BLACK ENGINEERING AND SCIENCE STUDENT DROPOUTS AT THE UNIVERSITY OF THE DISTRICT OF COLUMBIA FROM 1987 TO 1991

by

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(ABSTRACT)

Black engineering and science students in colleges and universities have not been researched sufficiently to determine the reasons for their success or failure. This was an exploratory study focusing on those factors that influenced non-persistence of African-American science and engineering students at the University of the District of Columbia from 1987 to 1991.

The subjects for this study were eight (8) African-American students who matriculated at the University of the District of Columbia from 1987 to 1991. The students were enrolled in the College of Physical Science, Engineering, and Technology during that period of time.

A survey of 59 questions grouped into five categories was administered as an interview over the telephone and by mail. The survey revealed the following: (a) Students own experiences lead to mind changes about career aspirations, and these aspirations are not always in concert with

parents; (b) academic success is no guarantee of persistence; (c) negative experiences do not dampen perceived need for further education; and (d) non-persistence is caused by lack of preparation, desire to transfer, disillusionment, financial difficulties, and changes in the environment.

In that the study involved only eight students, the data was not sufficient to warrant definitive recommendations for curriculum changes, program changes, or approaches being used by pre-college programs to interest African-American students in selecting science or engineering related disciplines. However, two areas have promise for future research: learned helplessness syndrome--how it and students' natural fear of failure may be related to non-persistence; and contextual learning--how it addresses a learning style not utilized regularly in teaching quantitative subjects.

The data did point out the need for continued assessment of first-year students, as well as continuous monitoring of their concerns on a semester-by-semester basis. Individually oriented treatment is encouraged for these students.

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CHAPTER I

THE PROBLEM

In American society today, a college education is perceived as a status symbol, a measure of academic achievement, and the beginning of professional and monetary opportunity. For African-American and other underepresented minority groups, a college degree is particularly important. Many African-Americans do not earn college degrees because of learning deficits in their elementary and secondary school education. Overall, they receive less of everything that is needed to succeed: Their teachers are less well trained, their schools lack equipment, and their courses lack rigor and relevance (Oakes, 1990).

It is accepted that many African-American students who do enroll in college in the areas of science, mathematics, and engineering do not stay long enough to graduate, or they change their career goals to those occupations which generate low incomes, such as education, the humanities, and the social sciences (Powell, 1990). Therefore, African-American student retention in the fields of science, engineering, and mathematics should be a priority for colleges and universities if they are to address the problem of underrepresentation.

It has been known for many years now that education for many blacks has been substandard. Environmental problems, historical poverty, prejudice and discrimination, and the residual effects of slavery, coupled with transiency and defeatism among students, teachers, and parents, have all conspired to give the black student a dysfunctional predisposition toward learning and authority in general (Carey, 1977).

"By the time the typical black youth reaches high school, they have gotten the message through poor grades, frequent disciplinary actions, low test scores, and teacher and counselor indifference to their problems that they are not a top candidate for college" (Carey, 1977, p. 39). Because they cannot see themselves as having a realistic chance of holding professional jobs which require higher education, they do not see the purpose of being proficient. What they have seen, however, is that the so-called proficient (qualified) blacks as well as the deficient ones are locked into the same low-status community with substandard housing, inferior schools, menial jobs, and low incomes; therefore, the typical black youth does not think they can succeed by working hard in high school. Negative factors about learning become a standard pattern of behavior.

"Few persons ever tell them that they should master mathematics, physics, or the basic sciences so that they can navigate ships, build highways, construct bridges, pilot jetliners, or even design skyscrapers" (Carey, 1977, p. 39). Hence, it becomes difficult, if not impossible, for them to accept these possibilities as being real because of the lack of empirical evidence. This causes many black students to consciously resist the academic training necessary for a professional career in the basic sciences and engineering. As a result, there are disproportionally few black engineers and scientists (Carey, 1977).

Although numerous programs initiated in the early 1970s through the mid-1980s may have helped to alleviate the problem, the minority percentage of total science and engineering professionals is still woefully small, about 2.5 percent in each broad category of science and engineering (Brodie, 1993).

"The history and culture of science, mathematics, and technological literacy and achievement must include that of people of color!" (Bailey, 1990, p. 243). Bailey agreed with Carey when he stated that history does matter. "A knowledge of one's own history, high self-esteem, intrinsic motivation, and academic achievement appear intimately interconnected" (Bailey, 1990, p. 243).

Although the black minority comprises roughly 12% of the total population in America (National Science Board, 1991), the number and percentage of African-American degrees attained in selected disciplines in 1989 (vs. U.S. population, 1986) was:

4.01% in engineering
4.58% in life sciences
8.86% in computer sciences
5.45% in mathematics
3.42% in physical sciences (p. 241).

Brookover (1985) stated that "most research on the retention and failure of black engineering and science students tends to stress deficient mathematical and science skills, along with low test scores on standardized tests" (p. 257). In typical American school districts, the achievement of black students, as measured by standardized tests in the basic skills and basic school subjects, is slightly lower in the elementary grades than the achievement of white students. Typically, this slight difference in achievement between black and white students increases as the students move through the elementary and secondary grades (Brookover, 1985).

Although every ethnic group taking the SAT test is performing better today than it did 15 years ago, a 1991 report by Sandia National Laboratories (Carson, Huelskamp, & Woodall, 1991) agreed with Brookover and stated, "In spite

of a 50 point improvement over the past decade in the average SAT score, black students still average nearly 200 points lower than whites" (p. 48). This phenomenon, however, should not be attributed specifically to racial differences. The Sandia Report suggested that the "disparity may be better correlated with school setting rather than race or ethnicity. Urban students regardless of race or ethnicity score significantly lower on standardized tests than their rural or surburban peers" (Carson, Huelskamp, & Woodall, 1991, p. 48). The same discrepancy in achievement generally occurs between the children of poor white families and more affluent white families. Black students, therefore, may be doubly disadvantaged by both race and locale.

There is ample evidence that in most American school districts "this pattern of increasing ineffectiveness of schools in teaching black students is present" (Brookover, 1985, pp. 257-258). But the predominant pattern of American education, over the past decades for which data are available, "demonstrates that schools have not been effective in teaching most black and some other minority students, particularly those from low-income families" (Brookover, 1985, p. 258).

Research by the Carson, Huelskamp, & Woodall (1991) does not completely agree with Brookover on this point. They found the following:

> Investigation of National Assessment of Educational Progress (NAEP) data revealed that performance has been steady or improving in virtually all subject areas tested, and the greatest gains have come in basic skills. Furthermore, these gains have not been at the expense of advanced skills. (Carson, Huelskamp, & Woodall, 1991, p. 48)

Although it is true that the average SAT score has been declining since the 60's, the reason for the decline is not decreasing student performance. It was found that the decline arose from the fact that more students in the bottom half of the class were taking the SAT than in years past (Carson, Huelskamp, & Woodall, 1991). Additionally, they found that "every ethnic group taking the test is performing better today than it did 15 years ago" (p. 48).

Carson, Huelskamp, & Woodall's (1991) analysis of the dropout data indicated that minority youth continue to lag behind their white peers on standardized tests:

> For example, in spite of a 50 point improvement over the past decade in average SAT score, black students still average nearly 200 points lower than whites.

> Similarly, Hispanic and Native American scores lag white scores by more than 100 points. However, this disparity may be better correlated with the school setting rather than race or ethnicity. Urban students, regardless of race or ethnicity, score significantly lower on standardized tests than there [sic] rural or suburban peers. (Carson, Huelskamp, & Woodall, 1991, p. 48)

Ogbu (1992) theorized that the inability to effectively educate minority students is not merely one of cultural and language differences, but thus far unrecognized is the nature of the relationship between minority cultures and languages and the culture and language of the dominant white Americans and the public schools they control. Ogbu (1992) stated:

> The relationship between the minority cultures and languages and the mainstream culture and language is different for different minorities, and it is this difference in the relationship that is problematic in the ability of the minorities to cross cultural and language boundaries and that calls for understanding in order to enhance the success of intervention and other efforts. (p. 7)

It is acknowledged, Ogbu (1992) stated:

> There are other forces at work, namely, how American society at large, the local communities, and the schools all contribute to minority problems in school learning and performance. Societal contributions include denying the minorities equal access to good education through societal and community educational policies and practices and denying them adequate and/or equal rewards with whites for their educational accomplishments through a job ceiling and other mechanisms. Schools contribute to the educational problems through subtle and not so subtle policies and practices. The latter include tracking, "biased" testing and curriculum, and misclassification. (p. 7)

The crucial issue in cultural diversity and learning is the relationship between the minorities' cultures and the American mainstream culture. Minorities, whose cultural frames of reference are oppositional to the cultural frames of reference of American mainstream culture, have greater difficulty crossing cultural boundaries at school to learn (Ogbu, 1992). African-Americans, whom Ogbu classifies as an involuntary minority brought into the United States against their will, and who often were relegated to menial positions

and denied assimilation into the mainstream society, are characterized by secondary cultural differences. Secondary cultural differences are differences that arose after two populations came into contact or after members of a given population began to participate in an institution controlled by members of another population, such as the schools controlled by the dominant group (Ogbu, 1992).

Ogbu (1992) stated:

> Secondary cultural differences do not merely cause initial problems in the social adjustment and academic performance of involuntary minorities but the problems appear to be extensive and persistent. One reason for this is that these minorities find it harder to cross cultural and language boundaries. (p. 10)

Secondary cultural differences evolved as coping mechanisms under "oppressive conditions," and the minorities have no strong incentives to give up these differences as long as they believe that they are still oppressed. The differences are interpreted as markers of their collective identity to be maintained, not as barriers to be overcome (Ogbu, 1992).

Friedman (1990) stated that the National Action Council for Minorities in Engineering (NACME) in cooperation with the Center for the Advancement of Science, Engineering and

Technology (CASET) undertook a national survey of under-represented minority students in engineering to assess their college experiences in relation to academic performance. The purpose of the study was to determine if professions need a sound empirical basis for designing intervention programs, which will be the basis for increasing the number of minority students who graduate from engineering programs. A 95-item survey instrument was sent to 2,584 African-American, Hispanic, and American Indian students enrolled full time in undergraduate engineering programs at 64 colleges and universities. The survey results were based on responses from 1,206 students. Selected questionnaire items revealed important facts and trends about the students, their perceptions of engineering programs, and their college success. Implications for retention and predicting grade-point averages were discussed.

The report recommended the following actions: (1) increase scholarships and grants for minority engineering students, (2) establish additional minority engineering support programs, (3) expose students to scientists and engineers at an early age, (4) provide faculty with training in cultural differences, and (5) reduce ethnic conflict on campus (Friedman, 1990).

A survey was conducted by Bond and LeBold (1977) at Purdue University to determine the factors that influenced the retention and attrition of African-American students in the engineering program. A comparison was made between the pre-college and college characteristics of African-American freshmen engineering persisters. Transfer students, as well as students who had withdrawn, were included in the study. The results of the survey indicated that the prevailing reasons for attending Purdue were related to salary, job opportunities, and an interest in problem solving techniques. Most of the African-American students admitted to the engineering program at Purdue dropped out and went to other colleges to study. Engineering persisters were more apt to be achievement oriented and more often participated in engineering and mathematical activities.

The students who dropped out of Purdue University or transferred to other colleges and universities changed or selected other fields of study other than engineering largely due to low grades and lack of interest (Bond & LeBold, 1977).

Those students who selected engineering as a career objective indicated the person or source most helpful in their choice. Thirty-two (32) percent reported that their choice was influenced by a relative, and 26 percent said

that friends or high school courses were the most helpful in their selection. Some other factors of influence were their work experience, and media (TV, radio, and printed materials). These factors accounted for another 26 percent (12% and 14% respectively). The combined influence of teachers and counselors was 14 percent (Bond & LeBold, 1977).

Another revealing set of statistics in the Purdue Study was the school year in which the students made their decision on the choice of engineering for a career. The majority of the students (53%) waited until the 12th grade to make their decision; while 24 percent had made their decision by the 11th grade. Only nine percent of the students had decided on the field of engineering in the 10th grade.

