-college program
phenomenon has grown to 147 programs and an enrollment of over
60,000 students. The goal of pre-college is to provide
supplementary education in mathematics and the sciences to en-
able black and minority youth to enter and graduate from
engineering school.

This thesis examines pre-college programs a decade after their
beginning to determine what progress has been made towards
reaching their goals. The impact of three issues are addressed.
One, have they increased student enrollment in engineering
college. Two, have they increased numbers of students graduat-
ing from engineering colleges. Three, are programs being
effective. Data for the study is based on literature research,
intensive interviewing and field observation of programs in
the spring of 1985. Four programs in the New England area
MassPep, (MS)2, Pre-Nuprime, and (Times)2 were examined as
part of the study.

The study concludes that pre-college programs have limited
data. They have insufficient documentation on student
participation to be able to determine if programs
have been successful in increasing the enrollment of black
students in engineering colleges and helping them to
graduate. Program effectiveness, evaluated on an individual
basis are varied.
INTRODUCTION

Pre-college programs for black students are relatively new. The prototype was established in 1973 in Philadelphia with the formation of the Philadelphia Regional Introduction for Minorities in Engineering (PRIME).

The goal of pre-college programs is to provide supplementary academic preparation for high school students considering and exhibiting an aptitude in mathematics, engineering and the sciences in order to increase the numbers of students enrolling and graduating from engineering colleges. Programs are funded in a variety of ways, mainly through private foundations, corporations, universities, and to a lesser degree, public and federal agencies.

Twelve years after PRIME got underway, pre-college programs have been accepted as productive entities. So much so, in fact, that programs are being replicated throughout the country. There are approximately three (3) million black youth between the ages of 15 - 19 in the United States; over 60,000 are enrolled in pre-engineering programs. In the Northeast, 12,400 are enrolled in pre-
engineering programs out of a population of 597,165. 1/
Yet, there has been little objective documentation of the
success of these programs.

Does the pre-college experience provide students with
the necessary skills to help them enter, and eventually
graduate from engineering colleges? What accounts for
program effectiveness?

This thesis will look at the pre-college program
phenomenon to attempt to examine program effectiveness.
Several questions will be addressed: one, are pre-college
programs increasing the numbers of black students entering
engineering colleges. Two, are these students graduating.
Three, what are the contributions to program effectiveness?

Chapter One provides an overview of pre-college
programs, outlines the reasons why they came into being,
and briefly states project purpose, statement of the
problem and literature review. Chapter Two outlines the
methodology used to design and conduct the study. Chapter
Three focus on the findings detailing those variables
examined. Chapter Four draws brief conclusions and
proposes several recommendations.
CHAPTER I. OVERVIEW

A. Project Purpose

The purpose of this thesis is the examination of pre-college programs approximately a decade after their beginning, to determine where they are today and what progress they have made towards reaching their stated goals of increasing black student enrollment and graduation from engineering colleges.

This study is important for several reasons: first, programs need to revisit their goals to see if they are being met and how, and if not, why not. Secondly, as Boyd (1975) states: "one of the scarcest professionals to find in American society today is the engineer or scientists who hails from an ethnic minority or the female majority". 2/

According to a report of the National Alliance of Black School Educator's Task Force on Black Academic and Cultural Excellence (1984), black student participation in the educational process beginning at the grade school level is cause for concern. A high percentage of black youth complete their high school education with minimal academic skills in the critical areas of mathematics, science and communication skills. 3/

Of import to the black community is the question of access to a significant number of well-paying, stable jobs that directly impact on one's ability to dictate where one lives and which educational system is affordable for one's
family. Third, the role of science and technology is increasing throughout our society and it has long been recognized that the leadership in industry and business in this country comes out of this group of people. Fourth, if the pool of scientists and engineers were higher, represented by an equitable ratio of the population, issues that directly affect the lives of minorities would be helped by these problems receiving greater exposure and participation of Blacks, Spanish speaking, and Native Americans. The ultimate purpose would be to help achieve a more equitable distribution of responsibility, power, wealth, and status within the United States.

There is an additional, personal reason I believe this study is necessary. For the past four years, I have been directly involved in a parallel program observing first hand problems associated with students within pre-college programs. As regional co-director for the National Association for the Advancement of Colored People (NAACP) New England State Conference of Branches, Afro-Academic, Cultural, Technological and Scientific Olympics (ACT-SO) program, I have been in a position to observe that black students are either being directed away from pre-college programs, or unfortunately, encouraged and recruited while inadequately prepared.
B. Review of Literature

Numerous studies have been undertaken within the past decade on the problem of black underrepresentation in engineering and the sciences. Many of the studies are sensitive and timely, but, they have concentrated mainly on the quantitative aspects of increasing the numbers of black engineers and scientists. This is necessary. There are, however, other variables that must be factored into the process. This section will concentrate on reviewing literature that is both quantitative and qualitative, with emphasis given to those issues most relevant to this thesis: one, are pre-college programs increasing the numbers of black students entering engineering colleges. Two, are these students graduating? Three, are pre-college programs being effective and if so, how.

In the *Retention of Minority Engineering Students* report compiled by the National Action Council on Minorities, the organization attempted to gather available data on black student retention in engineering by inviting 137 engineering colleges to submit proposals to provide student services towards the retention of minority undergraduate students. Out of fifty-one proposals received, eleven were funded. The goal of the eleven projects was to increase the numbers of minority retention by designing and implementing specific programs aimed at
incoming freshman. The purpose of the study included the following: (a) establish baseline data and develop an overview of the retention problem, (b) determine the generalizability of previous findings based on the study of individual programs; (c) determine the potential for improving retention rates by adding or modifying support services; (d) identify those student characteristics and behaviors that influence and/or are influenced by program services and (e) suggest implementation guidelines that could be used at the college and pre-college levels to improve the retention of minority engineering students.

Six projects filed reports indicating their retention levels had slightly improved, moderately improved and/or greatly improved. For example, Lamar University established a study center for a peer tutorial program: retention improved from 40% to 80%. 5/. Perdue University utilized peer/tutor counselor's and study skill courses: retention improved from 82% to 89%. 6/. Rensselaer Poly-Tech established a summer program and provided additional, student support services: freshman retention improved from 83% to 95% 7/.

Participants were representative of minority freshman enrolling in engineering schools throughout the country.
If the students in the study were representative, then it would appear that the national engineering effort started in 1973 to produce students better prepared to succeed in engineering was working:

... 51% had been in the top 10% of their high school classes
... 48.1% were above the national SAT mathematics average;  
... 66.9% had participated in pre-college preparation programs;  
... 51% had taken calculus in high school;  
... 41.9% had taken both chemistry and physics 8/.  

