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INFLUENCES AND ACADEMIC INTERESTS OF FRESHMAN MINORITY ENGINEERING STUDENTS AT MICHIGAN STATE UNIVERSITY: IMPLICATIONS FOR MINORITY STUDENT RETENTION

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By

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ABSTRACT

INFLUENCES AND ACADEMIC INTERESTS OF FRESHMAN MINORITY ENGINEERING STUDENTS AT MICHIGAN STATE UNIVERSITY: IMPLICATIONS FOR MINORITY STUDENT RETENTION

By

Gerald O'Dell Thompkins

This researcher examined the drive of minority engineering freshmen to seek an engineering degree at Michigan State University. The specific focus was to identify the academic interests of and influences on minority engineering freshmen entering the College of Engineering at Michigan State University. The research design used a survey instrument in the form of a questionnaire developed by the researcher using selected motivational factors and influences identified in the literature. Two hundred fifteen minority freshman engineering students participated in the study.

The study was primarily descriptive in nature, using simple descriptive statistics in the form of means, standard deviations, frequencies, percentages, and ranks. The chi-square test of statistical significance and a two-sample t-test were also used to analyze the data. Major conclusions regarding factors influencing minority students to seek an engineering degree were as follows:

1. Professionalism and economic factors were perceived to be the most influential academic interests of minority students.

2. Self-determination, role models, and information received from the college were perceived to have much influence on minority students.

3. Expanding the world view and respect in society were perceived to have the least effect on minority students.

4. The need of the country, brothers and/or sisters; the need of the community, other relatives, and friends were the motivational factors and influences that were perceived to have the least influence on minorities.

5. Male respondents perceived their own interests/aptitudes to have a greater influence than did female respondents.

6. Female respondents perceived media presentations (TV, magazines, etc.) to have a greater influence than did male respondents.

7. Family/individual factors were perceived to have a greater influence than institutional factors on minority students.

8. Respondents whose fathers had no degree level of education perceived religious leaders to have a greater influence than did respondents whose fathers had a degree level of education.

Committee Chair: Dr. Louis F. Hekhuis

To my parents, O'Dell and Mary G. Thompkins, who have always provided their unselfish love, devotion, support, and guidance in all my endeavors. Your encouragement throughout the years has helped me persevere and succeed. Without your wisdom, insight, and inspiration, I could not have survived the harsh experiences that life sometimes inflicts on us. I owe you both a tremendous debt of gratitude for all you have done to make me a better person and to enrich my life, and for instilling in me the value of helping others. God has blessed me with the greatest parents a son could have.

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CHAPTER I

STATEMENT OF THE PROBLEM

Introduction

Since the late 1960s, educational administrators, social scientists, policy planners, and social critics have been concerned about the low proportion of minorities in institutions of higher education. In response to these concerns, programs have been planned and implemented at the federal, state, and local levels to improve higher educational opportunities for minority youths in the United States.

Early admission studies spanned a time of changing perceptions of minority student admissions. By the early 1970s, recruiting and selecting minority students were the primary concerns. Studies that followed showed enrollment fluctuation by time and geographical regions (Brooks & Horowitz, 1972; Sedlacek, Brooks, & Mindus, 1973; Sedlacek, Lewis, & Brooks, 1974; Sedlacek, Merritt, & Brooks, 1975; Sedlacek & Pelham, 1976). Some states and regions showed gains, whereas others had declines in percentages of minority enrollments. For instance, the percentage of black students enrolled as full-time undergraduates peaked in 1978 at 10.6%, but by 1984 the total enrollment of blacks at all levels had dropped to 8.8% (Wharton, 1986). For black freshman enrollment, the middle states and western

areas made the greatest gains from 1969 to 1975: 6% to 13% for the middle states and 5% to 9% for the western areas. However, the same regions had the largest drops in 1974 and 1975 (Sedlacek & Webster, 1978).

Although the overall number of minority students in higher education has increased slightly (Reed, 1978), their continued underrepresentation in institutions of higher learning remains a matter of great concern to educators, groups and individuals who are committed to educational equity. Although federal, state, and locally initiated programs (e.g., Upward Bound, A Better Chance, the Detroit Area Pre-College Engineering Program [DAPCEP], Talent Search, and Accelerate Students Potentially Interested in Research and Engineering [ASPIRE]) are making important contributions toward increasing educational opportunities, it appears that these efforts are necessary but not sufficient in attempting to eliminate the underrepresentation of minority students in higher education.

As the issue of admission of members of ethnic minority groups to institutions of higher education has continued to receive significant attention for several years, and in all probability will for the next decade, additional avenues may be deemed necessary. Fortunately, several institutions have vowed to continue their commitment to ethnic minorities, particularly in view of the declining enrollments in higher education and the continuing need for compliance with federal and state regulations to obtain funding (Walton, 1979).

Institutions still committed to attracting ethnic minority groups face other issues beyond those of recruitment and admission criteria. Retention of minority students after their admission is one such issue. The issue of retention has been particularly pronounced among black students admitted to predominantly white institutions of higher education (Walton, 1979). Several studies and reviews have suggested that factors that might contribute to a high rate of attrition among ethnic minority groups include lack of academic preparation, inadequate counseling for minority groups, and the unavailability of a "strong support person" for most minority students (Reed, 1978; Sedlacek & Brooks, 1979; Smith et al., 1976).

Another issue that has been advanced but less documented by scholars is that of segregation of minorities into certain departmental majors. At those institutions with minority students, a high percentage of minorities are enrolled in the social sciences and humanities, with clear underrepresentation in engineering sciences. Such segregation in universities and colleges suggests that similar segregation in the job market is inevitable, with minority graduates taking jobs in the social sciences and humanities, which are usually low paying. Unless such a trend is checked, education will then effectively widen the very gap it is expected to bridge.

Of particular concern are the low proportions of minorities (blacks, Hispanics, and Native Americans) in engineering. In spite of the formalized efforts initiated in 1972 to increase the number of blacks and other minorities in the engineering profession, 12

years later the Engineering Manpower Commission (1983-84) showed very low figures for minorities in undergraduate engineering programs. The Commission showed that, out of the total 394,000 college students majoring in engineering, 30,000 (or 7.6%) were minorities. Yet in the United States as of the 1980 census, minorities (blacks, Hispanics, and Native Americans) comprised approximately 22% of the college-age population.

This problem of underrepresentation of minorities in engineering is worsened when one considers the well-documented fact that ethnic minority students leave school, apparently without achieving their desired educational goals, at a much higher rate than do their white counterparts (Sedlacek & Webster, 1978). Thus, the figure of 30,000 (or 7.6%) provided by the Engineering Manpower Commission (1983-84) is deceiving, given that a high proportion of these students drop out of engineering fields before graduation. These two issues of low enrollment rates and high attrition rates of minorities in engineering-related fields probably explain the alarming statistics of underrepresentation of minorities in the high-tech fields of engineering and science. For instance, according to the U.S. Bureau of Labor Statistics, of the 1.6 million engineers in the country, only 2.7% are black.

Although the 1989 report of the American Association of Engineering Sciences (AAES) indicated that the number of minorities has been increasing for the last two years, figures released by the Engineering Manpower Commission (1985-1988) indicate that blacks, Hispanics, and Native Americans are still severely underrepresented

in engineering. Better participation seems crucial if the nation is to meet its long-term need for highly trained personnel. To address this problem, certain efforts throughout the United States have been designed to improve elementary and high school science and mathematics skills for minority students.