The National Academy of Sciences-National Research Council (1975) distributed a questionnaire to the 200 engineering colleges with the largest minority enrollment in 1974 requesting the retention rates of minority students. Out of the 200 engineering colleges, only 30 engineering colleges responded with useful information. Another lengthier questionnaire was sent to 71 of the original engineering colleges and requested the opinions of those persons who were responsible for minority programs in

engineering. Information about engineering programs, services, and statistical data was requested. Of these 71 schools of engineering, only 31 schools responded. Visits were made to 29 schools with active programs to look at their procedures for increasing minority student enrollment.

The National Academy of Sciences-National Research Council visiting team found that students had insufficient preparation in mathematics and the physical sciences, inadequate motivation toward engineering as a career choice, lack of adequate financial resources and no self-confidence. These were the most common reasons for attrition of minority engineering students. There was also a need for a larger number of Hispanic faculty and staff at engineering colleges where Hispanics numbered about half of the total student population. The amount of personal contact among the students, faculty, and staff was an important variable in the retention program of these engineering schools.

Among the recommendations were that successful precollege academic programs be continued and expanded to increase the academic skills of the under-prepared students who have a keen interest in engineering. Another recommendation was that able minority juniors and seniors or graduate students should be identified to tutor other students.

In an attempt to understand college students' impressions of scientists, Beardslee and O'Dowd (1961) surveyed the attitudes of students from four northeastern colleges. The results of this investigation uncovered a pervasive stereotype of scientists. College students depicted the scientist as a very radical, individualistic, strange, and intelligent individual who is socially withdrawn and indifferent to others. With this type of image of scientists prevailing on college campuses, it is little wonder that large numbers of students shun majors in science.

Bayless (1991) stated:

> A National Science Foundation report predicted that a shortfall of 250,000 degreed engineers will occur in the next 20 years. In the year 2000, 85% of new entrants into the nation's work force will be members of minority groups and women, and the number of people with disabilities in the work place will rise. These three groups have historically been under-represented in science and engineering. (p. 44)

The Sandia Laboratories Report by Carson, Huelskamp, & Woodall (1991) does not agree with Bayless' interpretation of the NSF report. They stated:

The potential gap identified was the result of the significant reduction in college-age youth in the post-baby-boom decade of the 1990s. If one assumes that the required number of technical degrees granted never should decrease, then the requirement for future technical degrees must be no less than the peak attained in 1986. Using this assumption, the NSF set the required supply of technical degrees at roughly 210 thousand per year. This number was not based on future demand for these degrees but on the average production from 1984 to 1986. Using the trends displayed previously, the NSF projected that 5% of college graduates, primarily 22-yr-olds, will obtain NS&E [natural science & engineering] technical degrees each year in the future. The difference between the assumed requirements (the 1984-1986 average production) and the 5% of 22-yr-olds is the identified "shortfall." This number accumulates to 675,000 by the year 2010. NSF's definition of a "shortfall" merely stated "that there will be a decline in production rates, not an actual shortage of scientists and engineers." (p. 132)

DeLoatch (1989) stated:

Led by numerous programs initiated in the early 1970s through the mid-1980s, minorities made significant gains,

effectively increasing their numbers two to three-fold. Even with these gains, however, the minority percentage of total science and engineering degrees is still woefully small. (p. 20)

For African-Americans, the fraction is about 2.5 percent in each broad category of science and engineering. A closer look at the science and engineering disciplines reveals interesting imbalances. For example, most African-American and Hispanic science degrees are earned in either social science or psychology. Very few are earned in mathematical sciences. According to DeLoatch (1989) data recently released on U.S. citizens earning doctorates in science and engineering in 1987 indicated that only 1.8 percent were earned by Hispanics. By comparison, the 1987 black total of science and engineering doctoral degrees was 2.1 percent.

Among black engineering doctorate recipients in 1987, none received degrees in electrical engineering, two in computer and information systems, two in mechanical, and five in physics and astronomy. While there were 45 degrees earned in biology, this number represented only 1.5 percent of such degrees awarded that year (DeLoatch, 1989).

Hewitt and Seymour (1992) found during their interviews with 210 engineering, science, and mathematics majors --

some who stayed and some who left at four-year colleges and universities in the state of Colorado -- that perhaps the most important factor was that the switchers and the non-switchers are not two different types of people. Both groups had similar high school preparation, undergraduate academic performance, and conceptual difficulties. Most switchers worked hard, struggled to persevere, and spent about two years in their major before changing. However, non-switchers made more effective use of resources and strategies that enabled them to tolerate or surmount their difficulties.

Problems that have been commonly proposed as reasons for high attrition in the Hewitt and Seymour (1992) study are large classes, poor laboratory facilities, and language or cultural differences with foreign faculty and teaching assistants. Besides the factor of poor teaching, the faculty was criticized for being unapproachable and for not helping the students in periods of academic difficulty. The fast-paced curriculum and work load contributed heavily to the decisions of the students to change their majors.

Although the minority students told Hewitt and Seymour that they left for the same reasons as their white counterparts, their problems tended to be more pronounced. Minority students unable to overcome their difficulties were

more prone than other students to blame themselves, not their major, and to leave school altogether (Hewitt & Seymour, 1992).

The engineering switchers reported that they had problems with the length of time to complete their major. The engineering switchers also became discouraged and lost their confidence because of low grades. They realized that they received inadequate counseling and very little professional advice from the faculty (Hewitt & Seymour, 1992).

By far, the most frequently mentioned reason for leaving was that switchers assumed a non-technical major would offer them a better educational experience or would be of greater intrinsic interest. This finding must, however, be read in conjunction with another: Becoming "turned off by science" contributed to almost half (45.9 percent) of all switching decisions. For engineering majors, it was the second most common reason for changing fields (Hewitt & Seymour, 1992).

The Study

This exploratory study will focus on those factors influencing non-persistence of African-American science and engineering students at the University of the District of Columbia. The independent variables under investigation are

past experiences, job experiences, community involvement, family situation, family attitude, and the dropout's attitude toward further education.

Purpose

In this study basic questions about the factors that affect dropping out by African-American engineering and science students at the University of the District of Columbia from 1987 to 1991 are analyzed and answered. Factors that led to the students dropping out or transferring from science (chemistry and physics) or engineering (civil, electrical, and mechanical) at the University of the District of Columbia were studied to assess the basic reasons that the students came to the reality that they no longer wanted to continue their studies in those disciplines.

Significance of the Study

This study is significant because most research on the retention and failure of African-American science and engineering students tends to stress the same theories that prevent access and entry, i.e., deficient mathematical and science skills, poor preparation, and low standardized test scores.

Several colleges, universities (UDC included), private foundations, and other special interest groups --

Philadelphia Regional Introduction for Minorities to Engineers (PRIME), Southeastern Consortium for Minorities in Engineering (SECME), Texas Alliance for Minorities in Engineering (TAME), Science and Engineering Center (SEC), and Junior Engineering Technical Society (JETS) -- are developing precollege programs and should be utilizing some of the more recently advanced variables -- internal and external environment, attitudes, academic and personal reasons, poor preparation, peer pressure, and role models -- in an attempt to influence African-American students in believing they too can become engineers or scientists.

Presently, those programs primarily address access and entry into scientific and engineering programs. Utilizing the assumption that if African-American students are exposed to the engineering and scientific environment through increased exposure to role models, field trips, mentors, as well as earlier classes in mathematics, chemistry, physics, engineering, and computer science, more African-American students will make these their choice of study. In fact, figures show that interest in studying engineering and science has increased among this group, but retention has not. Brodie (1993) quoted Dr. George Campbell, Jr., NACME president and the chief author of a 1991 study of minority enrollments in engineering schools, who stated:

> Since 1986, minority freshmen enrollment in all engineering schools actually has increased by about 49 percent, and Black enrollment has risen by more than 40 percent, the study shows. White enrollment has dropped by 10 percent.
>
> However, only 35 percent of all engineering minorities graduate, compared to more than two-thirds of their white counterparts. African-Americans graduated at a rate of less than half, yet accounted for 53 percent of the minority pool. (p. 28)

It is also significant to explore other theories that may answer the question of why the number of African-American students studying science and engineering continues to lag behind white students despite past efforts of those exposure driven programs (PRIME, SECME, TAME, SEC, JETS) to increase the minority participation rate to population parity by the year 2000. The need for this increase becomes more important because the college age population is predicted to decline sharply from 1983 to the year 2000, and if the rate of engineering graduations remains the same for minority and majority populations, the number of engineering graduates will decline from 72,000 to 54,000 (DeLoatch, 1989). Population parity by minorities could go a long way in eliminating that projected shortfall. In order to

achieve parity, measured on the basis of the 1980 census data for the college-age population, blacks would have to reach 14.1 percent of the graduates, Hispanics 7.6 percent, and American Indians 3.5 percemt (Minor, 1985).

"Five years ago minorities composed about 14 percent of the freshmen engineering enrollment, and the fact that we're only 7.4 percent of the graduates means that we're losing minorities at twice the rate of non-minorities" (Campbell, 1993, p. 21). No specific reason was proffered by Campbell for this phenomenon. According to NACME for the 1987/88 fall semester minorities in engineering numbered 6,145 for African-Americans, 3,826 for Hispanics, and 354 for American Indians for a total of 10,325 minorities out of a total of 94,814 freshmen.

The engineering Manpower Commission of the American Association of Engineering Societies, Inc. (1992) reported that 63,653 bachelors degrees (Note: numbers of men and women may not add up to total because of "unknown" category) were awarded in Engineering (53,042 men and 9,972 women). Of this total 2,374 were African-American (1,525 men and 750 women), 2,708 were Hispanic (2,076 men and 508 women), 6,479 were Asian (4,845 men and 1,242 women), 163 were Native American (126 men and 31 women), and 4,389 were Foreign Nationals (3,721 men and 490 women).

Campbell (1993) also said:

> While we're tremendously pleased with the influx of minority talent to the engineering work force, it's important to note that what we're seeing reflects an increase in interest among minorities at the pre-college level, but it represents little progress in dismantling barriers. (p. 21)

One of the major barriers for minority students is financial aid. "Other barriers represent some of the same issues that plaque the rest of society: lowered expectations [by both faculty and students], lack of peer support and a dearth of natural mentors" (Campbell, 1993, p. 21).

This significance is carried further because the roles of the colleges and universities are indeed important ones. The problem of correcting underrepresentation is for the most part an educational one. Colleges and universities are experts in the education field so they are prime candidates for making contributions to the solution (Committee on Minorities in Engineering, 1979; Kauffman, 1980).

A special report by Black Issues in Higher Education (1992) titled "Top Degree Producers by Disciplines." reported that of the top fourteen producers of black

bachelors degrees in engineering ten (71%) are historically black institutions. The top fourteen producers mentioned in this report included the following: Howard University, Prairie View Agricultural & Mechanical University, North Carolina Agricultural & Technical State University, Tuskegee University, Southern University, South Carolina State, The University of the District of Columbia, Jackson State University, Alabama Agriculture and Mechanical University, and Grambling State University.

Definitions

Black or African-American: Reference to a member of the black race, i.e., black, Negro. Used interchangeably.

Engineering student: Any black student enrolled in the electrical, civil or mechanical engineering curriculums at the University of the District of Columbia from August 1987 until May 1991.

Science student: Any black student enrolled in the chemistry or physics curriculum at the University of the District of Columbia from August 1987 until May 1991.

Dropout: Any black student who entered in August 1987 but withdrew or transferred to another discipline besides engineering and science before completion of a degree (May 1991) at the University of the District of Columbia. Used interchangeably with non-persister.

Persisters: Any black student who enrolled in August 1987 and completed the curriculum in science or engineering by May 1991 at the University of the District of Columbia. Used interchangeably with completers or graduates.