In addition to traditional predictors such as high school mathematics and science grades, the Retention study states that "recruiters and admissions offices should consider previous participation in a pre-engineering program and academic self-concept in the decision to admit students since both are positively related to minorities persistence in engineering."

The study initiated student questionnaires for entering freshman that asked the following: a student's academic background (specifically if they were pre-college); demographic information; high school attended; study habits; work habits; perception of engineering as a
profession and field of study; perception of self; and expectations concerning engineering program study and work requirements. Questionnaires were also implemented at the completion of the term. Students were asked about work and study behaviors during the term; academic support; frequency and level of involvement in minority student organizations; characteristics of classes; number of students in class; number of minority students in class; instructor evaluation; role of prior academic experience. Colleges were asked for program and student records, i.e., retention statistics, number of student transfers, number of students enrolled, academic casualties for the past four years, student's high school transcripts, semester quarterly grade reports, and academic actions. 9/

The retention study concluded that (1) Minority Engineering Programs (MEP's) with early warning systems, i.e., those programs with strong faculty support and interaction with students directly related to academic performance were able to minimize attrition. (2) MEP's with summer programs also had higher retention; (3) black students with pre-college program experience and good academic standing in high school have a higher percentage of college GPA's.

The report recommended that low cost, non-residential summer programs be offered by colleges to students from
surrounding communities; that colleges include summer
programs in financial aid packages; and that government
sponsored programs should modify their services to meet
student needs.

The authors state that because pre-college programs
are extremely diverse it was impossible in the context
of their study to determine which factors are responsible
for the relationship between participation and college
grades: (a) high school teacher encouragement to pursue
engineering degrees, (b) interaction between pre-college
staff and teachers, (c) reviews of fundamentals, (d) exposure
to the profession, (e) trips, (f) role models, and (g)
realistic perceptions of engineering. 10/

In their study, Factors Affecting the Participation
and Performance of Minorities in Engineering, Morning,
et al (1982) state that the purpose of their study was the
analysis and review of why blacks score lower on
standardized mathematics aptitude and achievement tests
from at least the fourth grade through college and why
black student rate of enrollment in calculus track
mathematics courses is significantly lower than that of
non blacks. To test their hypothesis, the authors utilized
nationally administered math achievement tests; pre-college workshops for freshman math by grade point and semester; enrollment in calculus and non-calculus track math courses (percentages were reviewed according to ethnicity).

The study found that the University of California’s Mathematics Workshop Professional Development Program (PDP) pre-college results were impressive. During the first year the average grade was B-, compared with D- for non-workshop students. The project also demonstrated the need for a support structure for non-academic problems as well as the academic support to improve math skills.

The report concluded that it was becoming more evident that where there is a willingness to address the institutional and societal factors which impact on learning, successful results can follow. As an example, the report noted that many major corporations are now actively involved in secondary school programs through the use of their personnel to help develop several aspects of a national minority engineering program.

In "Women and Minorities in Science and Engineering," J. B. Slaughter, Director of the National Science Foundation states: "the human resources of this country constitute one of its most important assets. This is
especially true of individuals with science and engineering skills, who expand the frontiers of knowledge, develop new technologies, and teach future generations. The importance of these activities make it essential that the best talent be drawn to science and engineering activity from every available pool." 12

The report confirms that the level of participation of women and of several racial and ethnic minorities is low. It also suggests that the problems of low participation may be related to the extent to which these groups participate in math and science training at all school levels: pre-college, college and post graduate.

Survey instruments were used by the Division of Science Resource Studies to ascertain participation levels included sampling experienced scientists and engineers who were in the labor force at the time of the 1970 decennial census; the new entrants surveys, designed to measure magnitude and characteristics of scientists and engineers who have entered the science and engineering labor force since the 1970 decennial census; and the roster of doctoral scientists and engineers, consisting of all known doctoral scientists and engineers in the U.S. since 1930.

In NACME's Annual Report (1983/84), the organization states as its purpose "to increase the number of Blacks, Hispanics, and American Indians who enter and graduate
from accredited engineering schools." NACME works to increase institutional support for programs that identify, prepare and retain secondary school and university students on an educational path leading to a baccalaureate degree in engineering. It also provides support for every step in the continuum from stimulating interest in mathematics, science and technology at the junior high school level to retention programs for university students.

Annual reports, bulletins and publications of the engineering manpower commission were used as sources for the NACME tables. In NACME's annual pre-college program directory for 1984, approximately 150 listings of local, regional and university sponsored programs designed to aid junior and senior high school students were identified. Included in the directory are descriptions of each program, its sponsors, and the services offered.

NACME has invested $390,000 to colleges and universities for student retention and $150,000 to pre-college and summer programs to initiate, expand or complete projects for pre-college and undergraduate students, including many programs conducted in cooperation with professional organizations. The NACME results of long-term investments and the work of organizations, directors, and volunteers can be seen in the three indicators that define progress in the minority engineer—
In Saving the African American Child, the primary purpose for the report, according to its authors is to review the public school systems within the country as they relate to the African American child and teacher. The National Black Educators Alliance, authors of the report utilized educational research service data and statistics from the Joint Center for Political Studies 1984 report. The study concludes that "the capacity of African American children to learn is intact, in spite of the malignant neglect by our social, educational and other systems." The study concludes that a major problem is one of resources; that completion of algebra by the ninth grade has emerged as a de facto requirement for later admission to quality institutions of higher education, and that it appears that calculus has already emerged as a common admissions requirement for certain programs. The National Black Educators Alliance recommends that studies be conducted of the efforts of coaching for standardized tests on the scores of African American students; that study patterns of counseling and advising service for African American students be undertaken; and that "successful" schools both public and private for African American children be identified.
The Commission on Behavioral and Social Sciences and Education in their article, "Identifying the Signs of Effective Pre-College Education" reviewed the quality of math and science education to determine if student scores on achievement tests were the most effective measure of success for schools, school systems, states and the country. The instruments used in this study were designed and developed by the committee and are detailed in the report Indicators of Pre-College Education in Science and Mathematics from National Academy Press (1985). 14/

The study concluded that "no single indicator of successful education exists. Instead, evaluators must consider several broad types of indicators together. The framework should include output variables, like academic achievement, process variables like course enrollment and the amount of instruction time for different subjects, and input variables like the number and quality of teachers and the content of instruction:" 15/ The committee identified specific variables to include in each category. But, it also noted the considerable problems that can be involved in converting these variables into workable evaluation standards.