Without doubt, engineering offers greater opportunities to college-bound students than do most other professions or occupations. Many engineers progress to the management ranks of industry; some go on to the executive levels. Clarke (1979) indicated that about 55% of all managers have engineering degrees. Yet engineers are in great demand, and an industrialized nation like the United States needs engineers to sustain its industry. The society's mission, therefore, should be to improve the engineering educational process, so as to develop greater pools of engineers and engineering technologists by involving all citizens of the country.

Minorities in Michigan State University's College of Engineering

Although the issue of recruitment, retention, and graduation of minority engineering students has been a major focus at Michigan State University (MSU) since 1968, the rate of improvement has been dismal. Of particular concern is the problem of high attrition rates among minority groups (blacks, Hispanics, and Native Americans) in the College of Engineering at MSU. In examining the data from the Office of the Registrar, it can be seen that, whereas more than 50% of majority students who start out as freshmen in the College of Engineering reach their senior year, less than 20% of

minorities who start out as freshmen reach their senior year after three years.

As in elementary schools, high schools, and many colleges throughout the nation, programs aimed at solving the problem of high attrition rates among minorities in engineering have been designed and implemented at MSU. Besides being one of the major participants in programs like DAPCEP, Upward Bound, and ASPIRE, MSU hosted the three-year Sloan Program from 1974 through 1977.

The Sloan Program was funded by the Alfred P. Sloan Foundation to address the issue of underrepresentation of minority student groups in engineering at MSU. The Sloan Program focused on two aspects of the problem--enrollment and retention. For enrollment, recruitment programs were developed to increase minority enrollment; for retention, innovative curricula and counseling programs were designed to retain these students until they successfully graduate from engineering.

Stonewater (1981), who evaluated the effectiveness of the Sloan Program, indicated that another unusual recruitment tactic, "internal transfer," was used in the MSU Sloan Program. With internal transfer, instead of focusing on high school students, the program tried to identify nonengineering minority students already at the university who were not satisfied with their chosen curriculum. Once these students were identified, an attempt was made to recruit them to the College of Engineering. With the Sloan Program placing greater emphasis on basic skills in mathematics and science, a counseling program with emphasis on adjustment problems

and building self-esteem, and a recruitment program for high school as well as internal transfer, it was expected that the results of these strategies would be reflected in increased enrollment and low attrition rates of minority engineering students at MSU.

Despite the fact that Stonewater (1981) reported that total enrollment of minority students in MSU's College of Engineering jumped to 165 from 118--an increase of 28%--during the first year of the Sloan Project, the objective of lowering attrition rates was not realized. The expectation that the Sloan curriculum and counseling program would help minority students persist in engineering was not realized (Stonewater, 1981). Stonewater also noted that, during the pre-Sloan, Sloan, and post-Sloan periods, attrition rates remained fairly constant, with 7 out of 10 minority students never completing an engineering degree. Thus, despite several years of various efforts to solve the problem of minority underrepresentation in the College of Engineering at MSU, the same problem remains today. It is a difficult one, but one that is worthwhile to pursue in view of several potential benefits at the individual, local, and national levels. A commitment must be made by corporations, educators, educational institutions, and the affected minorities themselves to explore new avenues of addressing this problem.

The Engineering Equal Opportunity Program at Michigan State University

The Engineering Equal Opportunity Program (EEOP) at MSU was established in 1968 when a small group of concerned faculty members

created the Engineering Equal Opportunity Program Committee (EEOPC) and began recruiting, advising, and providing financial assistance to interested minority students. In 1976, the EEOPC recommended the creation of the position of Director of Minority Affairs, which the Dean of the College of Engineering approved. The director of this newly created position was given the responsibility for all activities relating to minority engineering students. The Office of Minority Student Education was established in conjunction with the new directorship; it was later renamed the Engineering Equal Opportunity Program (EEOP).

The main responsibility of the EEOP is to serve engineering students at MSU who are members of groups that are disproportionately represented in the College of Engineering. The EEOP also coordinates precollege engineering activities at MSU, mainly serving the Detroit, Flint, and Greater Lansing school districts.

The latest addition to the program during the 1987-88 academic year was the admittance of the EEOP as a member of the National Consortium for Graduate Degrees for Minorities in Engineering, Incorporated (GEM). This consortium is a nonprofit national corporation formed for the sole purpose of encouraging minority students with bachelor's degrees in engineering to pursue graduate work in engineering at any one of the 55 member universities.

Purpose of the Study

The purpose of this study was to examine minority freshman engineering students' motivation in seeking an engineering degree at

MSU. The specific focus was to identify the academic interests of and other significant influences on minority engineering freshmen entering the College of Engineering at MSU. The researcher explored 30 individual motivational factors (academic interests) and 15 types of family, friend, and other influences that minority freshmen report as significant in their motivation to pursue an engineering degree.

Nature of the Problem

In the College of Engineering at MSU, less than 50% of the minority freshman students proceed to their sophomore year after one year of admission. Attempting to determine where the other 50% usually go has proven to be difficult. However, one can assume that among the 50% who drop out of the College of Engineering, some transfer to other colleges at MSU or other universities, others transfer to other universities but still continue with an engineering curriculum, and others drop out of school altogether.

Under such circumstances, certain questions remain unanswered about the students who leave the College of Engineering during their freshman year. These questions include:

1. Why did these students enter the engineering program in the first place?

2. When and through whose influence did they develop a desire to become engineers?

3. Why is the desire to be engineers so short-lived that the students leave the college as soon as they start?

4. What are the main interests of these students? Are they internal or external?

5. For how long had these students nursed the desire to be engineers? Was it at the early part of schooling or later in high school?

6. Were the students' academic interests accompanied by appropriate preparation at the higher and lower grades?

7. What influence did parents, friends, and immediate family members have on these students' decisions?

Answering these and many other related questions is crucial in determining the best and most effective way to prepare these students for engineering degrees.

Value of the Study

The study findings will provide descriptive information about the academic interests of and influences on minority students entering their freshman year at MSU. Such descriptive information will be useful for educational planners, pre-engineering program planners and administrators, and the minorities themselves to assess the programs designed to solve the problem of underrepresentation of minority students in engineering. The main consumers of such research findings will be educational counselors of minority students at engineering colleges.

Research on academic interests is particularly important at the freshman level, where students coming from different high schools (inner city, rural, and urban) converge to pursue rigorous programs.

These interests might have originated at home, at high school, or on arrival at the college, but these interests, if nurtured carefully, may set the student in motion to strive to achieve those goals. More important, when these interests are identified at an early stage, students will be provided with the accompanying skills to best prepare them for their areas of interest.

In past attempts to solve the problem of underrepresentation and low retention rates of minorities in the engineering fields, the role of immediate family members has been ignored. Family members, particularly parents, brothers, and sisters, play a vital role in influencing students' decisions in selecting a career. Sometimes these influences take the form of a student striving for a curriculum in which he/she is not interested or is not academically prepared for, just to satisfy one's parents or siblings. This kind of influence is unfortunate when it is not accompanied by appropriate academic preparation for the curriculum in question.

On the other hand, parents may have certain ambitions and expectations for their children. If their desires are translated into the amount of encouragement and support given to the children, their influence may positively contribute to the children's success. This sociological influence was reiterated by Walton (1979), who indicated that internal motivation seems to arise from many underpinnings which are psychological, physical, and social in nature.