CHAPTER II

RELATED LITERATURE

Given the dearth of research on minority persistence in science and engineering, it might be well to consider some of the studies of dropouts at the undergraduate level, particularly those that deal with institutional environment, attitudes, academic readiness or preparedness, quality of preparation, and peer pressure or role models.

Herman A. Young and Brenda Hart McAnulty, University of Louisville, and Brian E. Daly, Jefferson Community College (1981), in a review of the literature on persistence in college stated:

> Most colleges know very little about why their students withdraw. Even when records are maintained, the data is subject to the practical need for statistical simplification, and individual experiences are eliminated. When records on non-persistence are kept, the reasons for withdrawal are usually summarized as financial, academic, personal, and unknown. The categories recording the largest number of responses are inevitably "personal" and "unknown," which provide little actual information on why students leave. (p. 177)

Reasons for Nonpersistence

This study is specifically concerned with identifying the causes that influenced a group of science and engineering students to drop out of the University of the District of Columbia. This section is organized into five segments, each dealing with dropouts or persisters. The first segment focuses on studies that deal with institutional environment. The second focuses on attitudes of students, especially African-Americans. The third focuses on studies that emphasize academic or personal reasons. The fourth focuses on poor preparation. The fifth and final segment focuses on peer pressure or role models.

Institutional Environment and Persistence

In a written survey, approximately 200 undergraduates and former undergraduates at the Speed Scientific School, University of Louisville, were asked how their perceptions of their college environment affected their decision to remain or leave the school. Of the 149 respondents, 35 were white non-persisters, 73 were white persisters, 32 were black non-persisters, and nine were black persisters. Analysis of the four subgroups provided a more complete description of engineering students at the college. Means were calculated for each of the four subgroups (persisting whites, non-persisting whites, persisting blacks, non-

persisting blacks) and statistical tests were performed to discover if there were significant differences in the means of persisters and non-persisters and between blacks and whites on the variables (significance = .10). Discriminant analysis was then used to discover if there were factors that could be used to predict whether a student would persist or not.

Four significant relationships (at the .10 level) were identified:

1. Academic skills. Black non-persisters (M=2.54) were least likely to identify a lack of basic academic skills as a problem. Conversely, white non-persisters (M=2.14) were most likely to identify a lack of basic academic skills as a problem area. Black and white persisters had almost identical responses.

2. Happiness in college. Black persisters (M=2.22) and non-persisters (M=2.06) were less happy in college than white persisters (M=2.45), and non-persisters (M=2.43).

3. Acceptance of authority. White (M=2.82) and black (M=2.89) non-persisters felt less resentment for authority than did white (M=2.40) and black (M=2.72) persisters.

4. Lack of discouragement. White (M=2.07) and black (M=2.22) persisters were less likely to feel discouraged

than were white (M=1.77) and black (M=2.00) non-persisters (Young, McAnulty, & Daly, 1981).

The experiences that students have while in the college setting are also important factors that affect persistence. These experiences may be closely tied to the college environment and its effect on the student. A number of studies found that feelings of not belonging on a campus contributed to minority attrition (Bean & Hull, 1984; Burrell, 1979; Edmunds, 1984; Suen, 1983). A positive racial environment on a campus is associated with good academic performance and persistence (Allen, 1981; Bennett & Okinada, 1984).

A longitudinal study of college dropouts aimed at identifying factors in the college environment that significantly affect the students' persistence in college showed that virtually every significant effect could be explained in terms of the involvement concept. Every positive factor was one that would be likely to increase student involvement in the undergraduate experience, while every negative factor was one that would be likely to reduce involvement. The involvement of students in their undergraduate program was an important factor in their success. A highly involved student is one who devotes considerable energy to studying, spends a lot of time on

campus, participates actively in student organizations, and interacts frequently with faculty members and other students. Conversely, an uninvolved student may neglect studies, spend little time on campus, abstain from extracurricular activities, and have little contact with faculty members or other students (Astin, 1975).

Astin's 1975 study of dropouts also produced some interesting findings regarding the fit between student and college. Students are more likely to persist at religious colleges if their own religious background is similar, blacks are more likely to persist at black colleges than at white colleges, and students from small towns are more likely to persist in small colleges.

The most important and pervasive environmental factor was that of living in a campus residence, and this positive effect occurred in all types of institutions and among all types of students regardless of sex, race, ability, or family background. Similar results had been obtained in earlier studies (Astin, 1973; Chickering, 1974) and have been replicated on several occasions (Astin, 1977).

These longitudinal studies also showed that students who join social fraternities or societies or participate in extra-curricular activities of almost any type are less likely to drop out. Participation in sports, particularly

intercollegiate sports, has an especially pronounced positive effect on persistence. Other activities that enhance retention include enrollment in honors programs, involvement in ROTC, and participation in professors' undergraduate research projects.

Astin's (1982) study showed that students living on campus, rather than at home, had a positive effect on their success in undergraduate studies. Other positive effects--an outside job, receipt of financial aid, and major in education--also had something to do with minority students' persistence. The selection of a prestigious or selective college or university was also a factor in the minority students' persistence.

The majority of the studies reviewed pointed out the need to be involved in more than subject matter in order to persist. Involvement encouraged by an acceptable, friendly environment more in keeping with the students' home environment seems to be the dominating factor in the persistence of students.

Attitudes and Persistence

Generally, the attitudes of African-American students must be deduced from what they say are their attitudes, what their concrete demands of college indicate, and what administrators and counselors feel are their attitudes,

apart from black expression (actions, mannerisms, facial expressions, and body language).

There are some relatively hard data on what may be the basis of attitude alienation. Epps (1970) noted that a person's attitude toward education is partially a reflection of his parents' educational values and their concepts that rewards are given to persons for traits that are unrelated to the basic skills of learning. Hall (1969) found that productive involvement among blacks is related to a sense of control over the environment. Conversely, the sense of powerlessness and inability to control one's destiny, characteristic of persons from lower socioeconomic groups and culturally deprived homes, reduces motivation and leads to unfavorable self-concepts, thereby inhibiting learning potential.

It may be that such negative attitudes are strengthened by contrast (feelings of social isolation, feelings of powerlessness over one's own destiny) when experienced in the college atmosphere where African-Americans had hope and promise through education. The Burbach and Thompson study concluded that African-Americans might well blame the University for these feelings that may not have been manifest prior to the student's matriculation (Erwin, 1976).

A notable difference in attitude occurs between blacks and whites on the subject of academic success. Erwin (1976) added, whereas white students "look upward" academically to know how many B's or A's they can earn, African-American students, perceiving the lack of preparation, in many instances, want to keep from failing. Some adopt the defensive mechanism of unrealistically high aspiration. If failure should come, it is then more excusable.

Erwin (1976) further added that professors are unprepared or ill-equipped to work with African-American students. The professors of African-Americans accepted those black students who met white standards of achievement, but no attempt was made to help those African-American students who were ill-prepared to cope and survive in the citadels of higher education.

There is a widely held belief in American society that mathematics and science are extremely difficult. Though this belief system may operate at an unconscious level, it has been incorporated into the thought processes of both African-Americans and white Americans. The cultural expectation for one's group to perform poorly in mathematics and science is an example of a social-psychological

phenomenon referred to as learned helplessness (Powell, 1990).

For more than two decades psychologists (Abramson, Seligman, & Teasdale, 1978) have observed that many persons, after having failed repeatedly at a designated task, abandon the activity and conclude that they can do nothing in the future to effect a more positive outcome. When carried to extremes, this resignation is translated into a state of reduced motivation and psychological depression in which the individual believes that whatever he or she does will end in failure (Seligman, 1975).

Seligman (1975) theorized that people can become victims of learned helplessness when they readily perceive that their efforts to control or succeed do not yield the anticipated outcome. Upon encountering continuous failure individuals may stop trying, not only in the settings where their failure was initially elicited, but also in other settings where there might be a better chance for success.

Bailey (1990) felt one response to the learned helplessness syndrome is: People learn different things in different ways and at different paces; therefore, they must be taught accordingly. If students are not taught in the manner in which they learn best, they cannot be expected to learn as effectively or efficiently. Bailey feels damage

may already be done to generations of African-American students by not understanding that these students learn more effectively in ways which (a) recognize their multiple intelligences, (b) respect their heritage, while valuing their diversity, and (c) appreciating and utilizing their different learning styles.

This helplessness syndrome, accompanied by students' fear of failure, may be an area for further research in trying to determine why the dropout rate is so high for African-American students in general and especially for those studying science and engineering.

Most of the studies on attitudes are best summarized by Ogbu (1992) when he hypothesized that past history of discrimination led to certain survival strategies as to what was needed to get ahead (persist), and this has made a major impact on academic attitudes and effort. The way education is perceived and responded to depends upon the economic niche of a particular group; their historical experience or anticipation in using education for personal, economic gain; and their evolved values and cultural frames of reference.

Academic and Personal Variables and Persistence

Stodt and Klepper (1987) summarized research on student reasons for dropping out from primarily residential colleges as more often personal than academic. When academic, the two

most frequently stated reasons were poor advising and boredom with courses.

Noel, Levitz, and Saluri (1985) listed six major factors in retention as academic boredom, academic unpreparedness, uncertainty about major and career, transition difficulty from high school to college, dissonance (between student and institution), and irrelevance (of curriculum). They suggested that these factors are the same, but intensified, for minority and non-traditional students.

Contrary evidence appears in Fox (1986) and Metzner and Bean (1987). Fox (1984, 1986) showed that for disadvantaged, urban, commuting students, academic integration into the institution is more important than social integration. Metzner and Bean suggested that non-traditional students dropped out of college for academic reasons or because they were not committed to attending the institution, but their reasons for leaving were unrelated to social factors at school.

Research done by Saufley, Cowan, and Blake (1983) showed that before coming to the university, many minority students were not only acutely aware of their academic deficiencies but had little hope of overcoming them. They had been systematically invalidated as persons with academic

potential, they had very negative academic self-images, and they were highly fearful of the academic setting. Their expectations of the university experience were shaped in part by a view of bureaucracy as a means of social control. Perhaps most important, many students had deeply internalized the feeling that they were almost certainly destined to fail there. When minority students, besieged by such negative influences, arrive at the university, their doubts are immediately reinforced. Isolation, alienation, non-acceptance, inadequate preparation, apparent racism, bureaucratic tangles, and unfamiliarity with the system combine to restrict these students further and often produce devastating patterns of behavior guaranteed to fulfill a personal prophecy of failure.

Kunjufu (1984) gave support to the findings of Saufley, Cowan, and Blake when he suggested that some teachers also feel African-American children cannot learn, regardless of their effort; consequently, the teacher's self-fulfilling prophecy becomes a reality.

Malcom (1990) took Kunjufu's thought further when she stated:

> Imagine, if you will, taking your best and brightest students and sending them off to colleges and universities to professors who do not believe they are

capable of achieving, who expect less of them, or who believe them to be "special admits." (p. 252)

McBay (1986) gave added support to the expectation theory in a study of the racial climate at the Massachusetts Institute of Technology (MIT). The study was commissioned by MIT itself. Several incidents were cited of encounters between black students and white faculty and between black and white students. McBay concluded that lower expectations and a belief that black students are intellectually inferior and devoid of an academic tradition in science and engineering are primary reasons such situations continue to exist in the science and engineering fields. She assumed that black students are failures in science and engineering because of the lack of faculty and university efforts in providing a warm environment conducive to the African-American, as well as the absence of pre-college studies. These factors are fueled by the faculty members' beliefs that African-American students will not succeed in the foundation courses in spite of their extra study sessions and conferences. African-American students believe they will not succeed because the faculty members believe that they are not smart enough to achieve or succeed in college.

Studies by Kunjufu (1984) and Malcom (1990) on student academic and personal variables as they relate to persistence clearly point out the importance of student and faculty expectations. If a warm friendly environment is provided, the chances of the students persisting is increased.

Poor Preparation and Persistence

In that many of the engineering and science students at UDC are graduates of the D.C. Public Schools, a 1989 study of students who dropped out of their system may provide some related data (Tuck, 1988). Some of these students return to get their high school diploma or General Educational Development (GED) certificate and enroll at the university. The study cited countless reasons why the students dropped out, but by far the most frequently cited reason was poor academic performance.