The committee recommended ways of improving the usefulness of indicators in the future, given limitations of time, money and methodology. Different school systems
or states for example, might coordinate their data collection efforts with major educational assessment studies.

While available data indicates enrollment in engineering colleges is increasing, there are indications that serious gaps in individual program approach to data collection exists. The ability of programs to provide uniform background information on pre-college participants varies. At best, programs can only approximate enrollment figures. In trying to determine if engineering students who were products of pre-college programs were successful in graduating from engineering schools, discovery of inaccuracies in information reviewed (Engineering Manpower Commission information on black freshman enrollment as quoted in the NACME Annual Report for 1984 versus the Thomas E. Ford article "Minorities in Engineering" in Engineering 1981), is an example of the problems encountered during the study. It was not possible to determine conclusively if pre-college programs alone had been successful in this effort.

A synthesis of the review of literature on pre-college engineering program effectiveness is a paradoxical. The literature indicates that pre-college program involvement has a positive influence on academic performance and that
academic factors, like motivation, self-image and perceptions of engineering as a profession also play a large role. The literature also indicates that virtually no measurement standards exist and consequently the evaluation of program effectiveness is complex and varied across the spectrum of programs.

The literature review also indicted a need for more financial support at the pre-college program level to conduct extensive research is needed. The NACME 1983/84 Annual Report showed that out of NACME's $4 million dollar budget, $150,000 was distributed to pre-college programs. The support of pre-college programs by NACME's technical services division should be expanded four or five times the current funding level to improve pre-college programs performance and effectiveness to an acceptable level.

This study then attempted to examine those variables and processes within programs that relate to data collection methods by asking what are the numbers of students involved within the pre-college program and those that have entered college. In addition, the study sought to verify those factors within pre-college programs both academic and non-academic that were previously identified as vital to black students success in engineering.
CHAPTER II. RESEARCH METHODOLOGY

The assessment of the effectiveness of pre-college programs for black students and the hypothesis that was developed and synthesized for this study was based in large measure on information gathered during the review of literature. The hypothesis expected as a measure of effectiveness was that a higher percentage of pre-college program students would have applied and been accepted to engineering colleges than non pre-college program students. A secondary hypothesis was that once in engineering college, it was expected that a higher percentage of black students with pre-college program experience would achieve (on the average) higher grades and experience less attrition.

Three data collection methods were employed in the research investigation. One, data was compiled on information available on black students who are currently enrolled in engineering colleges utilizing standard instruments from the National Science Foundation and the Engineering Manpower Commission. 17/ Two, an analysis of black engineering graduates was attempted by examining available data to see if a direct correlation existed between pre-college and non pre-college graduates.
Non-standard instruments utilized in the NACME retention study were analyzed. Third, from this process a set of questions were developed to be used in conducting interviews. This was a special instrument developed as part of this study to focus on input, process and output variables of the pre-college programs. In order to gather as much current data from the local perspective as possible, both the interviewing and field observation method was selected. Interviews were conducted with over fifty participants in four programs: administrators, students, parents, instructors, staff personnel, industry representatives, and board members. (See Appendix A) This last approach was selected to gather more indepth information on the qualitative aspect of the study. Follow-up interviews it was reasoned, would allow for additional analysis.

The pre-college programs involved in the study (three under the banner of NACME and one independent) were selected due to their reputation, experience and track record. The programs geographical locations allowed for greater access to administrators, staff, students and parents within the minimal time frame allowed for interviewing. (Since interviewing was conducted in the spring, school vacations, SAT examinations, and school activities took priority). Interviewing was also selected
in the belief that individuals will share more information with personal contact in a give-and-take format that is both informative and information sharing.

While programs varied in their institutional settings and methods of delivery, individuals were asked about the same issues. A set of interview questions was designed with varying modifications (administrators, parents and students were asked essentially the same questions according to their levels of participation. Interviews were conducted with administrators, instructors, and staff personnel at program quarters. Interviews with students were conducted in a variety of settings. With students in the pre-Nuprime program, a group interview with eighteen students was conducted during two evening session from 7:30 p.m. to 9:00 p.m. Additional interviews with pre-Nuprime students occurred after class periods and over the telephone. Students who were alumni of the (MS)2 program who are currently attending MIT were interviewed over the telephone. (These students were deeply involved in studying for mid-terms). One student still in high school who will be returning to (MS)2 this summer was interviewed at the local MBTA bus station. Parental interviews were the most challenging; most parents worked and consequently schedules were in continual conflict. Interviews with parents
generally took place in the evening over the telephone; two
interviews took place on a Saturday afternoon. (See
Appendix B for Interview Questions)

The central issue of defining what it takes to measure
the success of pre-college programs needs definition. Is
it getting students prepared and enrolling in college
and/or is it getting students prepared to enter and then
graduate? This clarification of success measurement was
attempted to test whether or not pre-college programs'
self-definition of success measurement is valid. Individual
pre-college components measure their own success by the
numbers of students they are able to get into
college. The problem with using entrance numbers as a sole
indicator of success, is that acceptance to engineering
school does not necessarily lead to graduation.
As previously stated in Chapter I, "no single indictor of
successful education exists. Instead, evaluators must
consider several broad types of indicators together." 18/

The four pre-college programs examined as part of this
study were:

Massachusetts Pre-Engineering Program for Minority
Students (MassPep). Established in 1979 by the local Urban
League, MassPep is an independent, non-profit organization
servicing students in selected Boston and Cambridge
schools.
Progress in Minority Engineering (pre-Nuprime). Sponsored by Northeastern University College of Engineering in 1977, pre-Nuprime was the first such program in New England designed to introduce high school minority students to engineering.

Mathematics and Science for Minority Students (MS)2. Located in Andover, Massachusetts, (MS)2 offers Black, Hispanic and Native American students from urban areas six weeks of summer study in mathematics and science.

To Improve Math Engineering and Science Studies (Times)2. Incorporated in 1983 (Times)2 is a program originated in 1978 and currently established in fourteen public schools in the state of Rhode Island. (See Appendix C)
CHAPTER III. FINDINGS

This chapter draws findings from the literature research data, interviews and field observation and suggests that pre-college programs offer both a plus and minus view of stated goals. The findings are separated into two parts. Part one is related to the question of whether or not pre-college programs increase enrollment and graduation numbers at engineering colleges, and what are the contributions that pre-college programs make to the issue. Part two details the findings of the issues, both academic and non-academic raised in Chapter II.

Part I.