Although minority program planners most clearly stand to benefit from this study, minority students and their parents will

also benefit. An understanding of the academic motives will help facilitate communication between students and their supporters (parents, immediate family members, and educational counselors) about the intended goals and objectives.

Research Questions

In this study, the researcher investigated the motivational factors and other significant influences of minority freshman students in the College of Engineering at MSU. Specifically, the researcher addressed the following research questions:

1. What are the perceived academic interests of minority students who seek an engineering degree?

2. What are the perceived motivational factors and influences of minority students to seek an engineering degree?

3. Do the academic interests of minority students vary with their parents' level of income?

4. Do the motivational factors and influences of minority students vary with their parents' level of income?

5. Is there a statistically significant difference in motivational factors and influences between male and female respondents?

6. Is there a statistically significant difference in the perceived amount of influence between institutional and family/individual motivational factors and influences?

7. To what extent do economic-related interests influence minority students to seek an engineering degree?

8. To what extent do role models influence minority students to seek an engineering degree?

9. Do the perceived academic interests of minority students vary with their parents' educational level?

10. Do the motivational factors and influences of minority students vary with their parents' educational level?

Delimitations of the Study

The study population comprised freshman engineering minority students (blacks, Hispanics, and Native Americans) at MSU during the 1989-90 academic year. Because the minority student dropout rate from the College of Engineering is highest at the end of their freshman year, this target population was considered the most appropriate cross-section representative of engineering minority students.

A second delimitation of the study is that the emphasis of this research was to provide an overview of students' academic motivation at all levels of their study, by using their perceptions at one time. While a longitudinal study in the future could provide useful data about the students' motivation over time, that was not within the scope of this research.

Limitations of the Study

This research was limited to an examination of the academic motives reported by students in response to a questionnaire inquiry. In this kind of study, it cannot be guaranteed that the motives

reported by students are necessarily the motives that were operating at the time of the investigation.

The study was limited to an examination of a sample of engineering minority freshmen at MSU during one academic year (1989-90). Although a survey of all minority engineering students at all levels in more than one university might be ideal, the academic motivation of these students is most likely to be typical of the academic motivation of minority engineering students at other academic levels. However, it cannot be assumed that this sample was representative of minority engineering students in general. Ideally, a two-stage cluster sample of minority engineering students in the United States, across most universities, would have been used.

The study was focused solely on students' personal reports of their perceptions of their academic interests and influences. Psychological measures such as the Thematic Apperception Test were not used.

Definition of Terms

The following terms and their definitions apply in this research.

Accelerate Students Potentially Interested in Research and Engineering (ASPIRE). A precollege engineering program, which serves the Greater Flint school districts, through certain Michigan universities.

Detroit Area Pre-College Engineering Program (DAPCEP). Like ASPIRE, DAPCEP is a precollege engineering program, which serves the Detroit area through several Michigan colleges and universities.

HBI. Historically Black Institutions in the United States, usually located in the southern states.

Minority. Include, for the purposes of this study, blacks, Hispanics, and Native Americans; however, MSU also includes Asians and Pacific Islanders in this category. (It should be noted, however, that these two groups are not considered to be underrepresented in engineering and in the technical sciences.)

Motivate. The process of arousing, sustaining, and directing behavior.

Summary

Chapter I presented an overview of the statement of the problem, as well as the research questions addressed in this study about the factors and influences that motivate minority engineering students to study engineering. In Chapter II, a review of the related literature is presented.

CHAPTER II

REVIEW OF THE RELATED LITERATURE

Introduction

The researcher's purpose in this study was to reflect on the state of minorities in the engineering pipeline and in the engineering profession. Because of the current underrepresentation of minorities (blacks, Hispanics, and Native Americans) in the fields of science and engineering, a great deal of emphasis has been placed on recruitment and enrollment programs. The task of substantially increasing the number of minority engineering graduates has presented perhaps the greatest challenge to engineering educators for the last decade. Because the pool of minority youths prepared and motivated to study engineering has been inadequate, certain programs in the middle school and high school systems were implemented in an attempt to identify, prepare, and recruit potential minority youngsters for engineering programs. Although a few engineering colleges have had substantial increases in the number of minority students entering as freshmen, many of these students turned out to be inadequately prepared to compete in a demanding academic environment. As a result, most of these colleges have had limited success in retaining minority students,

with particularly high attrition rates in the first year (Landis, 1976).

Several researchers have recognized that comprehensive recruitment and enrichment programs alone may not necessarily solve the problem of the underrepresentation of minorities in the engineering pipeline and profession (Reed, 1983; Sedlacek & Webster, 1978; Stonewater, 1981; Suen, 1983; Teachman, 1987; Walton, 1979). Activities that may directly increase a student's chance of success in engineering programs can be identified. These activities, together with the current recruitment and enrichment programs, will appropriately address the current problems minority students face in science and engineering education. Landis (1976) cited some of these activities as including close academic advisement; a particular emphasis on orientation and adjustment to the environment of the institution; a concerted motivational program; the development of a positive, success-oriented environment; a study-skill-building program; a comprehensive and accessible tutoring program; close monitoring of students' progress; a personal counseling component; a mechanism for social interaction and development; and career development.

Although there is evidence that some of these activities are available to a certain extent, formally or informally, within engineering colleges, there is very little evidence of the existence of motivational programs and activities designed to create a positive, success-oriented environment. Unfortunately, a negative

self-image and general sense of alienation are often factors limiting the performance of minority students (Landis, 1976).

Structural models of educational attainment specify how differences in family background are reflected in varying educational attainment. However, these models may be incomplete because they do not include variables involving activities that take place at home, which are not necessarily socioeconomic in nature. Do some activities that take place at home create a home environment conducive to higher educational attainment? Do parents provide certain types of educational resources that can enhance their children's educational achievement?

Complete structural models of educational attainment need to be developed, not only to determine the proportion of variance in educational achievement explained by family socioeconomic variables (father's education, mother's education, parental income, number of siblings), but also to examine the effect of certain nonsocioeconomic family activities on educational achievement. Such models will take into consideration the fact that parents use material and nonmaterial resources, as well, to create a home atmosphere that fosters academic skills, motivation, and orientation. Because the use of these resources may start soon after the baby is born, they are likely to produce long-lasting results.

Because the focus of this study was on the issue of academic motivation and influences and how they may affect the success of minorities in engineering fields, the review of literature centered

on the following topics: engineering as a profession of opportunity, recruitment and retention of minorities in engineering, the role of tribal colleges, role modeling, the concept of academic readiness, academic motivation, and motivational factors and influences.

Engineering: A Profession of Opportunity

The engineering profession includes a wide variety of specialized fields, such as aerospace, agricultural, biomedical, ceramic, chemical, civil and environmental, electrical, geological, industrial, mechanical, metallurgical, nuclear, petroleum, and systems engineering. As Clarke (1979) indicated, engineering is a profession that equips individuals with the ability not only to solve today's known problems but, equally important, to comprehend and invent ways to solve tomorrow's problems, which are not even known today. It is through the work of engineering that an economy can be made more efficient.