Work and economic factors were also reported to contribute to the dropout problem. Many students leave high school to go to work in support of their family of origin or their own family; this was particularly true for males. In addition, many urban students often know only of low-status, dead-end employment and are not motivated to believe full-time employment will be forthcoming or fulfilling; they do not consider a high school diploma as worth the effort

(Hahn, 1987). Yet, while many students drop out of school with the intent of improving their economic condition, the majority are finding opportunities to be greatly limited. These limited options persuade some to return to complete their high school work and then go on to higher education.

Triesman (1974) looked at the study habits of black students taking calculus and those of Asian students, who typically excelled. He found that black students became negative toward the university because of the indifference shown toward them on campus. It was as if they had two different worlds in which they must live. They would come to the campus and leave as fast as they could. African-American students, reared to be self-reliant, were now hurt by the very qualities and perspective that enabled them to be successful in their public schools earlier.

Most of the studies relate poor preparation with the negative feelings of students that have been shaped by their acceptance of negative influences, i.e., substandard housing, inferior schools, menial jobs, and low income to name a few. This acceptance usually guarantees that the self-fulfilling prophecy of failure becomes a reality.

Peer Pressure, Role Models, and Persistence

The key to role modeling is in the hands of faculty. Involvement in science and engineering, an appreciation of

the intrinsic rewards of knowledge and achievement, and a sense of dedication and perseverance come primarily from student involvement with the faculty. A faculty person's affective style is as crucial as his cognitive expertise. Because the rewards of the higher education system are primarily based on cognitive factors (e.g., intellectual expertise, research, publications, and continuing education), many scholars have ignored their affective development regarding communication skills, ability to show concern in a way that reinforces the student, and concern for helping students develop professional attitudes and conduct. When students see a caring "human being" who is financially, professionally, and personally successful, they are more apt to be motivated to follow in the same direction (Young, 1981).

Use of role models should not be a single encounter. The student needs to interact on a long term basis with the model to observe the model as an engineer or scientist and thus perceive the model as a real person, possessing all the attributes students see in themselves (Fuller & James, 1980; National Action Council for Minorities in Engineering, 1987; Thomas, 1984).

Not nearly so consistent are the results of studies that investigate the relationship of the race of the role

model to the race of the target group. Thomas (1984) studied both white and black students who were majoring in science. He found that both groups were more likely to have had contact with and encouragement from scientists than were students majoring in other fields. In addition, Thomas found that the race of the mentor was very important, in that 98% of the white students and 90% of the black students reported contact with a scientist of the same race.

Garrison & Brown (1985) agreed with the results of Thomas that it was indeed important for minority students to see members of their own ethnic group working as scientists. They further found that these same-race mentors had a very important influence on the students' decisions to pursue science careers (Hayden, 1988).

On the other hand, the National Action Council for Minorities in Engineering (1987) suggested that although it is desirable, role models need not be members of the targeted minority group. They do, however, need to be genuinely concerned for the well being of the individual students and the target group as a whole (Hayden, 1988).

A study by Holland & Eisenhart (1981) investigated the role of women's college peer groups in aiding women to continue along or in encouraging them to drop out of certain career paths. One of the findings was that the majority of

women in their samples had discarded math or science career identities before coming to college. They were not encouraged to consider such identities during college. In the cases where new careers or identities were considered, the trend was away from math or science careers. Of those women who declared a math or science career in college, 45% had discarded this identity by the middle of their sophomore year. This failure to consider, or the tendency to discard, math or science careers appears to be a function of several different factors, including peer groups.

In summary, college-bound and college-aged women need help to overcome the inertia of past career identities, which tend to channel their interests toward non-math or science careers. Peer groups tend to support this inertia and, in some cases, to drain energy and interest away from career alternatives that have relatively high demands because they constitute a sphere of activity and attraction that is often very disparate from one's studies. Because the presence of peer relationships and activities is pervasive in college life, special efforts on the part of colleges and universities are needed to overcome these biases so that more women have the knowledge and support to pursue nontraditional careers (Holland & Eisenhart, 1981).

Streett (1992) agreed with Holland and Eisenhart when he stated:

> To properly address the challenge of bringing women and minorities fully into our system of education, we must change the culture of engineering faculties. For years we have attempted to improve the success rates of these students by setting up special support programs manned by professional staff, rather than insisting that faculty tackle the problem head on. Students are not the problem -- they are among the best and brightest of their generation. The problem is within the system, within its traditions of accepting large numbers of well-qualified students, of assuming that they have similar cultural, social, and economic backgrounds . . . of placing them under intense academic and psychological pressure, and of mercilessly "weeding out" those who do not thrive in this environment. This "weeding out" has at times been so aggressive that we have ripped out many of the late blooming flowers in the process. (p. 1)

Streett's view is supported by Anderson (1990) who wrote:

> A person's self-concept is influenced by what others, especially significant others, think of that person.

> We know that parents, teachers, counselors, and principals are significant others in the lives of students. We also know that while self-concept is resistant to change, what a person thinks of others likewise is not easily changed. Comments and notions derived from statistics regarding the abilities and the expectations of students have been shown to affect student performance. Behaviors that result from students operating under perceptions of low achievement and even lower expectations gravely alter the progress of those students. Thus, the significant others in the schools must become more sensitive to the effects of their behavior on students' performance, especially in mathematics. (p. 266)

Blacks, to be competitive in the arenas of scientific accomplishment and technological innovation, will have to be exposed to the sciences at an early age. They will have to be inspired to enter those fields, motivated, and given the confidence that allows all the rest to happen (Johnson, 1984).

The disproportionate low numbers of African-Americans in engineering and technology and the concomitant low numbers of African-American people employed as engineers, technicians, and architects probably indicate that many

black high school students do not have a parent, a relative, or friend in engineering, technology, or architecture to emulate and to provide them with incentives and information by which to ignite their interest toward a career in one of these challenging professions. Also, they are likely to by-pass the more advanced courses in mathematics and science (algebra/geometry through trigonometry, general chemistry, and general physics) for which they can foresee no need but which are necessary foundation courses for anyone preparing for a course of study in technical fields (Carey, 1977).

A 1988 report from the Office of Technology Assessment (Educating Scientists and Engineers: From Grade School to Grad School) supported Carey in his thinking and agreed there are studies that document that black students have less of the prerequisites generally correlated with choosing science and engineering careers and that they are less likely to take the most demanding science and mathematics classes.

Bailey (1990) took a different view: "Black students can learn science, mathematics, and any other subject as well as anyone else can if we learn how to teach them!" (p. 241). Malcom (1990) agreed when she attested, "Black people have a rich history of scientific and technical achievement"

(p. 246). Too often their achievements are obscure and unknown.

Oakes (1990) supported Malcom's thinking when he noted that "disproportionate numbers of poor and minority students are taught during their entire school careers by the least-qualified teachers and classrooms staffed by teachers holding only emergency credentials" (p. 18). Black students also are less likely to have effective and enthusiastic science teachers. However, according to the report Educating Scientists and Engineers: From Grade School to Grad School (Office of Technology Assessment, 1988), when course-taking, achievement test scores, and socioeconomic status are held constant, blacks are more likely than whites to be interested in majoring in science and engineering.

The majority of the research points out the need to change our system of education so that it becomes adequate for all students but especially African-Americans who learn more effectively in an enlightened, supportive, and encouraging system (Fuller & James, 1980; Young, 1981; Holland & Eisenhart, 1981; Thomas, 1984; Johnson, 1984; National Action Council for Minorities in Engineering, 1987; Bailey, 1990; Streett, 1992). The educational system must reach out to students, welcome them into engineering and science, and provide them with the curricula, the advice,

and the instruction that will enable them to realize their full potential.

There may be disagreement that role models and the target group should be of the same race. Thomas (1984) and Garrison & Brown (1985) agreed they should be, while the National Action Council for Minorities in Engineering only thought it to be desirable; the benefit received from these role models to the target group members is clearly positive.

Implications

Based on the review of the literature, the researcher accepts the following conclusions and implications:

1. Teachers of African-American students must be better prepared and taught not to base their assessments of students, and others' abilities on where they live or their family backgrounds. The National Action Council for Minorities (1987) contends that families don't need to have middle class social status or educational status to communicate values and exhibit behaviors that promote development of self-confidence and self-discipline in their children. Science as it is practiced today is viewed as deriving its roots largely from Western (European) cultural development. Although other cultures have made contributions, those contributions generally are not viewed as the focal point of today's science. The dominance of

science by whites makes its image (white oriented discipline) difficult to change by underrepresented minorities. Those minorities are being asked to become something that they have not seen and that they may not believe possible or important to be (Bechtel, 1989). Someone must see within those students a potential to contribute that will inspire a commitment to mentor, guide, and transform the student into a scientist or engineer. Studies by Thomas (1984) and Fuller and James (1980) show that use of role models should not be a single or infrequent encounter.

2. The lack of precollegiate preparation in mathematics and science is often thought of as the single most important cause of the underrepresentation of minorities in science and engineering careers. Studies by Sherman and Jones (1976) found that parent encouragement affected the children's choice of a college major. The National Action Council for Minorities in Engineering (1987) went on farther to identify the family and home environment as the most significant factor in children's academic achievement. In fact Susan Berryman (1983) reports that in the area of mathematics and science, the public schools fail to serve any student particularly well. The National Science Foundation (1986) study showed that black students and Asian

students take more years of mathematics in high school than do whites and Native Americans. Half of all blacks, two thirds of all Asians, two fifths of both whites and Native Americans had enrolled in four or more years of mathematics in high school. More important was the fact that the types of mathematics courses taken also differed significantly by race. Blacks and Native Americans were not as likely as were whites and Asians to have taken algebra I, algebra II, geometry, or trigonometry. Table 1 shows the percentage of whites, blacks, Asians, and Native Americans who have taken algebra I through calculus (National Science Foundation, 1986).

3. Most problems caused by primary cultural differences are due to differences in cultural content and practice. One solution is for teachers and interventionists to learn about the students' cultural backgrounds and use this knowledge to organize their classrooms and programs, to help students get along with one another, to communicate with parents, and the like (Ogbu, 1992).

Ogbu stated:

> First, teachers and interventionists must recognize that involuntary minority children come to school with cultural and language frames of reference that are not only different from but probably oppositional to those

Table 1

Percentage of Students Taking Mathematics by Race

Subject	Whites %	Blacks %	Asians %	Native Americans %
Algebra I	71	64	66	57
Geometry	60	46	68	34
Algebra II	38	29	39	22
Trigonometry	26	16	43	14
Calculus	8	4	19	4

Note. Data in Table 1 are from Women and Minorities in Science and Engineering. National Science Foundation. Washington, DC: 1986.

> of the mainstream and school. Second, teachers and interventionists should study the histories and cultural adaptations of involuntary minorities in order to understand the bases and nature of the groups' cultural and language frames of reference as well as the children's sense of social identity. . . . Third, special counseling and related programs should be used (a) to help involuntary minority students learn to separate attitudes and behaviors enhancing school success from those that lead to linear acculturation or "acting white" and (b) to help the students to avoid interpreting the former as a threat to their social identity and sense of security. Fourth, programs are needed to increase students' adoption of the strategy of "accommodation without assimilation. . . ." The essence of this strategy is that students should recognize and accept the fact that they can participate in two cultural or language frames of reference for different purposes without losing their own cultural and language identity or undermining their loyalty to the minority community. (p. 12)

4. Another important implication is how we view racism. Race problems are difficult to tackle because most administrators, staff, and faculty fail to realize that

their policies and actions are discriminatory. Officials must move beyond talking about racial problems and begin taking action to improve the situation.