What one finds in attempting to determine enrollment figures for black students entering engineering colleges is that information and data currently available, specifically from the National Action Council on Minorities in Engineering, the Department of Labor Statistics, and the National Science Foundation, is that pre-college programs do not track or differentiate black engineering graduates based on pre-engineering involvement during high school. The answer to whether or not pre-college programs have been effective in helping black students to graduate from engineering schools is inclusive. Current data is
insufficient to accurately state that pre-college programs deserve all the credit. Data does suggest, however, that while enrollment figures are climbing, so is attrition. Allowing for normal attrition, blacks are still not graduating from engineering colleges at the same rate as enrollment figures would indicate.

Attrition for black students for example, increased steadily from 46.9% in 1974 to 69.9% in 1984, while freshman enrollment climbed from 1424 in 1974 to 6661 in 1984. (See Table 1). Engineering degrees awarded to blacks in 1973 amounted to 1.5% out of a total of 2.9% (minority), a gain of .07% in seven years. In comparison, degrees awarded to women engineers went from 1.4% in 1973 to 9.6% in 1980, a gain of 8.2%! (See Tables 2, 3) Women, it seems have gained more ground than blacks!

Pre-college programs for the most part are outside of the main stream of academia. This makes it difficult at times to obtain information necessary to administer to students. The (MS)2 program, for example, a self-contained, independent school system graduates students with a 96% - 100% acceptance rate at major colleges throughout the country. (MS)2 controls its academic sphere; there are no institutional and arguably few
other barriers to the progressive learning process.

One of the ways each pre-college program measures its own success rate is by the numbers of students who gain admittance to engineering colleges. The problem with using entrance numbers as a sole indicator of success, is that current lack of meaningful statistics and data on students who come out of a pre-college environment, is an impediment to both local and national efforts. Pre-college programs must develop methods for recording and retrieving detailed information on student and program output.

Pre-college programs do provide services to students beyond academics. Programs provide input variables of considerable value — motivation — self confidence, career exposure and guidance, for example, that have positive implications.

In the summary of program findings that follows, the input variables take on additional meaning when one considers the importance of each individually and collectively, and their roles in the process of educating black students.

Part II

A. Program: ___
In interviews with program administrators, instructors, parents and students, the statement most often heard was that preparation in math and science should begin at an earlier age. Of the four programs examined, only Times 2 is the exception with programs in the middle schools.

..."we must capture their imagination in math and science before the 6th, 7th, and 8th grade!" (program director)

Programs offer to improve academic performance by building self-confidence, study habits, library skills, and to bring a realistic understanding of what it takes to enter the world of work:

..."pre-college programs claim to offer solid foundations, i.e., college level courses. I don't necessarily agree. A few, however, do offer self-learning, something I think is more important than academics for a great many of our youngsters. They also offer positive reinforcement and feedback. (admissions officer)

While some pre-college programs offer structured course development, (the (MS)2 program for example), the process is not standardized among programs. Some programs concentrate on intangible elements.
..."we are not doing much curriculum development. Our objective is to interpret the real time goals."
(program director)

On the other hand for some students attending pre-college summer programs, grades improved markedly. The NACME Retention report indicated that in a review of data correlated between students who were involved in pre-college programs versus those who were not, pre-college students had better performance records than their counterparts.

..."after one summer with the program, my SAT scores jumped 200 points!"
(program student)

Program administrators operating during the regular academic year expressed similar statements about curricular.

..."we actually shaped the summer academic program...during the school year this was handled by both the school and us. Even though we had input, we had no real control. For this reason, a Saturday academy is being considered. This will help sustain the quality of teaching and maintain the program in other ways. (program administrator)

Pre-college programs are also experiencing the same problem with respect to finding qualified math and science
teachers. The National Science Teachers Association (NASTA) expresses grave concern over the deterioration of science and math instruction in the schools and called for broad based reforms that would result in the allocation of greater resources for science instruction.

B. Recruitment Findings

Students in pre-college programs based in the public schools are recommended for the program by teachers and counselors based on aptitude and interest.

..."our students are identified by teams established within each school. Each team is made up of personnel from program staff and school personnel chosen by the program." (program coordinator)

The recruitment process as it now stands paves the way for the above average student's access to the program. Students who are marginal, at least in terms of grades, are left out in a process that seems more a screening "out" than a screening "in", although administrators claim the opposite.

...there is a great need for pre-college programs. However, most programs deal with the top 10%; those students with good potential.. the "cream of the crop".....but, most times those that need it most have little or no access to the program. The issue is ....what about those kids in the middle, bottom? It doesn’t seem to be filtering
down. That's how we measure these programs — let's get both sets of students together .. see what happens. (admissions officer)

For the summer sessions, programs rely on and in many cases give preference to those students who had been participants during the regular school year. In at least one particular program, enrollment is expanded to include students from throughout the public school system. Again, (MS)2 is the exception. Recruitment of students is national with a major concentration within public schools in the urban centers. A further qualification is that (MS)2 does include in its recruitment efforts the stipulation that a representative number of students from the Boston area be included in its student body.

C. Parental Involvement

Parents involvement in most programs range from "fair" to "good." Program administrators and instructors agree parental involvement is both crucial and a weak link within programs.

..."parent involvement is nil..at least not what it should be. Part of this is our fault; the other is parents inability to understand and become involved in their children's particular interest in math, science." (assistant administrator)
Communications must be improved between program personnel and parents so that parents can better understand the long-term process required to prepare for professional careers in mathematics, engineering and science.

..."my parents know very little about science and the types of math I'm doing... sometimes I wish I could talk to them about it...and ask for advice." (16 year old)

D. Instructor/Teacher Factors

Students stressed that public school environment wasn't "friendly." In some schools (Boston in particular), the racial climate for students, despite long-term desegregation and admittance to previously exclusive examination schools, remains the same. In private programs like (MS)2, direct concentrated efforts are made to understand and translate cultural differences into positive, realistic experiences for all participants. This is evidenced in part, by the cultural diversity of instructors, teaching assistants, and administrators.

..."peer tutorials are excellent! Black students need to and do associate with other black students who understand..."your struggle." One can say, I don't understand this problem!...without feeling stupid." (teaching assistant)

Programs claim to foster positive learning experiences for students. The reality, however, is that not all individuals and not all programs are sensitive to students
needs. In programs that did foster cultural diversity and positive learning experiences, (Pre-Prime and (MS)2 for instance) students did better academically.