In high-technology companies, engineering is an avenue of upward mobility. Much of the management of these companies has been drawn from the ranks of engineers (Kauffmann, 1980). Therefore, if fuller integration of corporation management is to be achieved, minority engineers must be represented in the engineering ranks. At the national level, O'Brien (1987) suggested that, to counteract the projected shortage of scientists and engineers, the nation must encourage three times as many women, minorities, and disabled individuals to earn bachelor's degrees and ten times as many to earn

doctorates in these fields during the next decade. With the continuing underrepresentation in science and engineering of white women, Native Americans, blacks, Hispanics, and individuals with disabilities, it will be difficult to address the crisis. This is particularly true because these minorities account for only 14.5% of all employed scientists and engineers, yet they represent 64.6% of the total population (O'Brien, 1989).

The crisis of the projected shortage of engineers in the United States takes another form, which Morgan (1989) articulated. During the 1990s, one-fourth of engineering faculty over the age of 55 will retire, and the supply in the pipeline will diminish substantially. The few individuals in the engineering pipeline have been shown to be mainly foreign students. More foreign students than American students go on to pursue advanced engineering degrees since colleges have to compete with industry. Engineers can do "so well" with just a baccalaureate degree that there is no incentive for most American students to get a doctorate. But for foreign engineering students, the converse is true (Morgan, 1989). Although the country may benefit greatly by hiring foreign faculty from among the foreign graduates, mostly from developing countries, educators and policy makers must bear in mind that these intellectuals will return to their homes as their countries become more developed and desire more engineers, as well. As a consequence, the United States will find itself becoming dependent on foreign expertise. It is therefore crucial that educators find ways to improve the engineering

educational process in America, to develop greater pools of potential engineers and engineering technologists by involving all citizens of the country.

Recruitment and Retention of Minorities in Engineering

Recruitment of members of ethnic minority groups to colleges of engineering in America is an issue that has received significant attention since the early 1970s. The concepts of preferential treatment and reverse discrimination became arguments in the courts, and the United States Supreme Court issued a decision on the well-publicized Bakke case, which many claimed was clouded with ambiguity (Walton, 1979). Affirmative action programs, federal and state regulations, and the projected shortage of engineers have prompted many institutions to continue their commitment in attracting students from ethnic minority groups that are underrepresented. The goal is usually to make the percentage of minority engineering graduates approximately equal to the percentage of these minority groups in the college-age population.

Despite several years of activities aimed at increasing the representation ratio of these minorities, blacks, Hispanics, and Native Americans continue to be underrepresented not only in engineering but also in other scientific fields (Kauffmann, 1980). However, Kauffmann recognized that the minorities-in-engineering effort is truly a national one, involving corporations, universities, colleges, school systems, and minority groups throughout the United States. Although the expected percentage and

representation ratio have not been attained, the effort has resulted in an increasing number of minorities entering engineering colleges (Kauffmann, 1980).

Institutions and colleges that vowed to maintain their effort to attract students from among ethnic minority groups that have traditionally been underrepresented in engineering face other issues beyond those of admission criteria. Retention of minorities after their admission is one such issue (Walton, 1979). Many schools have poor success in retaining minority students who are admitted, with particularly high attrition rates during their freshman year (Landis, 1976). Even in general, retention of minorities in American higher education has become an increasingly perplexing problem, and researchers have attempted to determine factors that may explain the high attrition rates among students from these ethnic minority groups (Kauffmann, 1980; Landis, 1976; Lang, 1986; Reed, 1978; Skoner, 1988; Stonewater, 1981; Walton, 1979).

Typically, researchers have agreed that the high attrition rate among ethnic minority students can be explained by their lack of role models, unreadiness for academia, inadequate counseling, unavailability of a strong support person, and alienation. These predictors of minority students' success in higher education have been used by many precollege engineering programs in trying not only to increase the number of minority engineering participants but also to decrease the attrition rates among minority students in colleges of engineering.

In an attempt to increase students' chances of success, these retention programs have used such activities as close academic advisement; emphasis on orientation and adjustment to the institutional environment; development of a positive, success-oriented environment, study-skills-building programs, comprehensive and accessible tutoring programs; close monitoring of student progress; personal counseling; a mechanism for social interaction and development; and career development. Many of these programs are now available to some extent in engineering colleges, and their existence is a factor in the retention and achievement of all students in those colleges (Landis, 1976).

Strategies that have been employed in retention programs have paid off in terms of student enrollment and career decision making. Minority students appear to be making earlier decisions about an engineering career, but attrition rates have not been reduced (Stonewater, 1981). Minority engineering students (blacks, Hispanics, and Native Americans) continue to have high attrition rates, particularly during their early college years (freshman and sophomore). Although these engineering minority retention programs are doing a remarkable job of improving the representation of ethnic minority students in engineering, Landis (1976) recommended that such programs include motivational aspects, to encourage these students to strive for excellence in the engineering profession. Teachman (1987) articulated the need to get families involved in all levels of students' academic development. With regard to both of these recommendations, the present researcher not only focused on

the academic motivation of these students and the influence of their immediate family members, but also examined the influence of peers, teachers, religious and community leaders, and professional people, as well as perceptions of the needs of the family.

The Role of Predominantly Ethnic Minority Colleges

In the United States, the three most underrepresented ethnic minority groups (blacks, Hispanics, and Native Americans) in institutions of higher education also have certain minority colleges and universities that most of their students attend. Included among those universities and colleges are the historically black institutions (HBI), which include the University of the District of Columbia and Howard University, both in Washington, D.C.; Jackson State College in Mississippi; Prairie View A & M University in Prairie View, Texas; and many other predominantly black institutions. Although not as distinct as the HBIs, predominantly Native American institutions include Oglala Lakota and Sonte Gleska Colleges, both in South Dakota; Nebraska Indian Community College in Nebraska; and Haskell Indian Junior College in Kansas. Predominantly Hispanic institutions include the University of Texas in El Paso, Miami-Dade Community College in Florida, and Arapanoe College in Colorado.

HBIs were established as part of a racially segregated system of higher education for the explicit purpose of educating black students, primarily to become teachers of other blacks (Lang, 1986). This system remained intact until the mid-1970s, when "white"

institutions were forced to seek out and admit "highly qualified" black students. But even recently, Lang (1986) indicated that 88% of the HBIs still have enrollments of 80% blacks; only three have enrollments of less than 50% blacks. Although scholars have questioned the justification for the existence of HBIs amid the challenges faced by institutions in their efforts to desegregate (Fleming, 1984), HBIs now encounter other challenges. These institutions now not only have to compete in recruiting black students, but they must also compete with other institutions in establishing and offering programs that will attract all students and prepare them for the current demands of society and the economy. They also must compete for excellence. However, Lang (1986) indicated that HBIs' current economic situations complicate these challenges tremendously. Thus, the curricula at these institutions are still aimed primarily at teacher education rather than other professional careers, particularly high technology and engineering.

The legal issues surrounding desegregation have raised questions in many states about the mission and future of HBIs. What is the educational legitimacy of black colleges, especially when, as Fleming (1984) argued, these colleges are suspected of being inferior to others educationally because of their poorer facilities, smaller budgets and endowments, weaker faculty salaries, and lower numbers of faculty publications? As a result of these concerns, many black students are now entering predominantly white institutions.