Conclusion

There is the need for systemic reform of schools so that they can better serve black students. There is also the concurrent need to build community-based and at-home programs to support science, mathematics, and technology education (Malcom, 1990).. Only by increasing the amount of time black children are engaged in meaningful educational activity in mathematics and science; by reaffirming the historical, contemporary, and future role of blacks in science and engineering; and by valuing and recognizing participation in these fields within our communities and families can we ever expect to change the trickle of talent which currently flows from the pipeline into a flood (Malcom, 1990). But, questions George L. Turin (1992),

> when special attention to some becomes the exclusion of all others, are we not balkanizing the educational community? If we reach a point where historically black colleges embrace a doctrine of "separate but equal" or the majority of institutions cease striving for an environment that nurtures everybody, then we have moved education and our society closer to what we

now see in the Balkans. We would have people who nominally live together but are completely alienated from each other. Even as we seek to provide special attention for some groups in some situations, let us not surrender the goal of all living and working -- together. (p. 2)

DeLoatch (1992) took another view and stated:

the HBCUs provide environments that are nurturing and caring for their students, many of whom would not have had access to higher education outside this unique component of academia. Ideally, we should have academic institutions where students, faculty, and administration should interact in a healthy way without regard to race, creed, or gender -- where the choice of institutions is independent of one's social and economic background. But, in the United States today this ideal is not reality. Many young people cannot freely choose where they go to study. The HBCUs provide a vital service to this nation, and to African-American citizens in particular, at a critical time in our human resource development. (p. 2)

CHAPTER III

METHODOLOGY

This study investigated the factors that influenced science and engineering students at the University of the District of Columbia to drop out or transfer to another discipline. The independent variables under investigation were past experiences, job experiences, community involvement, family situation, family attitude, and the dropout's attitude toward further education. In this chapter, the methods and procedures are described, the research design is presented, the population is described, and data collection and analysis procedures are presented.

This was an in-depth study of eight dropouts utilizing an interview survey. In the interview surveys, rather than asking respondents to read questionnaires and enter their own answers, the interviewer asked the questions verbally and recorded the respondents' answers. The interviews were conducted over the telephone.

> Having a questionnaire administered by interviewers rather than by the respondents themselves offers a number of advantages. To begin, interview surveys typically attain higher response rates than do mail surveys. . . . It would seem that respondents are more

> reluctant to turn down an interviewer at their doorstep, or even on the phone, than they are to throw away a mail questionnaire. (Babbie, 1990, p. 187)

Additionally, within the context of the questionnaire, the presence of an interviewer generally decreases the number of "don't knows" and "no answers," because the interviewer can probe for answers. They can also provide a guard against confusion over questionnaire items, and finally, the interviewer can observe as well as ask questions (Babbie, 1990).

Case Study Site

The seeds of higher education for the District of Columbia were planted in 1851 when Myrtilla Miner founded a "school for colored girls." In 1879, Miner Normal School became part of the public school system. Similarly, Washington Normal School, established in 1873 as a school for white girls, was renamed Wilson Normal School in 1913. In 1929, by act of Congress, both schools became four-year teachers colleges and the only institutions of public higher education in the city. Years later, after the long awaited Supreme Court desegregation decision, the two schools united in 1955 to form the District of Columbia Teachers College.

However, for many residents who did not wish to become teachers or who were black and poor, the opportunity for

advanced technical training or study for a liberal arts degree was an unattainable goal because of the unavailability of such schools (University of the District of Columbia, 1990-91). Two predecessor schools, Washington Technical Institute and Federal City College, were established to and did serve these needs until their incorporation with DC Teachers College to the University of the District of Columbia.

On August 1, 1977, the Board of Trustees publicly announced the consolidation of the District of Columbia Teachers College, the Federal City College, and the Washington Technical Institute into the University of the District of Columbia under a single management system with its mission statement as follows:

Mission Statement

> Early in our nation's history, access to higher education was limited primarily to those pursuing careers in the ministry, medicine, and law. Later, with the advent of the land grant college system, higher education expanded its mission to meet the demands of an industrial and agrarian society. This involved not only the training of young men and women for a variety of careers, but also the development of scholars and researchers in the humanities and the natural and

social sciences. During the past hundred years, our colleges and universities have played a major role in providing the nation with scientific technology, an educated leadership, and an ever increasing level of literacy among the mass of citizens.

Now, as our nation enters its third century, higher education must reaffirm its commitment to improving the quality of life by providing instruction, advanced technology, career preparation, and education in the liberal arts.

Among the land-grant institutions of America, the University of the District of Columbia has a unique opportunity to direct the land-grant traditions of teaching, research, and extension to urban problems. Aware of the urgent need of strengthening intercultural harmony, the University is committed to fostering an appreciation of the variety of cultural styles that characterize Washington, D.C. and the American people. The University of the District of Columbia strives for excellence in meeting the higher education needs and aspirations of the people of the nation's capital at the lowest possible cost to the student.

Towards these ends, the University has established the following goals:

Goal A. -- Student Access: The University of the District of Columbia will ensure the legislative entitlement of the residents of the District of Columbia to public post-secondary education.

Goal B. -- Student Choice: The University of the District of Columbia will offer a variety of programs within its available resources to provide choices for post-secondary education to the residents of the District of Columbia.

Goal C. -- Student Advisement: The University of the District of Columbia will seek to provide maximum educational opportunities that will assure the quality of student achievement.

Goal D. -- Land-Grant Functions: The University of the District of Columbia will be innovative in translating the traditional land-grant functions of teaching, research and public service in solving urban problems and in improving the quality of urban living in the District of Columbia.

Goal E. -- Institutional Quality: The University of the District of Columbia will ensure the quality of institutional excellence as determined by tangible achievements.

Goal F. -- Institutional Growth and Development: The University of the District of Columbia will continue to grow and develop as a comprehensive university.

Goal G. -- Advancement of Knowledge: The University of the district of Columbia will contribute to the advancement of knowledge at local, national and international levels through traditional and innovative approaches to teaching, research and public service. (University of the District of Columbia, 1990-91).

Location

The University of the District of Columbia currently occupies twenty-five temporary or permanent buildings in three areas of northwest Washington: at Georgia Avenue and Harvard Street, Mount Vernon Square (Downtown area), and Connecticut Avenue and Van Ness Street. Another site is located at Washington National Airport. All university buildings are easily reached by public transportation.

The university's location in the nation's capital offers student access to cultural, intellectual, and political activities unequal anywhere in the United States. The three branches of the federal government the Library of Congress, the Smithsonian Institution, the numerous galleries, museums, halls for the performing arts, and other facilities of the capital provide a rich setting for educational endeavors. The Washington metropolitan area features numerous parks, woodlands, beaches, and mountains, all within easy commuting distance of the District. Bicycle paths, hiking, and bridle paths, and historical sites are found throughout the area.

> Washington, DC offers students a rich sociocultural setting reflecting the ethnic makeup of the city. Museums, radio stations, entertainment events, and community activities oriented to the multi-cultural community abound. Opportunities for students to participate in the life of the community are enhanced by the university's commitment to involvement in the life and needs of the city. (University of the District of Columbia, 1990-91).

The University of the District of Columbia had a total of 11,422 students (1991) of which 9,810 (86%) were residents of the city and 1,612 (14%) were non-residents. This population consisted of 4,814 males (42%) and 6,608 females (58%). Included in the student body were 2,750 students who were classified as foreign by visa. Washington, DC, is claimed as the home city of 5,839 (51%) students. The median age of the students was 25 (University of the District of Columbia, 1991-92).

The University of the District of Columbia's student profile in 1986 was: Each entering class of new students was comprised of new, first-time freshmen and transfer students in a ratio of approximately 2:1. The majority of transfer students were from out of the city (45%) or out of the country (26%). Most came to the University of the

District of Columbia from four-year colleges. The majority of new, first-time freshmen were from the District of Columbia (61%) with over half of these (32%) of all first-time freshmen entering directly following graduation from DC high schools. Ten feeder high schools account for nearly 80% of all UDC's new freshmen from the District of Columbia. In fall 1986, UDC's share of the DC Public School college-bound graduates was 24% (percentage reflects only the high school graduates entering UDC directly after graduation) (University of the District of Columbia, 1986).

Many of the new, first-term freshmen that the University of the District of Columbia attracts are underprepared for college study. "Their reported reasons for selecting UDC were its location and low-tuition" (University of the District of Columbia, 1986). Similarly, a higher percentage of the University of the District of Columbia's new freshmen required tutorial or remedial work (52% math, 38% English, 16% reading, 12% other). Only 36% of UDC's new freshmen took an advanced or college preparatory curriculum in high school. Three-fourths were employed 20 or more hours per week; 52% had at least one dependent. Most reported family (33%) or personal (56%) income below $10,000 annually, and over half were first-

generation college students (University of the District of Columbia, Fall 1985 & Spring 1986).

College of Physical Science, Engineering, and Technology

Engineering (electrical, civil, and mechanical) as well as the sciences (chemistry and physics) are located in the College of Physical Science, Engineering, and Technology at UDC. The 1990-91 UDC Undergraduate Catalog stated:

> The College has long recognized the need for a range of educational options to meet different career objectives. It places a high value on its responsibility to assist students in developing their academic capabilities and potentials, in gaining a mastery of the skills and technologies man has so far developed, and in challenging new horizons. (p. 103)

The College of Physical Science, Engineering, and Technology had a total of 692 students (1991) enrolled in the following disciplines: chemistry 67 (10%), civil engineering 145 (21%), electrical engineering 360 (52%), mechanical engineering 108 (16%), and physics 12 (2%). There were 497 (73%) residents of the city and 195 (27%) non-residents included in this total. This population also consisted of 578 males (85%), 111 females (15%), and 3 unspecified (.4%) of which 402 (59%) were full-time and 290 (41%) were part-time. Of the full-time enrollers, there

were 325 (81%) males and 77 (19%) females. The part-time enrollment consisted of 238 (82%) males and 52 (18%) females. The breakdown by ethnicity is in Table 2.

The engineering programs are accredited by the Accreditation Board for Engineering and Technology, Inc., and the chemistry program by the American Chemical Association. The physics program has no accreditation.

Population

Out of a class of 104 freshmen students identified by UDC Report SRSW 3123 (June 1992) who indicated the intent to major in one of the five selected disciplines in the college, twenty-six (25%) had dropped out or changed their major by their scheduled term of graduation, spring semester 1991. The breakdown was 12 of 54 (22%) for electrical engineering, 4 of 19 (21%) for civil engineering, 1 of 15 (7%) for mechanical engineering, 1 of 5 (20%) for physics, and 8 of 11 (73%) for chemistry.

Letters were sent to all 26 students requesting permission to call or talk to them in private. All eight consenting respondents were interviewed.

Data Collection Procedures

The initial interview questions were taken from a modified survey instrument (the wording changed from that of

Table 2

Ethnic Breakdown of Selected Disciplines at UDC, Fall 1991

MAJOR	ETHNICITY	TOTAL	PERCENTAGE
CHEMISTRY	Unspecified	9	12.67
	Asian	4	5.63
	Black	54	76.05
	White	3	4.22
	Other	1	1.40
CIVIL ENGINEERING	Unspecified	11	11.45
	Asian	5	5.20
	Black	69	71.87
	Hispanic	7	7.29
	White	3	3.12
	Other	1	1.04
ELECTRICAL ENGINEERING	Unspecified	34	12.97
	Asian	33	12.59
	Black	177	67.55
	Hispanic	7	2.67
	White	10	3.81
	Amer. Ind/Alas	1	0.38
MECHANICAL ENGINEERING	Unspecified	9	32.14
	Asian	4	14.28
	Hispanic	6	21.42
	White	5	17.85
	Other	4	14.28
PHYSICS	Unspecified	3	25.00
	Black	7	58.33
	Hispanic	1	8.33
	White	1	8.33
Total		527	

Note. From Statistical Table of UDC Students, Fall 1991; University of the District of Columbia Computer Report No. SRSY5011.

a generic nature to one dealing with a specific institution and discipline, science and engineering) used by the DC Public Schools in a 1988 study designed (1) to explore patterns of behaviors and attitudes, as well as the academic, demographic, social, and economic circumstances of dropouts, and (2) to explore other factors which influence attitudes, aspirations, and needs after leaving school which could ultimately affect their re-enrollment (Tuck, 1988). An additional section was added asking specifically why the student decided to transfer or drop out of engineering or science at UDC.