..."unfortunately, teacher expectation of the black student most times is thinking...this kid can't make it! It's important to take a kid and learn about him/her first...understand where the student is as opposed to deciding where you think he/she is. (parent)

E. Linkage

The summer experience for all students strongly indicates the need for continuing communication during the regular academic year. Students, during the summer weeks were in constant communication and interaction with their peers, instructors and administrators. This interaction helped students develop socially and academically.

..."I spent the whole month of September talking about my spending the summer at a college campus! I had a chance to really get to know my teachers and met a lot of really nice kids. Now my friends are thinking about joining the program." (17 year old)

F. Networking

Pre-college programs on the average, network with universities and colleges. In most instances they are affiliated with at least one college. Networking among programs, however, is limited.
..."we must forge effective linkages. Any pro-movement that helps youth must be identified and replicated." (program director)

Program administrators admit to being less than effective in networking with each other. Emphasis is placed on competing for the same dollar as a reason for minimal interaction. While this competition for monies is real, programs that are better able to attract and maintain dollars are those with a broader vision and outreach.

G. Role Models

Role models in pre-college programs were rated as very important to the black student by administrators, instructors, parents, and the students themselves. Role models are recruited from academia, industry, the community and government. Role models help with the conceptualization of self and profession. For individuals who have always had an abundance of heros/heroines to look up to the concept of role models for the black student may seem trivial or out of place. The reality is just the opposite. Black students have not had the opportunity to hero worship and/or an abundance of heros to pattern oneself after. This need is a great one and much sought after by the pre-college program. These mentors provide students with one-on-one and/or group exposure to potential opportunities available after high school and college from the perspective of career choices, job mobility and advancement.
"Role models help students learn what other kinds of things are necessary in order to be successful...especially if there is no one at home to guide them. (counselor-coordinator)"

Role models coordinate on-site visits and field trips to engineering laboratories. They can be instrumental in getting internships during the summer breaks and can also assist in obtaining financial contributions and in-kind donations of equipment and materials.

"...we had college students as T.A.'s (teaching assistants)...it was great! You could always ask questions you were too timid to ask anyone else."

"...my mentor was an architect...he knew a lot about electricity and is helping me learn about how buildings are built."

On the other hand, the role model for many students were family members or close friends.

"...my mother is my role model and best friend...she's also a teacher. (student)"

H. Resource

Pre-college programs do not enjoy the stability of long-term funding. Resources for programs is a continual struggle. With pending federal and state cutbacks, and diluted financial commitments from private sources, potential growth is limited. While the demand for pre-college programs continues to grow, resources to maintain programs continues to decline.
I. **Self-Image**

There is a direct correlation between a student's academic performance and self-esteem. When asked to rate themselves from "poor" "fair" "good" or "excellent", most students considered themselves to be from "good to excellent" depending upon circumstances. When asked to elaborate, students cited reasons as:.....

"on a good day when things seem to go my way, I'd say "excellent" ...if I'm having problems at school or home or with a friend then I might say fair."

Among those students whose self-image was higher, academic performance was higher.

"students need positive feedback. we must continue to say over and over...you can do it!...everytime they do something successful, let's award them and then push them on to something else. (parent and instructor)

"black students spend three-fourths of their energy being accepted. A measurement of their environment within its own context. Confidence once learned becomes familiar. You know the rules of the game. You have gained an inner strength...your energy is not constantly being used up trying to protect yourself, rather than learning the art of conceptualization, the "how to" of learning becomes a reaching in the dark too many times. (instructor)
J. **External Factors**

(i) This is a problematic area for most programs. Black students come from low-to-moderately-low income families where the pressure for work often offsets personal need for supplementary academic instruction. It can be a question of what does one do first, feed the brain or the body.

"...we must provide students in need with economic subsistence. I don't particularly like this, but not addressing the issue is akin to an ostrich with my head in the sand."

(ii) With respect to extra curricular activities, the majority of students are "joiners." They are involved in numerous activities outside the home and school (church, community center, and sports). In many instances, participation in pre-college programs is limited by students being over committed in these areas.
CHAPTER IV. CONCLUSIONS AND RECOMMENDATION

This study began by trying to determine if pre-college programs were increasing the numbers of black students in engineering colleges and helping them to graduate. The study also attempted to ascertain if programs were being effective; are they making a difference. There are several conclusions to be made concerning the pre-college effort. Programs are making some progress in channeling students into engineering and the sciences. What is difficult to measure are the outcomes of this progress. This conclusion is based on the fact that programs do not employ standard mechanisms to track their students beyond the high school level. There is a serious need for pre-college programs at the high school level to document academic performance and tutorial support requirements for program participants. There is little standardization among programs in terms of curricular development. A state of the art program for pre-college programs is needed. Pre-college programs are, in the opinions of students, "good for me" and their reasons are as different as the students themselves. Pre-college programs need sustained financial commitment. I believe the single most successful indicator for program measurement is for programs to maintain current data on participants from high school to college.
Programs must continue follow-up of students to be able to retrieve necessary data on enrollment, retention and graduation. This will enable programs to maintain current resources, seek new funding bases, and receive direct feedback from students and faculty on academic and supportive services that impact on their ability to remain in engineering school.

The following recommendations are suggested:

1. Pre-college programs must track participants beginning with their entrance into the program through pre-college graduation. Given the restraints of finances, this responsibility could be co-sponsored by the program at the high school level and one at the college/university level.

2. Pre-college programs at both ends of the gate, entering and graduating from engineering college, must maintain current data on participants and work in tandem with each other to accomplish this task.

3. Academic supportive services for students must begin at the grade school level with algebra starting in the sixth grade and pre-calculus beginning in the tenth.

4. Program priorities and resources must focus on building stronger academic platforms. Programs must provide in addition to regular instruction, after school and Saturday tutorials to meet student needs. Program schedules must fit the needs of students.
(5) Student and teacher recruitment should begin in the spring for the coming fall. This will allow for time to publicize the program to incoming students and teachers and allow for pro-active, rather than re-active, planning and delivery of services.

(6) Program administrators must be active participants with respect to the decision making process related to teacher selection and curricular development. While most programs have input into this process, choices appear limited. The summer programs are good examples of where programs have control over teacher selection and curricular.

(7) Programs need specific, structured outreach to parents. This can be accomplished (for example) with the employment of a part-time staff person. This parent-counselor must work a time schedule that is not at cross purposes with those of parents.

(8) Cultural training and exposure to different ethnicities among students must be a prerequisite for participation in the program for administrators, instructors and staff.