Although the shift from the HBIs to predominantly white colleges may be viewed as a move toward desegregation, the change significantly affects the retention-program equation in two major ways. First, at predominantly white campuses, blacks are alienated and mostly forced to cluster in certain college majors like education and sociology; very few enter technical fields. This shifts the concern regarding segregation from between institutions to segregation within institutions. Second, as Sedlacek and Webster (1978) and Suen (1983) indicated, general attrition rates of black college students on predominantly white campuses are substantially higher. Likewise, Astin (1977) reported that black students dropped out of predominantly white colleges at a rate of 49.5%, compared to a dropout rate of 41.4% among white men and 30.9% among white women. More recently, Cortina (1980) found that black students dropped out at a rate of 73.4%, compared to the overall dropout rate of 47.7% in predominantly white universities and colleges.

Although the factor of ethnic minority colleges does not stand out as clearly for Hispanics and Native Americans as it does for blacks, it further complicates the retention equations. The HBIs serve to demonstrate that more issues deserve further research in an attempt to address the underrepresentation of minorities in higher education, particularly in scientific fields. Attention needs to be given to other factors like the role of the family, community influences, and academic motivation in updating the attrition structural models.

Role Modeling

Modeling in the Skinnerian sense implies the establishment of an external reward system for "appropriate" behavior and the eventual shaping of desirable patterns of responses. Walton (1979) indicated that the concept of role models as used in addressing the problem of underrepresentation of minorities in higher education is restricted to providing examples of academic prowess on university and college campuses with which members of ethnic minority groups can identify. Therefore, intellectual modeling is emphasized, with minimum emphasis on "adjustment" from a purely socioeconomic or cultural point of view. When used as one of the factors in the minority retention structural models, the concept is broadened beyond the behavioristic model and includes the concept of psychological identification (Walton, 1979).

The concept of psychological identification originated with the work of Bandura and Walters (1963), who suggested a socio-behavioristic approach to the modification of behavior--in this case, intellectual behavior. The approach is said to be best applied in the context of dyadic and group situations (Walton, 1979). It is therefore expected that ethnic minority students who establish a sense of psychological identification with scholarly mentors whom they value, and who also receive rewarding interaction through either direct or vicarious reinforcement, are more likely to emulate the intellectual attributes of the model (Walton, 1979). Role models for the minority student groups in engineering must then

be "successful models" in the engineering profession, for minority students to match the response of their models.

As part of the programs designed to address the problem of underrepresentation of minorities in the engineering profession, it is important to identify successful scholarly mentors who exhibit behaviors that are generally expected of persons in the engineering pipeline and profession.

The issue of whether the race of the model and the learner is an important variable in determining the effects of vicarious reinforcement on imitation was summarized by Walton (1979), who argued that:

> The genuinely positive attitudes and scholarly abilities of the model would tend to offset any effects that may result when the race of student and mentor are different. The presence of scholarly mentors with whom minority students can identify, and who manifest some empathy and sense of identification with minority students, could serve as a facilitator of academic success among ethnic minorities. . . . Both persons involved in role modeling (student and mentor) must seek to broaden the extent of their interaction. (p. 125)

For the nature of the relationship suggested, it is fairly clear that not every engineer, graduate student, or faculty member can be a mentor to be involved in role modeling. However, it is a relationship that potential mentors can learn and acquire when they understand and are fully involved in addressing the existing problems.

Despite the difficulty of implementing the role-modeling strategy in addressing the crisis of underrepresentation of minorities in engineering, some minority pre-engineering programs like DAPCEP, ASPIRE, and Upward Bound have incorporated the use of

role models. Typically, the program directors invite professional engineers to give talks to minority students. The pre-engineering students are taken on tours in the industries to meet with engineers. Although these activities are nowhere near the suggested psychological identification, they represent the best effort at this time to help minority students identify and understand engineering as a profession. More needs to be done in this area.

The Concept of Academic Readiness

Another significant concept in the lack of full participation of minorities in engineering sciences and other technical fields is that of academic readiness. This concept takes two forms: unreadiness for academia in terms of prerequisite courses and psychological unreadiness. Although the issue of unreadiness in content or subject matter can be addressed through enrichment programs, the concept of psychological unreadiness is fairly complex and not so easy to solve. As Walton (1979) indicated, many members of minority groups arrive on college and university campuses with psychological attitudes that seem to be counter to academic progress. The solution to psychological unreadiness seems to be role modeling, as discussed earlier.

Academic enrichment programs alone may not be sufficient in addressing unreadiness for academia in terms of subject matter. It is important to address the issue from its source--that is, to identify reasons why most minority students enter college with lower quantitative and communication skills than their white counterparts.

Demographers and educationists have found that most minorities, particularly blacks, live in the inner city, and their children attend inner-city elementary, secondary, and high schools. Educators are aware of the problems of inner-city school districts, which include lack of discipline, less competent teachers, poor facilities, and low student motivation. Thus, the solution to this problem may involve a complete overhaul of the American educational system, particularly the inner-city public school districts.

Academic Motivation

Academic motivation has been defined as the force behind an individual's behavior in school. Atkinson and Birch (1978) indicated that the study of motivation traditionally involves an analysis of the various factors that incite and direct an individual's action. In terms of the behaviorist approach, motivation can be defined as the extent to which certain stimulus objects or events affect the probability of occurrence or nonoccurrence of the behavior in question.

Included in the concept of academic motivation is achievement motivation, which Atkinson and Birch (1978) defined as the tendency to strive toward a goal when the factors present are the motivation to succeed, the probability of success, and incentives for success. The motive to succeed was defined by Madsen (1974) as a relatively general and stable characteristic of the person, which is present in any behavior situation.

These definitions, while ultimately convey the meaning of the concept of academic motivation, are appropriate to the present study to the extent that they describe the likely motivation of the target population to pursue and persist in the College of Engineering. In this study, therefore, the term "academic motivation" was not limited to achievement motivation because several other motivational factors such as affiliation and fear of failure have been identified in the literature (Biggs, 1982; Carpenter & Western, 1982). Thus, for the purpose of this study, the concept of achievement motivation (Atkinson & Birch, 1978) was integrated with that of academic motivation (Doyle & Moen, 1978; Moen & Doyle, 1977).

Little has been written about the internal motivation of minority students as far as academic excellence is concerned. Probably this is because internal motivation seems to derive from many underpinnings that are psychological, physical, and social in nature (Walton, 1979). But internal motivation is a highly desirable phenomenon that sets a student in motion to strive for unparalleled academic heights. The need for motivational programs for minority students was articulated by Landis (1976), who recognized that:

> Many minority engineering students succeed in inner-city schools with minimum effort. Standards maintained in mathematics and science courses in many inner-city schools are far below those in suburban schools. Minority students should be made aware from the start that they are undertaking a difficult course of study and that only through dedication and hard work will they succeed. . . . It is important that the student be aware that sacrifice and hard work now will pay off

> in terms of success later in his/her career. The pertinent motto of a program in the Midwest is "No deposit, no return." (p. 738)

Given that minority college students are already disadvantaged in terms of their poor entering characteristics, they will need to work harder than students from "better" school districts. Thus, a concerted, ongoing motivational program is of great importance to them and should pervade all aspects of any retention program. Minority students should have a clear perspective on the opportunities and rewards associated with an engineering career (Landis, 1976). As reported in a recent article in the New York Times (Marriot, 1990), many programs managed by colleges are now seeking better ways to motivate blacks to turn to college. These programs, from after-school engineering clubs to overnight visits to campus dormitories, give black students a chance to experience the flavor of college life and its challenges. The same approach can be extended to other minority groups, as well.