Interviews were conducted over the telephone and by mail. Follow up caused some interviewees to be exposed to both methods.

A letter of solicitation (Appendix C) to participate in this study was sent to the 26 students who had been identified as fitting the criteria desired, i.e., enrolled in engineering or science at UDC in 1987 but dropped out or transferred before the class graduated in 1991. The participants were asked to indicate their desire to participate by returning a form (Appendix D) indicating by which method they preferred to be interviewed, telephone or face-to-face. They were also asked to furnish telephone number(s) or place(s) they could be interviewed. The

participants were assured of confidentiality to enhance honesty in their interviews as well as an explanation of the purpose of the research. A follow-up letter (Appendix E) was sent as a reminder to all non-respondents ten (10) days after the initial letter. As a final appeal to enlarge the sample, a third letter (Appendix F) was sent to the remaining non-respondents.

The Survey Form

The questions on the prepared survey form (Appendix G) were grouped as follows:

Category I: Past Experiences

The first category of questions in the interviews (items 1-15) asked the dropouts to reflect on their past experiences. Information was obtained regarding their attitudes, behaviors, and personal situations before they dropped out. In addition to being asked to give their main reason for leaving, the dropouts were probed for responses to a variety of circumstances which may have influenced their decision to leave.

Category II: Job and Community Experiences

The second category of interview questions (items 16-20) focused on activities away from school, such as past and present job experiences and community involvements. These items solicited information regarding possible interests and

future aspirations. An attempt was made to determine how and by whom these dropouts can be or were influenced.

Category III: Family

The third category of items (items 21-26) focused on the dropouts' family situations, family attitudes, and other influences while in school and since leaving. It was expected that those items would provide information on the dropouts' family and economic situations as well as on the dropouts' support systems.

Category IV: Attitude Toward Further Education

The fourth category of items (items 27-30) solicited information regarding the dropouts' attitude toward further education. Other items pertained to personal changes and program requirements needed for the dropout to return to school.

Category V: Reasons for Actions

The fifth and final category (Part II) focused on factors that may have influenced the student to change career aspirations.

Validation of Instrument

The researcher field tested the instrument with four colleagues (one teacher of engineering, one administrator of engineering, and two students who were on-time seniors) at the University of the District of Columbia. With their

assistance, the questionnaire was modified to include a section dealing specifically with what influenced the student in making the decision to be a persister or a non-persister. The questionnaire was evaluated as being one that could be used to secure the information needed to do the study. Kerlinger (1986) stated, "Content validation, then, is basically judgmental. The items of a test must be studied, each item being weighed for its presumed representation of the universe" (p. 418).

Reliability

In the abstract, reliability is a matter of whether a particular technique, applied repeatedly to the same object, would yield the same results each time (Babbie, 1990). In expressing this problem within case study research, Guba and Lincoln (1981) suggested that the reader be able to follow a "decision trail" used by the investigators throughout the study. This trail should enable the reader to form similar conclusions from the information presented in the analysis of data.

The researcher of this study was careful to ask the respondents each question without paraphrasing and to record exactly the answer given. Each question was asked in the order of the prepared survey form. When a clarification was needed, the interviewer recorded the question and his answer

for use if the same clarification was needed by another respondee.

Babbie (1990) stated, "The methods for maximizing reliability are pretty straightforward. Ask people only questions they are likely to know the answers to, ask about things relevant to them, and be clear in what you're asking" (p. 133).

Data Analysis

The purpose of this research was to provide a description of a group of non-persisters in engineering and science at the University of the District of Columbia from August 1987 until May 1991.

To accomplish this, summary statistics were used for demographic variables. Questionnaire responses were compiled and can be found in Appendices A1-A9.

Screen 10 (online transcript) was viewed for each student to record number of classes failed or withdrawn from, in addition to the calculation of the cumulative grade point average.

Screen 43 (personal data form) was viewed for the purpose of determining living status of students (at home or not, living with parents), age, and gender.

The information combined from the three sources served as the data for the summary.

CHAPTER IV

RESULTS

This study was designed with a two-fold mission: (1) to explore patterns of behavior and attitudes, as well as the academic, demographic, social, and economic circumstances of UDC science and engineering dropouts while they were still enrolled; and (2) to explore other factors which influence dropouts' attitudes, aspirations, and needs after leaving which could ultimately affect their reenrollment.

Two sources of information were used in this study: Personal, in-depth interviews were conducted with dropouts (either those still out of school, those currently enrolled, or those who have graduated), and cumulative school records were reviewed for answers to all questionnaire categories.

Population

Twenty-six students were identified or categorized as dropouts or transfers from engineering (mechanical, electrical, or civil) or science (chemistry or physics) by UDC Computer Report No. SRSW3123, a report that was generated to identify characteristics of students. Appendix B contains a complete list of information on this report. From this group of 26 students, five were either deceased or incarcerated. Out of the 21 remaining students, 14 responded yes to a letter of solicitation for their

assistance in conducting the research. From this group of 14 students, six of them did not respond to any of the other mail or telephone solicitations for their input. From this group of twenty-six, there were only eight students left to be a part of this research (Table 3).

Findings

The findings include a description of the participants, their reasons for dropping out, and the views of the dropouts on the conditions at the university that had an impact on their decision.

Dropouts Currently Enrolled

Enrollment records verified that six of the eight dropouts were currently (1991) reenrolled or had graduated. Among these, three were male and three were female.

In-School Experiences

Comparing the records of the six returnees and the two non-returnees records makes a case for the need for an early intervention environment. Four (50%) out of eight of the returnees had cumulative grade point averages of less than 2.00 at the time of dropping out or transferring. In comparison, 16 (61.5%) of the 26 intended population had grade point averages of less than 2.00. Four of the eight returnees (50%) had cumulative grade point averages of at least 2.52 as compared to ten (38%) of the twenty-six intended

Table 3

Profile of Population (N=26) and Sample (n=8)

Characteristic	Population N	Population %	Sample n	Sample %
Gender				
Female	10	38	3	38
Male	16	62	5	62
Secondary school system				
DC Public Schools	18	69	5	62
DC Parochial	3	12	3	38
Out-of-State Public	3	12	0	0
General Education Diploma (MD)	1	4	0	0
Unknown	1	4	0	0
Enrollment classification				
Part-time	17	65	6	75
Full-time	9	35	2	25
Living at home with both parents				
Female	6	60	2	25
Male	10	63	4	50
Greater than 2.00 cumulative GPA				
Female	8	80	3	100
Male	2	13	1	20

Note. Rounding may cause percentages not to equal 100.

population who also had cumulative grade point averages of at least 2.52.

Withdrawals

A student at UDC may withdraw from the university (drop all classes in which they are enrolled) up to and including the last day of classes prior to the beginning of the final examination period. In addition, whenever a course is repeated, the higher grade will be counted in computing the GPA. Some students normally withdraw when they learn they have the possibility of receiving a low or failing grade as a way of avoiding probation or protecting their cumulative grade point averages. Comparing the withdrawal records of the returnees to school and non-returnees to school, two non-returnees had withdrawn from 22% of their classes (an average of 17.5 classes taken). The six who returned or transferred only withdrew from 15% of their classes taken (an average of 32.66 taken).

Failures

Comparing the course failures, in support of an early intervention environment, the two non-returnees received the grade of "F" in 31% of their classes (an average of 17.50 taken) while the returnees or transferees received the grade of "F" in only 0.6% of their classes (32.66 taken).

Academic Preparedness

When asked the question of their academic preparedness, five out of eight of the respondents indicated they were neutral or not academically prepared, and three indicated they were academically prepared when entering the University of the District of Columbia.

Of the returnees (6), three of the six indicated they were not academically prepared, and three of the six indicated they were academically prepared.

Reasons Cited for Leaving or Transferring

The most prevalent reason cited for dropping out was academic suspension (25%). Although they did not cite it as the reason they dropped out or transferred, two of the eight respondents spoke of the lack of warmth or one-on-one comraderie they thought should exist between students and instructors. See Appendix A1 for individual reasons for leaving or transferring as well as other related comments.

Six of the dropouts indicated they had taken time (at least one semester) to reconsider their decision before actually leaving. Further, two of the eight respondents interviewed felt they did not want to leave but were forced to because of the university's imposed suspension (a student with 30 hours and not maintaining a 2.00 CGPA will be suspended for one semester).

Attitudes Toward Curriculum, Classes, and Teachers

From the questionnaire, it was found that six of the eight participants in the study felt what they were learning was important. Six of the eight interviewed felt that their academic curriculum was satisfactory, one was neutral, and one indicated that more help should have been available for students in academic trouble.

Upon describing their classes, one felt that UDC should have offered more classes at different times. Six of the students felt the classes were not boring, while one thought they were boring only while being enrolled in science classes, and one student was neutral on the whole question.

Describing their teachers, six of the eight did not feel their instructors should have been different in any way, but the research responses contradicted this answer; i.e., one student felt the instructors were more interested in research than instruction; one student when asked whether poor teaching was the reason for dropping out or transferring, answered neutral; one student felt that instructors were not warm enough or did not show one-on-one comraderie. All eight of the respondents indicated their teachers did not directly influence them in their decision to leave school. See Appendix A2 for students' main reasons for leaving the University of the District of Columbia.

Dropouts' Views on Possible Improvement

When asked what they felt the university was missing the most that kept them from continuing to completion of their degrees, three of the eight indicated that nothing was missing, while the remaining five cited such factors as (a) lack of dormitories, (b) lack of professors to keep in sequence for part-timers, (c) more personal relationship with instructors or more one-on-one comraderie, and (d) the need to be warmer to students.

When asked what they enjoyed most while attending UDC, the most prevalent factors cited involved some aspect of the school program: availability of library, teachers in general and the cooperation they showed, a math teacher who thoroughly explained and relayed work to students, atmosphere of the university and because it was close to home, use of musical practice (piano) rooms, all major courses, biology class, and math classes. See Appendix A3 for all responses to this question.

When asked to describe the single most important thing UDC could have done to have kept them in science or engineering, seven out of eight felt the university could have done such things as providing help in more difficult classes, counseling by the science department as to the workload involved, more encouragement by teachers, more one-

on-one relationship, a warmer atmosphere, and by having dormitories. One felt UDC could not have done anything to prevent dropping out. See Appendix A4 for all responses to this question.

Personal, Family, and Other Influences

As earlier indicated, seven of the respondents interviewed were living in families with both parents; one was living with a spouse while attending school. Three of eight indicated they had both parents completing college, while four of eight had both parents completing high school. Only one student indicated both parents were not high school graduates. Four of eight had at least one sibling to drop out of UDC.

Upon describing their family's direct involvement and influence on their education, all eight of the respondents felt they had managed to keep their school problems from causing a strain on their families. Four of eight also indicated their parents had been upset or disappointed with their dropping out of school, while two of eight felt their parents did not care because it was their decision and they would have to live with it. See Appendix A5 for all responses to this question.

When questioned about familial influences having the most influence on their future, four of the eight

respondents indicated that their parents (two out of eight) or father (two out of eight) had the most influence. Three of the eight indicated they had the most influence on themselves, and one cited a non-relative such as a friend.

Educational Aspirations

Dropouts Currently Reenrolled

Among the six of eight who reenrolled, five reenrolled in UDC. The student who transferred to another school was "kind of sorry" for leaving.

Educational Level

It was found that all eight students interviewed felt their present level of education (less than a college degree) was not enough for them to achieve their future goals. See Appendix A6 for a complete list of intended majors. Two of the eight felt if they returned, the University could help them with a special kind of program to provide more financial aid and mathematics tutoring.

Work Experiences

Six of the eight respondents worked part-time while in school, but only one actually admitted dropping out of school to work. One had worked both full-time and part-time and one not at all. See Appendix A7 for all responses. Also, five of the eight respondents indicated they had not

engaged in any community activities while they were doing their studies.