(9) Pre-college programs must establish communication linkage between students, teachers, parents, staff and administrators on a continuing basis.
The concept of role models needs expansion. Role models for black students are not in abundance. It is, therefore, unrealistic to ask too few to carry the need for so many. This overload has caused "burnout" of too many committed people. The recommendation here is for the team approach. The role model concept is that a team be developed for no more than three (3) nor less than two (2) students composed of the student, parent, program administrator and or staff person, instructor/teacher, and role model (and designee). The role model designee is another professional in the same or similar field who can substitute for the primary role model when needed. The function of the team is to provide direct counseling, guidance and tutorial to students and feedback to program administrators relative to program content.

Pre-college programs must continue to provide historical information to black students relative to their ethnicity and the numerous contributions made to the world of mathematics, engineering and science by blacks. Student self-image and self-esteem will be enhanced by the knowledge and understanding of these accomplishments.
Chapter I: Footnotes


2. Ibid. p.12


5. Ibid. page 32 (Table 1)

6. Ibid. page 32 (Table 1)

7. Ibid. page 32 (Table 1)

8. Ibid. page 21 (Table 1)


10. Ibid. p.45


12. Women and Minorities in Science and Engineering, National Science Foundation, 1982 p.1


15. Ibid. p.27

Chapter II: Footnotes


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Appendix A

Profile of Interviewees

Interviewees for this study agreed to be interviewed after receipt of a brief synopsis of the thesis concept. 85% of the interviews were conducted on site. Telephone interviews were used to contact prior pre-college students and parents. Twenty-five of the interviews were high school students, three college, and one former college student. Five were program directors, and two assistant administrators, two program coordinators, one program secretary and one college admissions officer. Five instructors were interviewed, three male and two female. Two board members and two corporate givers interviewed were from industry. Finally, three single parents and two parents with both husband and wife living at home were interviewed.

Program Administrators

Program directors interviewed were predominately male, black, and between the ages of 30 - 50. One program had a female associate director. The (MS)2 program had the only white male director. All program directors and assistants (with the exception of one who was finishing credits for graduation) were college educated and had worked in the education field an average of one to five years. Staff
personnel (program secretary and coordinators) were evenly divided between male and female and had been with the program at least two years. The one admissions officer interviewed (freshman) had been with a major university for ten years.

Students

The high school students interviewed were from two main sources: the Boston and Cambridge public schools, and four public high schools sixty miles south of Boston. They were between the ages of fourteen (14) and nineteen (19) in grades nine through twelve. The majority had definite goals and/or plans to attend college, with the students from Boston deciding early to enter engineering and/or math related fields. The students from the south shore were a little more hesitant about commitments, especially the ninth grade students. Students had an average of two years in the program.

Three students currently attending college in the Boston area who were former students in a pre-college program were also interviewed. These students, from different sections of the country were recruited for the (MS)2 program. One was a junior majoring in computer science and the other two were majoring in industrial engineering.

Instructors

The majority of the instructors came from the public
school system. However, of the five instructors interviewed, all were associated and recruited for programs from private industry. The (MS)2 program utilized its internal teaching staff supplemented with teaching assistants from major universities. The MassPep program recruited nationally for its six week summer session in contrast to the academic year when public school teachers were instructors.

Parents

Parents interviewed were (guestimate) generally in their thirties to early forties. Three single parents and two sets of couples agreed to be interviewed. With the exception of one parent, each had been involved with the pre-college experience for at least two years and had had positive experiences with the programs. Half of the parents felt, however, that they were not being fully utilized a statement acknowledged by program directors. Both single and two-parent families held full-time jobs. One family spoke little English but were adament in their desire to get a good education for their daughter. Because of limited English their participation in the program was minimal.

Board Members

Two board members were interviewed. One is a small business-man in the City and the other works for a Fortune five hundred
company as an engineer. Both were male in their late fifties, one white and one black, and had been involved in the pre-college experience for at least five years. Their primary goal as board members was to raise monies for the program from industry and foundations. They were both positive in their belief that pre-college programs were necessary and "product oriented."

Admissions Officer

The admissions officer interviewed was selected because he was both a product of pre-college program (Hampton Institute, Virginia) and because of his ten year experience as a freshman recruiter for MIT.
Appendix B

**Interview Questions**

How did you become involved in (name) program.

Are you doing anything different today than you did say one year ago?

Were there any surprises you weren’t prepared for.

What is your recruitment process for students?

What is your recruitment process for instructors.

How is your program funded. Are you actively involved in the raising of monies and how.

What problems have been the most difficult to overcome?

What are the rewards (if any) about your program? If none, why not.

How many of your students go on to college? In engineering? math?

How has the advent of students part-time employment affected their participation in the program?

How has extra-curricular activities?

What services does your program provide to students?

**Questions for Students:**

How did you hear about (name) of program.

How long have you been in program.

Do you think/know that your grades have improved since joining? How do you know.

What do you like best about (name) program. Why

What do you like least? Why.

What subjects are you confident in taking exams in. Why

What grade were you in when you started studying math? Algebra? How long have you been taking math?

Who do you admire the most? Why?

What does this person do for a living?

What are your career choices? Why? What kinds of plans have you made towards the future?
Appendix C

MATHEMATICS AND SCIENCE FOR MINORITY STUDENTS
(MS)2

(MS)2 is an academic summer program conducted by Phillips Academy in Andover, Ma., in mathematics and science for minority students. Established in 1977 in response to a growing awareness that Black, Hispanic and Native American people are acutely underrepresented in the medical, engineering, and scientific professions, (MS)2 aims to supplement the work of the high schools and help students develop competence and self-confidence for the demanding college courses in science and mathematics that are crucial for work in the technical professions.

In 1974, the Headmaster and others at Phillips Academy recognized that minority students were not being adequately prepared to face the challenges of mathematics and scientific careers. Evidence strongly indicated that an early solid foundation in math is mandatory for success in mathematic and scientific fields as is a nurtured curiosity for science. It was also felt that working with high school youth would challenge the school system to improve their curriculum. The concern of these individuals led to the origin of the (MS)2 program. Certain results from this train of thinking has produced positive results: A Chicago school has enlarged its mathematics offerings while a New York City school utilizes the performances of their (MS)2 students to assess the effectiveness of their mathematics curriculum. The Andover-Dartmouth Teachers Institute evolved from (MS)2, when after observing the success of the program, Phillips Academy with a grant from the Ford Foundation decided to pioneer the idea of helping inner city teachers better prepare themselves to teach higher level mathematics.