Motivational Factors and Influences

Because of differing interpretations of the concept of motivation, motivation specialists also differ in their identification of motivational factors and influences. The review of literature on motivational factors and influences revealed approximately 20 such factors, ranging from personal prestige and power to concern for national development (Biggs, 1982; Carpenter & Western, 1982; Hooper, 1983).

The question of who and what influences students' motives for an education has been addressed to some extent by educators. Teachman (1987) believed that parents have the greatest influence on students' motives for pursuing an education. Parents use material and nonmaterial resources to create a home atmosphere that fosters academic skills, motivation, and orientation (Teachman, 1987). Yet others, like Bardouille (1981), have argued that parental influence is not as great as that of the educational system itself.

Writers have generally agreed that it is difficult to measure motivation directly (Schroth, 1979). Most motivational researchers have used a survey approach to identify factors that influence motivation toward particular behaviors (Day, 1987). Because of differing conceptions of motivation, motivation researchers have adopted existing instruments or devised instruments appropriate for their own research situations and purposes.

Summary

Studies designed to address the current underrepresentation of minorities in the engineering and scientific fields have focused primarily on recruitment, role modeling, readiness for academia, and counseling efforts. Studies of what motivates students to seek and persist in the engineering pipeline are still lacking. Pre-engineering programs have made a significant contribution to identifying and preparing potential minority engineering students. But institutions that have attracted potential minority engineers face the challenge of retaining these students until they graduate.

Thus, programs beyond enrichment and recruitment are necessary if the problem of underrepresentation of minorities in engineering fields is to be solved. Planners of such programs may find it necessary to involve students' family members, community leaders, professional people, religious leaders, and teachers at all levels.

The research design and methodology of the study are described in Chapter III. The focus of the study was on academic interests and influences from the perspective of freshman minority engineering students at MSU.

CHAPTER III

RESEARCH DESIGN AND METHODOLOGY

Introduction

The primary purpose of this study was to examine minority freshman engineering students' motivation in seeking an engineering degree. More specifically, the researcher sought to identify and analyze the academic interests of and other motivational influences on minority engineering freshmen entering the College of Engineering at Michigan State University. The secondary purpose of the study was to determine whether selected demographic characteristics of respondents, parents' income and educational levels, size and type of home community, and respondents' social background had an affect on the respondents' perceptions of academic interests and motivational factors and influences.

The research design included the use of a survey instrument in the form of a questionnaire developed by the researcher (see Appendix A). Based on the review of related literature on academic interests and motivational factors and influences, the survey instrument was constructed to incorporate some of the academic interests and motivational factors and influences. The questionnaire included 30 academic interests and 31 motivational factors and influences. For each of the academic interests,

respondents were asked to indicate the extent to which they agreed or disagreed that the said academic interest was a reason for seeking an engineering degree. Likewise, for each of the motivational factors and influences, respondents were required to indicate the amount of influence the said factor had for seeking an engineering degree. Nine other questionnaire items sought to identify the respondents' demographic characteristics and some general information about the respondents' background.

Population and Sample

The population for the study comprised all minority freshman engineering students (blacks, Hispanics, and Native Americans) at MSU for the 1989-90 academic year. Although Asian Americans are minorities in the United States, the group is not considered a minority in the College of Engineering because they are proportionally overrepresented in the college. Thus, Asian American freshman students in the College of Engineering were excluded from the study.

About 254 minority students enrolled for the first time as freshmen in the College of Engineering at MSU in Fall 1989. In addition, about 70 minority freshman students who joined the college earlier, but later than 1989, were still freshmen. Consequently, the overall target population of the study consisted of approximately 324 minority freshman students enrolled in the College of Engineering at MSU for the 1989-90 academic year. Records from the Office of the Registrar at MSU and the Engineering Student

Affairs Office indicated that, of the total 254 minority freshman engineering students who first registered in Fall 1989, 224 (88%) were blacks, 21 (8%) were Hispanics, and 9 (4%) were Native Americans.

A random sample of 250 freshman minority engineering students was selected for the study. In selecting the sample, the researcher attempted to ensure that the number of respondents in each gender and ethnic group was proportional to their representation in the engineering student population.

Instrumentation

The survey questionnaire used in the study was developed by the researcher using selected motivational factors and influences identified in the literature. The questionnaire was divided into three sections. Section A consisted of 30 statements expressing academic interests. For each of the statements, the respondents were asked to rate the extent to which they agreed or disagreed that the expressed academic interest was the reason for seeking an engineering degree. The measurement used was of the Likert-type scale given by:

1 = Strongly disagree
2 = Disagree
3 = Agree
4 = Strongly agree

In Section B, 31 influences (people and situations) were provided. On an ordinal Likert-type scale in which

1 = No influence
2 = Little influence
3 = Some influence

4 = Much influence
5 = Great influence

respondents were asked to rate the extent to which each stated individual or situation had influenced their decision to study for an engineering degree.

Section C of the questionnaire was designed to collect demographic information on the respondents. Some of the demographic questionnaire items concerned the respondent's home background, the environment in which the respondent had been raised, whether the respondent had participated in a precollege program (e.g., DAPCEP, Upward Bound, ASPIRE) while in high school, and the approximate number of hours the respondent studied each week.

To establish the content validity of the questionnaire, an earlier version of the instrument, which also contained some open-ended questions, was pilot tested. The pilot test involved distributing the questionnaire to 12 beginning sophomore minority students in the College of Engineering at MSU in April 1990. Pilot testing was done to check the clarity of the items. The responses from the pilot test were used to further develop and edit the questionnaire before it was sent to the sample drawn from the target population.

Cronbach's alpha reliability coefficient was used to estimate the internal consistency measure of the reliability of the questionnaire regarding the responses to the academic interests and motivational factors and influences (see Appendix B). The following alpha coefficients were obtained:

Academic interests (30 items)	0.973
Economic interests (9 items)	0.970
Motivational factors and influences (31 items)	0.740
Institutional factors and influences (12 items)	0.360
Family factors and influences (17 items)	0.496
Role-modeling factors and influences (9 items)	0.753
Overall interests, factors, and influences (61 items)	0.930

Various researchers have determined different levels of alpha coefficient to be acceptable for the study. For example, Day (1987) set alpha of 0.6 to be an acceptable level of internal consistency. In this study, although the alpha coefficients of institutional and family motivational factors and influences were 0.36 and 0.50, respectively, the overall alpha coefficient was 0.74 for the 31 motivational factors and influences and 0.97 for the academic interests. The overall alpha coefficient for both academic interests and motivational factors and influences (61 items) was 0.93, which was fairly high.

To enhance the credibility of the study, a cover letter accompanied each questionnaire to explain the purpose of the study. Both the cover letter and the instrument were checked and approved by the University Committee on Research Involving Human Subjects at MSU before being sent to the respondents.

Data Collection

With the help of the office of Engineering Equal Opportunity Programs (EEOP), the Engineering Student Affairs Office, and the Registrar's Office at MSU, a list of all freshman minority

engineering students was compiled. The list constituted the sampling frame for the study. From this list, a simple random sample of 250 freshman minority engineering students was selected to participate in the study. From the Engineering Student Affairs Office and the EEOP office, the addresses of the participants were identified. Survey questionnaires with stamped return envelopes were then mailed to all the study participants through the EEOP office. Respondents were asked to mail back the completed questionnaire through the U.S. mail or to drop it in any on-campus mail box.