Current Employment Status

It was found at the time of their interview for this study four of the eight respondents were employed part-time. Three others were employed full-time in skilled positions that required some additional formal training and one worked in a purchasing department. The four working part-time were in mostly clerical-related jobs. See listing in Appendix A8.

Future Employment Aspirations

With regard to future aspirations, all eight respondents indicated they had already chosen a skill or profession they would like to pursue, with the majority of these (seven) requiring formal training (i.e., urban geographer, advanced radiology technician, electrical engineer). The other respondent aspired to enter a profession which could possibly be entered without additional formal education (i.e., heating and air conditioning). See Appendix A6 for listing.

All of the respondents expected their lives would be better in five years time. They felt they would all be working in their chosen fields.

Summary

The study revealed that students enrolled in science and engineering at the University of the District of Columbia dropped out or transferred for some of the same reasons as students at other colleges and universities: (a) lack of academic preparation, (b) dearth of role models or mentors, (c) lack of financial support, (d) loss of interest in engineering or science, (e) desire to attend another institution, (f) employment, and (g) unfriendly environment. See Table 4.

The students and their parents had positive perceptions of education. It was the students' belief that their lives would be better if they acquired further education.

The participants also expressed general satisfaction with the university and its programs, but felt the university could have (a) more counseling by the science department on the workload involved and the encouragement of the teacher, (b) more one-on-one relationships, (c) dormitories and housing, and (d) help in more difficult courses.

With respect to each variable, the results of this study produced no significant difference in the reasons why females dropped out versus the reasons males dropped out.

Table 4

Students' Response tos "I decided to leave engineering and science at UDC because _____."

Response	SD	D	N	A	SA
Changed mind about discipline	0	3	0	2	3
Finished the course	1	7	0	0	0
Transferred to another school	1	6	0	1	0
UDC had poor reputation	0	7	1	0	0
Uncomfortable in black setting	3	5	0	0	0
Encouraged to leave by family	3	4	1	0	0
Money problems	1	4	3	0	0
Lack of employment	1	6	1	0	0
Inadequate financial aid	0	5	2	1	0
Health problems	0	8	0	0	0
Changes in personal life	0	4	3	0	1
Generally poor teaching	0	6	2	0	0
Classes mostly boring	0	6	0	1	1
No intellectual atmosphere	0	6	2	0	0
Large classes	1	5	3	0	0
Academic problems	0	5	1	2	0
Schedule conflicts	1	5	1	1	0
Poor advising	0	5	1	1	1

Table 4 -- Continued

Question	SD	D	N	A	SA
Non-teaching staff unhelpful	0	5	1	0	2
Poor facilities	0	6	2	0	0
No economical housing	0	4	2	2	0
UDC policies unreasonable	0	6	1	1	0
UDC procedures frustrating	0	2	2	1	3

Note. The questions were answered by: SD=Strongly Disgree, D=Disagree, N=Neutral, A=Agree, SA=Strongly Agree.

One factor that may be an area for further study was that of the perception that science-related instructors lacked warmth or one-on-one comraderie. It is accepted by many that some students have been turned off by their high-school scientific programs because they do not learn well in abstract, coupled with their perception of a lack of warmth or one-on-one comraderie may have some relationship. This researcher did not delve further into what was meant by this statement.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

This chapter contains the conclusions and recommendations derived from the data and the experiences of the researcher. Both conclusions and recommendations are suggestive only, they are based on data from only eight students. Whenever possible, the recommendations are supported with related literature.

Many African-Americans students who do enroll in college in the areas of science, mathematics, and engineering do not stay long enough to graduate, or they change their goals early.

The purpose of the study was to identify factors that led students to no longer want to continue their studies in a quantitative discipline. The findings led to the following conclusions:

(1) Regardless of earlier preparation or intentions, students have mind changes about career aspirations based on their own experiences, whether internal or external.

(2) Students and their parents are not always in concert as to what is or what is not in their best interest as it relates to education.

(3) Having success in a certain discipline is not always the factor that drives the student to complete the course of study.

(4) Whatever the academic experience may have been, positive or negative, that experience does not necessarily dampen students' desires to further their education.

(5) Students dropped out of engineering and science at the University of the District of Columbia for some of the same reasons as other schools: (a) lack of preparation, (b) desire to transfer to another school, (c) disillusionment
with the subject area, (d) financial reasons, and (e) changes in the external and internal environment.

In that the study involved only eight students, the sample providing the data was not large enough to warrant changing or developing a program or interventions to the curriculum. Nor did it provide any findings that could dictate changing the approach now being used by pre-college programs to interest African-American students in selecting science or engineering related disciplines.

The data did point out the need for continued assessment of first-year students as to their readiness for engineering or science, as well as continuous monitoring of their concerns on a semester-by-semester basis.

Individually oriented treatment of students is also encouraged for priority in these programs.

Recommendations

Ways to retain students to completion of college have been proposed by a number of researchers (Astin, 1977; Berryman, 1983; Brookover, 1985; Garrison and Brown, 1985; DeLoatch, 1992; Hewitt and Seymour, 1992) studying dropout data and ongoing program initiatives. In essence, it has been recommended that (1) different programs should be designed for different types of dropouts, (2) an appropriate mix of educational and noneducational services should be included in each program, (3) there should be accurate and timely identification of students with a high risk of dropping out, and (4) there should be programs designed for early prevention, late prevention, and recovery (Rumberger, 1987).

The study and personal experiences of the researcher revealed the need to continue seeking new ways to help in the retention of students. Some possibilities follow:

1. Use new methods of presenting or teaching mathematics and science.

The current science curriculum and the traditional approach to teaching science compound the social and

psychological problems faced by minority students. The scientific curriculum is rigorous, sequential, objective, highly cognitive, and apparently divorced from the affective domain in which the black culture places strong emphasis (Kochman, 1971). Blacks often evaluate the affect of the situation before making a decision on the cognitive content, thus black students are more likely to size up the "vibrations" they receive from a teacher or authority figure before deciding to believe what that person has to say (Kochman, 1971).

It is further recommended that steps be taken to make the classroom instructional climate more conducive to the needs of students requiring individualized attention because of their particular learning style. For example, faculty and teaching assistants should be trained in teaching contextually. One such approach being utilized and seemingly having some success on the high school level is Tech-Prep, a course of study which combines technical education and college preparatory academics to teach practical, hands-on techniques utilizing the resources of the school system, the university or college, the employment sector, the community, and the family (Hull & Parnell, 1991).

Reissman (1964) argued positively for combining

practical and academic education. He maintained that patterns exist that are characteristic of disadvantaged learners, and if those patterns are understood and used as a basis for planning in teaching and guidance, they can greatly improve achievement.

Kunjufu (1984) added support when he stated effective teachers must be cognizant of the students' cultures and learning styles before a curriculum is designed. The ultimate quest to develop positive self-images and discipline in black children cannot be achieved if the culture of the child is not included in the curriculum design.

2. Create a more supportive environment.

Jacqueline Fleming (1984) stated the need for a supportive environment, especially during the college years. The three aspects of support Fleming cited are opportunities for friendship, which she says is perhaps the most important (reinforced by the student in this study who requested more one-on-one comraderie); opportunity to participate in the life of the campus (reinforced by the student in this study who asked for dormitories or housing); and the opportunity to feel a sense of progress and success in academic pursuits (reinforced by the students in this study who requested help

for students in academic trouble and the need for more support while enrolled in science classes).

Fantini and Weinstein (1968) cautioned that love and understanding are not key variables in effective teaching. What is needed is an accurate and firsthand knowledge of the students' concerns, interests, and learning styles. Gordon and Wilkerson (1966) pointed out being sensitive means more than just having a generalized empathy; the teacher's attitudes and expectations are also of critical importance.

3. Establish variable instructor strategies.

The needs of some students cannot be met by requiring them to earn more credits in courses that are taught utilizing traditional methods. They need some courses designed specifically for the way they learn best. In some cases their learning needs may be best met by courses that emphasize the application of abstract concepts in the real world and that involve hands-on learning. Other instructional techniques will be required for other students. No longer can we speak of the liberal arts versus the practical arts as though we live and learn in separate worlds. The students of the future will require both. If we fail to match in any sytematic way the goals of schooling with the real-life needs of individuals living in a

knowledge-rich but application-poor society, we will fail in our educational calling (Hull & Parnell, 1991).

4. Provide professional development for faculty to help them understand cultural diversity.

The black cultural frame of reference sets different values and priorities in accepting and evaluating experiences. The mode of communication within the black culture, which is oral-aural (spoken/heard), reinforces the affective domain; whereas the prestige mode of communication in the dominant culture, which is visual-mental (seen-of the mind) reinforces the cognitive domain. Thus, learning styles and motivational factors vary between blacks and whites as well as among whites (Kochman, 1971).

The need to understand cultural diversity is present at UDC where the faculty breaks down as follows: Engineering has six African-Americans, seven whites, and four Asians; chemistry has five African-Americans and seven whites; and physics has four African-Americans and four whites.

5. Work to change attitudes of students and teachers.

Four of the eight students stated they were not academically ready to be successful in an engineering, science, or mathematics curriculum at UDC. This could be a specific factor in why professors think that African-

American students will not be successful in those curriculums. Therefore, black students have a double handicap facing them as they try to enter the fields of science, engineering, and mathematics. In some instances, the professors do not have the expertise or teaching strategies needed to teach ill prepared students, or they form a negative attitude about the learning potential of African-American students.

6. Lower the incidence of failures and withdrawals.

Academic failure was cited as a reason for dropping out by two of the eight respondents, and it is strongly recommended that UDC provide more help for learners in academic trouble as requested by one of the two students in this study who were suspended. It is further recommended that policies be established or reinforced to encourage student participation in activities that provide help in mathematics, financial aid, and general tutoring as requested by four of the eight respondents. It is also recommended that incentives and awards--opportunities to be educational assistants, laboratory assistants, and laboratory fellows--be offered in these programs to recognize student progress and achievement.

7. Provide more opportunities for faculty mentoring of students.

The key to role modeling is in the hands of the faculty. Involvement in science and engineering, an appreciation of the intrinsic rewards of knowledge and achievement, and a sense of dedication and perseverance come primarily from student involvement with the faculty. A faculty person's affective style is as crucial as his cognitive expertise. When students see a caring "human being" who is financially, professionally, and personally successful, they are more apt to be motivated to follow in the same direction (Young, 1981).

Areas for Future Research

Learned helplessness syndrome--an observation by psychologists Abramson, Seligman, & Teasdale, (1978) that persons having failed repeatedly at a designated task abandon the activity and conclude that they can do nothing in the future to effect a more positive outcome--is a prime area for future research in that many students have developed a fear of quantitative types of subjects and may upon continuous failure or less than average performance stop trying in the area where the failure was initially encountered. This feeling, accompanied by students' natural fear of failure, may be an area for further research in

trying to determine why the dropout rate is so high for African-American students studying science and engineering.

Contextual learning--learning material in the context of solving "real world problems" and in "real world environments," long the hallmarks of vocational education--may be an area for future research in that it addresses a learning style that may not be best served by the heavily cognitive oriented method presently used in teaching quantitative subjects.

Studies should continue to be carried out to determine the percentage of African-American science and engineering majors who (1) graduate from college, (2) graduate with quantitative degrees, (3) complete a graduate degree, (4) complete a graduate degree in a quantitative field, and (5) enter a career field requiring quantitative expertise. This data should be a priority for colleges and universities if they are to address the problem of underrepresentation among the African-American population in attempting to reach population parity.

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APPENDICES

APPENDIX A

QUESTIONNAIRE COMMENTS

APPENDIX A1 -- Questionnaire Comments

Students' reasons for leaving or transferring:

"I was put on academic probation (suspension)"

"I wanted to transfer to another school -- kind of sorry I left"

"I lost interest in science"

"Found employment"

"Realized science was not what I wanted"

"Personal problems, undecided what I wanted to do"

"Faculty members not warm enough in science"

"Academic probation (suspension) -- had to regroup"

APPENDIX A2 -- Questionnaire Comments

What was your main reason for leaving UDC?