The (MS)2 program challenges scholars to work hard, with the installation of a solid work ethic. Second, the program nurtures self-confidence by providing an academic, majoritive environment for students to learn to work and achieve. Third, the program exposes students to subject matter and laboratory facilities which, for many, are not available at home schools. Finally, rewards stemming from the positive momentum that students take back to their respective home schools takes on new, refreshing and vitalizing incentives for their teachers. The (MS)2 program feels confident that this situation only stands to better the home school environment.
Emphasis is placed on deepening the students' understanding of fundamental concepts while at the same time strengthening the ability to employ basic techniques.

Homework assignments are substantial; the program's selectivity assures both students and faculty have high expectations for the work to be accomplished in each course. The program provides a series of field trips, college counseling to third year scholars and brings a number of minority professionals involved in mathematics and science to the campus.

(MS)2 students spend at least twenty-two hours a week in class. At least nine or ten hours of mathematics and science each week, three hours of English (except for third-summer scholars, who are exposed to the college admission process). The average time for homework is between four and five hours per night. (MS)2 scholars are graded according to Phillips Academy's rigorous scale of 6 to 0. Lectures, field trips and afternoon activities complement academic rigors with students quickly learning time management.

Six (MS)2 teaching assistants were available for one-on-one tutorials or full class review sessions. College counseling, field trips, distinguished visitors (for example, Dr. Kenneth Manning, Professor of the History of Science at MIT) address students, providing strong role models from outside Phillips Andover. (MS)2 believes this is important to the scholars both in intellect and self-image.

Courses are for the most part taught by Phillips Academy faculty. Five in mathematics, two in biology, two in English, one in chemistry, one for probability and one in third year analytics, one for third year mechanics, and a college counselor are part of the regular staff.

For further information:
Mathematics and Science for Minority Students (MS)2 Program Secretary
Phillips Academy
Andover, MA. 01810
(617) 475-3400 Ext. 293
pre-NUPRIME: NORTHEASTERN UNIVERSITY PROGRESS IN MINORITY ENGINEERING

pre-Nuprime is a pre-engineering program designed to let students find out about engineering as a career. It helps sharpen the skills needed for an engineering program in college, and it puts students in touch with people already in the field of engineering.

pre-Nuprime is a local, practical and very successful program established by Northeastern University of Boston in cooperation with Sippican Ocean Systems, Inc., of Marion.

The program is especially designed for but not limited to minority high school students in Marion, Wareham, Rochester and Mattapoisett (Massachusetts).

The Sippican/Northeastern pre-Nuprime program began in the spring of 1979. Since then, it has become one of the most successful minority pre-engineering programs in the northeastern United States. pre-Nuprime began with just six students. Classes were held in a conference room at Sippican Ocean Systems. Today, more than thirty students benefit from pre-Nuprime. With financial assistance from Sippican, a number of pre-Nuprime students have been accepted at Northeastern University's College of Engineering. Several of these students are now completing their work/study programs at Sippican.

Students attend classes one night a week for twenty-two weeks from September to June. The program is designed to improve the math skills you will need to enter the field of engineering study. Students learn the language skills and study habits required for academic success in a college program; receive career counselling and learn about procedures for obtaining financing. The program also includes various cultural and recreational activities.

pre-Nuprime is administered by Northeastern University's College of Engineering, Office of Minority Affairs in cooperation with representatives from Sippican.
For further information:

Northeastern University College of Engineering
pre-NUPRIME
220 Snell Engineering Center
360 Huntington Avenue
Boston, Ma. 02115
(617) 437-2156

Sippican Ocean Systems, Inc.
Marion, Ma. 02738
(617) 748-1160
TO IMPROVE MATH, ENGINEERING AND SCIENCE STUDIES
(TIMES)2, Inc.

Times 2, Inc., is a program designed to increase the number of minority students interested and qualified to prepare for careers in mathematics, engineering and other sciences. The goal of the program is to increase the number of Rhode Island minority students entering and successfully completing engineering study. Times 2 attempts to achieve this goal by identifying students beginning in the seventh grade, and providing effective academic preparation during high school. It is a non-profit organization supported by contributions from businesses, member organizations and foundation grants. Membership on the board of directors is limited to those businesses and companies currently engaged in engineering and the sciences, community groups and professional societies. Technical assistance and help in program development is provided by NACME.

The program offers services to youth and their families at no cost. Teachers receive assistance in the development of curriculum, career education activities and development of methods for applying classroom learning experiences to the solution of engineering problems.

Times 2, Inc., was started by the Rhode Island Urban Project. In 1978 a feasibility study spearheaded by representatives from major industry, community members and educators was undertaken to study the possibility of expansion. Implementation of pilot programs began in 1979 at Bishop McVinney Regional and Gilbert Stuart Middle School in Providence, and the Thompson Jr. High School in Newport. In 1980, the school committee voted to fully implement the program into the above schools; between 1981 and 1983, six schools were added to the program.

Times 2, Inc., has a member board comprised of twenty-five businesses and organizations with an open process for membership, with an executive committee that meets monthly. The program employs a full time executive director and secretary. Teachers are recruited from the public schools involved in the program. Each participating school has an active operating committee who coordinate Times 2 projects, allocates budgets, and helps develop programs.

Times 2 receives program and financial support as a direct result of contributions from member organizations and foundation grants and from Providence College and the University of Rhode Island. In addition, Times 2 students are involved in university sponsored activities during the academic year and summer tutorials.
The program utilizes employment outreach in the form of summer employment, apprenticeship and internships with participating businesses, educational and corporations for students in the program. College counselling is an integral component of the program.

For further information:
Times 2, Inc.
480 Charles Street
Room 301
Providence, Rhode Island 02904
(401) 421-8276
Massachusetts Pre-Engineering Program (MassPep) for minority students is an educational program whose purpose is to identify, motivate and qualify minority youth in grades 7 through 12 for college study leading to engineering careers. MassPep feels this is the key to increasing the number of engineers tomorrow.

In 1977, members of the Urban League of Eastern Massachusetts and the General Electric (GE) Foundation met to discuss the prospect of setting up summer programs to involve inner-city minority youth with local technical institutes. A planning group was formed composed of representatives from the Museum of Science, Boston and Cambridge public schools, engineering colleges and universities, industry, and community groups who studied the possibility and recommended that an independent, non-profit agency be established.

MassPep was formed in 1978 as a result of these efforts. In January 1979, the program began operating out of offices provided by Wentworth Institute of Technology. In January 1980, MassPep became incorporated as an independent non-profit organization.