To ensure a high return rate, frequent announcements were made at regular minority engineering students' meetings to encourage those who had received the questionnaire to respond. This procedure helped the investigator maximize the survey response rate without using the conventional methods of follow-up surveys. Moreover, it would have been difficult to implement a follow-up survey because the respondents' identities were anonymous.

In all, 215 freshman engineering minority students responded to the survey, a return rate of 86%. This number represented about 66% of all freshman minority engineering students at MSU in the 1989-90 academic year. Although a traditional follow-up survey was not done, it may still be concluded that the 215 (86%) questionnaires represent a fairly high return rate.

Data Analysis

The study was primarily descriptive in nature, using simple descriptive statistics in the form of means, standard deviations,

frequencies, percentages, and ranks. Because most of the questionnaire items used in the study were answered using an ordinal Likert-type scale, means, standard deviations, and ranks were used to determine the extent to which academic interests and influences motivated minority students to seek an engineering degree. The mean ratings for the academic interests had a possible value in the range from 1.00 to 4.00. Similarly, the mean ratings for the motivational factors and influences could range from a low of 1.00 to a high of 5.00. A high mean rating might be interpreted to mean that academic interest was the reason for seeking an engineering degree or that the motivational factor and influence had a great influence on the minority student's seeking an engineering degree. Intermediate mean values can be interpreted according to their distance from the minimum or maximum value.

The chi-square test of statistical significance was used to determine whether statistically significant relationships existed between academic interests and certain demographic characteristics of the respondents. A two-sample t-test was also used to determine the significance of the difference in the amount of influence between institutional and family influences and the differences in perceptions between male and female respondents. The .05 alpha level was used as the criterion for statistical significance.

The following ten research questions were addressed in this study:

1. What are the perceived academic interests of minority students who seek an engineering degree?

2. What are the perceived motivational factors and influences of minority students to seek an engineering degree?

3. Do the academic interests of minority students vary with their parents' level of income?

4. Do the motivational factors and influences of minority students vary with their parents' level of income?

5. Is there a statistically significant difference in motivational factors and influences between male and female respondents?

6. Is there a statistically significant difference in the perceived amount of influence between institutional and family/individual motivational factors and influences?

7. To what extent do economic-related interests influence minority students to seek an engineering degree?

8. To what extent do role models influence minority students to seek an engineering degree?

9. Do the perceived academic interests of minority students vary with their parents' educational level?

10. Do the motivational factors and influences of minority students vary with their parents' educational level?

The Statistical Package for the Social Sciences (SPSS-X) was used in analyzing the data for this study. The data-analysis procedures were performed to answer the research questions in the following manner.

Research Question 1. What are the perceived academic interests of minority students who seek an engineering degree?

Percentages of responses to each response option (Strongly Disagree, Disagree, Agree, Strongly Agree) and the mean of the responses were computed for each of the 30 academic interests. Based on the mean ratings, the academic interests were ranked; the academic interest with the highest mean took rank 1, whereas the academic interest with the lowest mean took rank 30.

Research Question 2. What are the perceived motivational factors and influences of minority students to seek an engineering degree?

Percentages of responses to each response option (No Influence, Little Influence, Some Influence, Much Influence, Great Influence) and the mean of the responses were computed for each of the 31 motivational factors and influences. Based on the mean ratings, the motivational factors and influences were ranked; the factor with the highest mean took rank 1, whereas the factor with the lowest mean took rank 31.

Research Question 3. Do the academic interests of minority students vary with their parents' level of income?

Parents' level of income was collapsed into three levels: (a) less than $30,000, (b) $30,000-$49,999, and (c) $50,000 or more. A chi-square test of statistical significance was used to determine whether there was a statistically significant relationship between respondents' perceptions of academic interests and their parents' level of annual income.

Research Question 4. Do the motivational factors and influences of minority students vary with their parents' level of income?

A chi-square test of statistical significance was used to determine whether there was a statistically significant relationship between respondents' perceptions of the motivational factors and influences and their parents' level of annual income. The three levels of parental income shown under Research Question 3 above were used in the cross-tabulations.

Research Question 5. Is there a statistically significant difference in motivational factors and influences between male and female respondents?

Separate mean ratings of perceptions for each of the 31 motivational factors and influences were computed. An independent two-sample t-test was used to determine whether there was a statistically significant difference in male and female respondents' perceptions of the motivational factors and influences.

Research Question 6. Is there a statistically significant difference in the perceived amount of influence between institutional and family/individual motivational factors and influences?

Thirteen institutional and seven family/individual motivational factors and influences were part of the 31 motivational factors and influences. The statements for each category included the following:

Institutional	Family/Individual
Teachers	Parents
Religious leaders	Brothers and/or sisters
Community leaders	Other relatives

Professional people

Seeing how people with degrees live

Seeing how people without degrees live

High school teacher

High school counselor

Information received from a college

A visit to a college campus

A member of the college faculty

Participation in a science fair

Participation in a precollege program

Friends

Myself

The needs of my family

My own interests/aptitudes

Perceptions of the 13 institutional motivational factors and influences were combined to form one measure of institutional influence. Similarly, perceptions of the seven family/individual motivational factors and influences were combined to form one measure of family/individual influence. A paired t-test was used to determine whether there was a statistically significant difference in respondents' perceptions of influence between institutional and family/individual motivational factors and influences.

Research Question 7. To what extent do economic-related interests influence minority students to seek an engineering degree?

Among the 30 academic interests included in the questionnaire, nine were economic related. These items included:

Increase opportunities for employment
Help secure a well-paying job
Assure a comfortable standard of living
Provide an escape from poverty

Assist in competing for employment
Lead to monetary advantage
Enhance my chances of employment
Help me earn good money
Offer a stepping-stone to job promotions

Means, standard deviations, and overall rank of the perceptions of each of the nine items were computed. A measure of the overall perception of the economic-related interests was computed by combining the perceptions of all nine of the items. The alpha coefficient for internal consistency and reliability among the nine economic-related interests was 0.97.

Research Question 8. To what extent do role models influence minority students to seek an engineering degree?

Nine motivational factors and influences of the total 31 involved role modeling. These items included:

Brothers and/or sisters
Teachers
Religious leaders
Community leaders
Professional people
Seeing how people with degrees live
Seeing how people without degrees live
A professional engineer
A member of the college faculty

Means, standard deviations, and overall rank of the perceptions of each of the nine items were computed. A measure of the overall perception of the role-modeling motivational factors and influences was computed by combining the perceptions of all nine of the items. The alpha coefficient for internal consistency and reliability of the nine role-model factors was 0.75.

Research Question 9. Do the perceived academic interests of minority students vary with their parents' educational level?

The respondents' fathers' and the mothers' levels of education were collapsed into three levels: (a) nondegree, (b) associate degree, and (c) degree. A chi-square test of statistical significance was used to determine whether there was a statistically significant relationship between respondents' perceptions of each academic interest and their parents' levels of education.

Research Question 10. Do the motivational factors and influences of minority students vary with their parents' educational level?

Using the respondents' fathers' and mothers' level of education as shown in Research Question 9 above, a chi-square test of statistical significance was used to determine whether there was a statistically significant relationship between respondents' perceptions of each motivational factor and influence and their parents' levels of education.