"Kind of lost interest in engineering"

"I didn't leave -- I changed majors"

"I was put on academic probation"

"Family problems"

"Basically, I wanted to transfer to another school"

"Found a job -- got employed"

"Poor grades"

"Science instructors were not warm enough"

APPENDIX A3 -- Questionnaire Comments

Thinking back, was there anything you especially enjoyed while you were attending UDC?

"One of the math teachers who thoroughly explained and relayed work to students"

"Use of musical (piano) room"

"Availability of library. Teachers in general, and the cooperation they showed"

"Math classes"

"Biology classes"

"Atmosphere and close to home"

"Enjoyed courses for major"

"No"

APPENDIX A4 -- Questionnaire Comments

<u>What do you think would be the single most important thing UDC could have done to keep you in the (science, engineering) program?</u>

"Nothing or anything could have been done"

"Nothing"

"Nothing -- still registered"

"Counseling by the science department of the workload involved and the encouragement of the teacher"

"More one-on-one relationship"

"Dormitories and housing"

"Help in more difficult courses"

"I don't think the science teachers were warm enough. When seeking advice they act as though you don't belong there"

APPENDIX A5 -- Questionnaire Comments

How did your parents feel about you leaving UDC?

"Was my decision -- I would have to live with it"

"I didn't drop out"

"Disappointed, but gave encouragement to keep going"

"Disappointed"

"Dad wanted attendance at A & T initially -- Didn't say no to me"

"Upset"

"No particular feeling -- felt it was my decision"

"Father upset about transfer from science to psychology -- but mother was supportive of transfer"

APPENDIX A6 -- Questionnaire Comments

Major currently enrolled, graduated from, or contemplating return to:

Psychology

Urban geography

Radiography

Electrical engineering

Physics

Business management

Printing management

Heating and air conditioning

APPENDIX A7 -- Questionnaire Comments

Positions held while attending school and working part-time:

Working in purchasing department

Clerical work

Stay-in-school program

Clerk-typist

Clerk-typist

Laborer

Batch clerk

Did not work

APPENDIX A8 -- Questionnaire Comments

Where working at time of interview?

X-Ray technologist

Project coordinator for human care services

Police officer

Clerk-typist

Running copier and duplicators

Clerk-typist

Work at UPS

Work in a purchasing department

APPENDIX A9 -- Dropouts' Comments

Describe the feelings you had about the classes and school work at UDC.

"They were all tough and on level -- very challenging"

"I enjoyed them -- I graduated"

"I did not put the time into them as I should have -- had to take off to regroup"

"Generally, classes were a little bit slow paced"

"No real bad or good experiences"

"I think they were up to par"

"OK"

"OK after university-wide classes you don't need"

APPENDIX B

INFORMATION CONTAINED ON UDC COMPUTER REPORT No. SRSW3123

APPENDIX B

Information included on UDC Computer Report No. SRSW3123 (University of the District of Columbia, 1992):

A=Term Readmitted

B=Sex

C=Admission Term (when requested)

D=Admission Type (new, transfer, readmit.)

E=Admission Action

F=Classification (fr., soph., jr., sr., grad)

G=Term Residency (resident, out-of-state)

H=Visa Type

I=Citizenship

J=Ethnicity

K=Registration Type

L=Full/Part-time

M=Graduation Code

N=Degree Checkout Sheet

O=Degree Checkout Term

P=Degree (AS, AAS, BS, BA, MA, MS, CAGS, ED.S.)

Q=First Term Major

R=Current College (Arts & Science or Professional Studies)

S=Last Term Major

T=Cum Hrs Attempted

U=Cum Hrs Earned

APPENDIX B - (Continued)

Information included on UDC Computer Report No. SRSW3123 (University of the District of Columbia):

V=Cumulative GPA

W=# Terms Enrolled

X=First Term Enrolled

Y=Last Term Enrolled

APPENDIX C

LETTER TO STUDENTS

LETTER TO STUDENTS

Dear :

I am presently engaged in research for the attainment of my doctoral degree from Virginia Polytechnic Institute and State University.

You have been selected to participate in this research because at one time you expressed an interest in engineering and science by enrolling in such courses at the University of the District of Columbia.

I would greatly appreciate your help in this study by allowing me to ask you some questions that related to you and some of your activities while enrolled at the University. You can be assured that confidentiality in this study will be maintained.

If you would like to assist me in this research, please fill out and return the enclosed form so we can begin the interview process.

Thank you in advance for your cooperation.

Sincerely,

Alfred O. Taylor, Jr.
Researcher

APPENDIX D

STUDENT RESPONSE FORM

STUDENT RESPONSE FORM

Dear Mr. Taylor:

I will assist you in your research and wish to be interviewed:

By telephone at _____ (home) or _____ (work) between the hours of _____ and _____.

In person at _____ between the hours of _____ and _____.

Sincerely,

APPENDIX E

FIRST FOLLOW-UP LETTER

FIRST FOLLOW-UP LETTER

Dear :

Approximately ten days ago, a letter was mailed to you soliciting your input in helping me do a study for my doctoral dissertation. Results from my study will assist in identifying ways we can help more African-American students be successful in pursuit of engineering and science degrees.

If you have already returned your form indicating how you wish to be interviewed, I am grateful to you for your help. If you have not yet returned the form, will you please fill it in as soon as possible and help to make this research project a success. In case the original has been mislaid, another copy is enclosed.

Thank you in advance for your prompt response to this urgent request.

Sincerely,

Alfred O. Taylor, Jr.
Researcher
(202) 282-7427 (W)
(703) 271-6317 (H)

APPENDIX F

SECOND FOLLOW-UP LETTER

SECOND FOLLOW-UP LETTER

Dear :

Approximately ten days ago, a letter was mailed to you soliciting your input in helping me do a study for my doctoral dissertation. Results from my study will assist in identifying ways we can help more African-American students be successful in pursuit of engineering and science degrees.

If you have already returned your form indicating how you wish to be interviewed, I am grateful to you for your help. If it makes you more comfortable to see the instrument, I have enclosed a questionnaire along with a pre-stamped return envelope and would be extremely grateful if you would take a few minutes to complete it for me. Because my study group is small, it is important, in order to make this research meaningful that all my identified audience participate.

Thank you in advance for your prompt response to this urgent request.

Sincerely,

Alfred O. Taylor, Jr.
Researcher
(202) 282-7427 (W)
(703) 271-6317 (H)

APPENDIX G

FORMER ENGINEERING OR SCIENCE MAJOR QUESTIONNAIRE

Interview Questionnaire

Directions: Circle the response and write additional information requested on the lines provided. Thank you.

1. While you were attending UDC, did you feel that what you were learning was important to your future?
   Yes No

   Why did you feel that way? _____

2. Do you think the academic program you had at UDC should have been different in any way? Yes No

   In what way? _____

3. While attending UDC, did your instructors or advisors ever recommend another program to you?
   Yes No

   What kind? _____

   _____

4. Do you think the instructors at UDC should have been different in any way? Yes No

   In what way? _____

   _____

5. In your opinion, what would you say was missing at UDC that kept you from continuing to completion of your degree?

   _____

   _____

6. Would you say that a particular university policy or practice caused you to leave UDC? Yes No

Which policy or practice? _____

_____

_____

7. Would you say the faculty and staff of UDC had anything to do with your decision to leave? Yes No

In what way? _____

_____

_____

8. Would you say that your friends had anything to do with your decision to leave UDC? Yes No

In what way? _____

_____

9. Describe the feelings you had about the classes and school work at UDC _____

_____

10. Did you leave UDC voluntarily? Yes No

11. What was your main reason for leaving UDC? _____

_____

_____

12. If you recall, how long was it from the time you first seriously thought of leaving UDC and the time you actually left? _____ months

13. Thinking back, was there anything you especially enjoyed while you were attending UDC? _____

_____

_____

14. After leaving finally, was there ever a time when you considered going back to UDC? Yes No

What kept you from returning? _____

_____

_____

15. What do you think would be the single most important thing UDC could have done to keep you in the (science, engineering) program?

_____

_____

16. While attending UDC, were you ever employed during the school year? Yes No

Was this part-time or full-time? _____

What was your job? _____

17. Are you now or have you ever been involved in any community activities? Yes No

What have you been involved in? _____

18. Have you chosen the skill or profession you would like to pursue? Yes No

What have you chosen? _____

19. Are you currently employed? Yes No

Is this part-time or full-time? _____

What do you do? _____

_____

20. Five years from now, do you expect your life to be better, worse, or about the same?
Better Worse About the Same

Why? _____

What do you expect to be doing? _____

_____

21. At this time, who would you say could influence you the most in deciding your future? _____

22. While attending UDC, did you live with both parents?
Yes No
With whom did you live? _____

23. While attending UDC, do you think you may have caused a strain on your family in any way? Yes No

24. How did your parent(s) or guardian(s) feel about you leaving UDC? _____

_____

25. What is the highest level of education completed by either of your parent(s) or guardian(s)?

Mother
____ Elem. ____ Jr. High ____ Sr. High

____ College ____ Other

Father
____ Elem. ____ Jr. High ____ Sr. High

____ College ____ Other

26. Do you have any brothers or sisters who also left the University (UDC) before graduating? Yes No

How many? _____

27. Do you think your present level of education is enough for you to achieve your goals in life?
Yes No

28. At the present time, what personal changes would you need to make before you would consider completing your college education? _____

_____

29. If you did return to school, do you feel that you would need a special kind of program in order to finish?
Yes No

Special in what way? _____

_____

_____

30. Do you consider engineering and science one of the programs you would still like to study?
Yes No

31. Why did you leave the program (science or engineering) at UDC?

_____

_____

PART II

Please check the category that fits your reason for taking the action you did.

I DECIDED TO LEAVE ENGINEERING & SCIENCE AT UDC BECAUSE

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
32. I changed my mind about what I wanted to study.	_____	_____	_____	_____	_____
33. I finished the courses I wanted to take (didn't come for a degree).	_____	_____	_____	_____	_____
34. I transferred to another school.	_____	_____	_____	_____	_____
35. UDC has a poor reputation.	_____	_____	_____	_____	_____
36. I felt uncomfortable at a predominantly black school.	_____	_____	_____	_____	_____
37. Family or friends encouraged me to leave.	_____	_____	_____	_____	_____
38. Money problems.	_____	_____	_____	_____	_____
39. Lack of employment.	_____	_____	_____	_____	_____
40. Inadequate financial aid.	_____	_____	_____	_____	_____
41. Health problems.	_____	_____	_____	_____	_____

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
42. Changes in my personal life (marriage, moving).	_____	_____	_____	_____	_____
43. Generally poor teaching.	_____	_____	_____	_____	_____
44. Little contact with faculty.	_____	_____	_____	_____	_____
45. Classes mostly boring (topics, discussions).	_____	_____	_____	_____	_____
46. No intellectual atmosphere.	_____	_____	_____	_____	_____
47. Large classes.	_____	_____	_____	_____	_____
48. I had academic problems (wasn't academically prepared).	_____	_____	_____	_____	_____
49. Schedule conflicts (class, job, baby-sitting).	_____	_____	_____	_____	_____
50. Poor advising and counseling.	_____	_____	_____	_____	_____
51. Non-teaching staff unhelpful (registrar's office, security).	_____	_____	_____	_____	_____
52. Poor facilities (labs, library, equipment, etc.).	_____	_____	_____	_____	_____

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
53. No economical student housing	_____	_____	_____	_____	_____
54. UDC policies were unreasonable (requirements, grading).	_____	_____	_____	_____	_____
55. UDC procedures were frustrating (registration, deadlines).	_____	_____	_____	_____	_____

Other reasons (please list) _____

_____

_____

What was the most important reason for leaving? _____

_____

_____

What could UDC have done to keep you enrolled? _____

_____

_____

If I need further clarification or if some other questions may surface later on, would you be willing to participate?

Yes No