The goal of the organization is to help minority students on the road to successful careers in engineering. Each MassPep school has a planning team consisting of mathematics, science, and English teachers and a guidance counselor. One of the team members acts as coordinator and is responsible for developing and implementing the program in his/her school. Through these team efforts, activities, projects and programs have been developed to motivate and interest minority students in engineering. Also, to show students how knowledge gained in the classroom is applied in a work environment, practical learning experiences are offered. Each MassPep school has access to a variety of business and government organizations. These "link up" organizations provide field trips, speakers, demonstrations, and role models. As a supplement to the school year, accelerated learning programs are held at university campuses during the summer and Saturdays.

Students are selected from the public schools of Boston and Cambridge. These include Boston Latin, Boston Latin Academy, Boston Technical, Mario Umana, Jamaica Plain High School, and Cambridge Rindge and Latin.
MassPep is supported by community groups, cultural institutions, high technology industries, engineering colleges, and public school systems. It is funded by businesses and charitable foundations.

For further information:

Massachusetts Pre-Engineering Program for Minority Students (MassPep)
at Wentworth Institute of Technology
550 Huntington Avenue
Boston, Ma. 02115
(617)427-7227
### TABLE 1

<table>
<thead>
<tr>
<th>Year</th>
<th>Black Freshman Enrollment</th>
<th>Black Undergraduate Enrollment</th>
<th>Bachelor's Degree Granted Black Engineers</th>
<th>Percent Attrition</th>
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<td>977</td>
<td>2757</td>
<td>314</td>
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<tr>
<td>1970</td>
<td>1424</td>
<td>3753</td>
<td>378</td>
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<td>1971</td>
<td>1289</td>
<td>4136</td>
<td>407</td>
<td>-</td>
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<td>1477</td>
<td>4356</td>
<td>579</td>
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<td>1684</td>
<td>4869</td>
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<td>2447</td>
<td>6319</td>
<td>756</td>
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</tr>
<tr>
<td>1975</td>
<td>3840</td>
<td>8389</td>
<td>734</td>
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</tr>
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<td>1976</td>
<td>4372</td>
<td>9828</td>
<td>777</td>
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</tr>
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<td>1977</td>
<td>4728</td>
<td>11,388</td>
<td>844</td>
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</tr>
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<td>1978</td>
<td>5493</td>
<td>12,954</td>
<td>894</td>
<td>63.5</td>
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<tr>
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<td>6339</td>
<td>14,786</td>
<td>1,076</td>
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<td>1980</td>
<td>6661</td>
<td>16,181</td>
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<td>1981</td>
<td>7015</td>
<td>17,611</td>
<td>1,445</td>
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<td>1982</td>
<td>6715</td>
<td>17,598</td>
<td>1,646</td>
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<tr>
<td>1983</td>
<td>6342</td>
<td>17,817</td>
<td>1,862</td>
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<tr>
<td>1984</td>
<td>-</td>
<td>-</td>
<td>2,022</td>
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</table>

**SOURCE:** 1983/84 National Action Council for Minorities in Engineering Annual Report

**Note #1:** Legend: \[
\frac{977 - 657}{977} = \frac{320}{977} = 32.7\%
\]

**Note #2:** The comparison of freshman enrollment figures to engineering graduates is inaccurate to the extent that the number of transfer students entering engineering schools with advanced standing has not been identified. However, figures indicate that retention is a serious problem.

**Note #3:** Inaccuracies were also discovered in the Engineering Manpower Commission (EMC) information reported on Minority and Black freshman enrollments in NACME 1983/84 Annual Report when compared with the report of Thomas E. Ford (Minorities in Engineering, 1981)
### TABLE 2

Full-time Freshmen Engineering Enrollments

<table>
<thead>
<tr>
<th>Year</th>
<th>Fall Women</th>
<th>Blacks</th>
<th>Hispanics*</th>
<th>American Indians</th>
<th>Total Minority Students</th>
<th>Minorities % of Total</th>
<th>Total Freshmen</th>
</tr>
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<tbody>
<tr>
<td>1973</td>
<td>2,417</td>
<td>2,130</td>
<td>790</td>
<td>67</td>
<td>2,987</td>
<td>5.75</td>
<td>51,920</td>
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<tr>
<td>1974</td>
<td>4,266</td>
<td>2,848</td>
<td>1,068</td>
<td>102</td>
<td>4,018</td>
<td>6.3</td>
<td>83,440</td>
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<tr>
<td>1975</td>
<td>6,730</td>
<td>3,840</td>
<td>1,384</td>
<td>120</td>
<td>5,344</td>
<td>7.1</td>
<td>75,343</td>
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<tr>
<td>1976</td>
<td>8,543</td>
<td>4,372</td>
<td>1,766</td>
<td>171</td>
<td>6,309</td>
<td>7.7</td>
<td>82,250</td>
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<tr>
<td>1977</td>
<td>9,921</td>
<td>4,728</td>
<td>2,121</td>
<td>244</td>
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<td>11,789</td>
<td>5,493</td>
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<td>225</td>
<td>8,380</td>
<td>8.7</td>
<td>95,805</td>
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<tr>
<td>1979</td>
<td>14,031</td>
<td>6,339</td>
<td>3,136</td>
<td>317</td>
<td>9,792</td>
<td>9.4</td>
<td>103,724</td>
</tr>
</tbody>
</table>

*Excluding the University of Puerto Rico

Source: Engineering Manpower Commission

### TABLE 3

Total B.S. Engineering Degrees and Those Awarded to Women and Minorities, 1979-1980

<table>
<thead>
<tr>
<th>Year</th>
<th>Women</th>
<th>Blacks</th>
<th>Hispanic*</th>
<th>American Indians</th>
<th>Total Minority</th>
<th>Minorities as a % of Total</th>
<th>Total</th>
</tr>
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<tbody>
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<td>1973</td>
<td>624</td>
<td>657</td>
<td>566</td>
<td>32</td>
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<td>43,429</td>
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<td>1974</td>
<td>744</td>
<td>756</td>
<td>640</td>
<td>31</td>
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<td>3.4</td>
<td>41,407</td>
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<td>1975</td>
<td>878</td>
<td>734</td>
<td>685</td>
<td>44</td>
<td>1,463</td>
<td>3.8</td>
<td>38,210</td>
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<tr>
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<td>1,378</td>
<td>777</td>
<td>680</td>
<td>41</td>
<td>1,498</td>
<td>3.9</td>
<td>37,970</td>
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<td>3.6</td>
<td>46,091</td>
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<td>1,076</td>
<td>808</td>
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<td>1,943</td>
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<td>1,320</td>
<td>1,003</td>
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<td>2,383</td>
<td>4.0</td>
<td>58,742</td>
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*Excluding the University of Puerto Rico

Source: Engineering Manpower Commission