Summary

The research design and methodology of the study were presented in this chapter. The population and sample were described, as was the survey instrument used in the study. An overview of the data-analysis methods for each research question was also presented. The data analyses and study findings are discussed in Chapter IV.

CHAPTER IV

PRESENTATION AND ANALYSIS OF THE DATA

Introduction

The primary purpose of this study was to examine minority freshman engineering students' motivation in seeking an engineering degree at Michigan State University. The specific focus was to identify the academic interests of and other significant influences on these students, as perceived by the students themselves. The study was designed to provide answers to the research questions presented in Chapter I. In this chapter, the results of the data analysis are presented in two sections. In the first section, respondents are described in terms of their demographic characteristics. The findings pertaining to the research questions are presented in the second section.

Demographic Characteristics of the Respondents

In all, 215 freshman minority engineering students at MSU participated in the study. Of that number, 199 (93%) were blacks, 8 (4%) were Hispanics, 2 (1%) were Native Americans, and 6 (3%) did not indicate their ethnicity. One hundred fifteen respondents (53%) were male and 100 (47%) were female. Respondents ranged in age from 17 years to 22 years. In terms of their field of interest in the College of Engineering, 65 (30%) were interested in electrical

engineering, 53 (24%) in computer science, 42 (20%) in mechanical engineering, 22 (10%) in chemical engineering, and the remaining 34 (16%) in other engineering fields (engineering arts, civil engineering, and agricultural engineering).

The distribution of respondents by gender and selected demographic characteristics (parental income and educational level) is presented in Table 4.1. Of the 208 respondents who indicated their parents' income level and/or educational level, 111 (53.4%) were male and 97 (46.6%) were female. The majority of respondents (37.4%) indicated that their parents' annual income was no more than $30,000.

Table 4.1.--Distribution of respondents by gender, parental income, and parents' educational level.

Demographic Characteristic	Response	Male		Female		All	
		n	%	n	%	n	%
Parental income	< $30,000	40	54.1	34	45.9	74	37.4
	$30,000-$49,999	34	58.6	24	41.4	58	29.3
	$50,000 or more	34	51.5	32	48.5	66	33.3
Father's educational level	Nondegree	47	57.3	35	42.7	82	40.4
	Assoc. degree	30	53.6	26	46.4	56	27.6
	Degree	33	50.8	32	49.2	65	32.0
Mother's educational level	Nondegree	59	62.1	36	37.9	95	45.7
	Assoc. degree	26	56.5	20	43.5	46	22.1
	Degree	26	38.8	41	61.2	67	32.2
Total		111	53.4	97	46.6	208	100.0

In terms of parents' educational level, 82 (40.4%) of the respondents indicated that their fathers had no college degree, and 95 (45.7%) said that their mothers had no college degree. However, 66 (33.3%) respondents indicated that their parents earned at least $50,000 a year. One hundred twenty-one respondents (59.6%) indicated that their fathers had at least an associate's degree, and 113 (54.3%) said their mothers held an associate's degree. From Table 4.1 it can also be seen that a higher percentage of female (61.2%) than male (38.8%) respondents reported that their mothers had a college degree. The data did not show a similar trend regarding fathers' educational level.

Respondents were also asked to indicate whether they had participated in a precollege engineering program before entering college. Of the 212 who responded to the question, 130 (61%) had not participated in any precollege engineering program, 37 (18%) had participated in the Detroit Area Pre-college Engineering Program (DAPCEP), and 44 (21%) had participated in other precollege programs before entering MSU.

The survey responses also indicated that the freshman minority engineering students at MSU came from different social backgrounds. Table 4.2 shows the distribution of respondents by the size and type of their home communities and the household backgrounds in which they were raised. As shown in the table, a majority of the respondents (55.3%) came from the inner city; the lowest percentage (3.3%) came from suburban areas. In terms of household background in which they were raised, 115 respondents (54.5%) indicated they

were raised by both parents, whereas 91 (43.1%) were raised in single-parent homes. Of those 91, 85 (93.4%) were raised by their mothers, and 6 (6.6%) were raised by their fathers. Five respondents (2.4%) said they were raised by someone other than their mother or father.

Table 4.2.--Distribution of respondents by size and type of home community and family background.

Demographic Characteristic	Response	n	%
Size and type of home community	Inner city	119	55.3
	Outer city	7	3.3
	Suburb	16	7.4
	Small city	33	15.4
	Large town	25	11.6
	Small town	11	5.1
	Uncertain	4	1.9
Household background	Both parents	115	54.5
	Single parent	91	43.1
	Mother	85	40.3
	Father	6	2.8
	Other	5	2.4

Respondents were also asked to indicate the approximate number of hours they spent studying each week and the approximate amount of expectation they perceived each of their parents had that they would successfully graduate from college. A four-point Likert-type scale ranging from 1 (low expectations) to 4 (very high expectations) was used to indicate the amount of expectation respondents' parents had that their son/daughter would graduate from college.

Table 4.3 shows the distribution of respondents by gender, number of hours spent studying weekly, and the expectations parents had that their son/daughter would graduate from college. One hundred three respondents (48.9%) spent, at most, 15 hours studying per week, 65 (30.8%) spent between 16 and 20 hours, and 43 (20.4%) studied at least 20 hours a week. The majority of respondents (58.3%) who spent no more than 15 hours studying each week were males.

Table 4.3.--Distribution of respondents by gender, weekly study hours, and parents' expectations that they will graduate from college.

Demographic Characteristic	Response	Male		Female		All	
		n	%	n	%	n	%
Weekly study hours	15 hrs or less	60	52.6	43	44.3	103	48.8
	16-20 hours	29	25.4	36	37.1	65	30.8
	21 hrs or more	25	21.9	18	18.6	43	20.4
Father's expectation level	Low	4	2.9	1	1.3	5	2.6
	Average	11	10.5	13	14.6	24	12.4
	High	32	30.5	17	19.1	49	25.3
	Very high	58	55.2	58	65.2	116	59.8
Mother's expectation level	Low	1	0.9	1	1.0	2	0.9
	Average	7	6.3	4	4.0	11	5.2
	High	23	20.5	16	16.0	39	18.4
	Very high	80	71.4	79	79.0	160	75.5

Regarding parents' expectations that the respondents would graduate from college, 160 (75%) of the mothers were said to have very high expectations, compared to 116 (59.8%) of the fathers.

Overall, very few respondents (less than 3%) indicated that either their father or their mother had low expectations that they would graduate from college. Although the expectations of mothers were perceived uniformly by both male and female respondents, the data indicated that fathers had slightly higher expectations for their daughters (65.2%) than for their sons (55.2%).

Presentation of Research Findings

The findings pertaining to the ten research questions are presented in the remainder of this chapter. Each research question is restated, followed by a presentation of the findings related to that question.

Research Question 1. What are the perceived academic interests of minority students who seek an engineering degree?

Respondents were presented with 30 possible academic interests for seeking an engineering degree. For each of the stated academic interests, respondents were asked to rate the extent to which they agreed or disagreed that the interest was the reason for seeking an engineering degree, using the following four-point Likert-type scale:

1 = Strongly disagree (SD)
2 = Disagree (D)
3 = Agree (A)
4 = Strongly agree (SA)

Percentages of responses to each option (SD, D, A, SA) and the mean of the responses were computed for each academic interest. The scale being of an ordinal type, a high mean rating near 4.00 indicated strong agreement that the academic interest was the reason

for seeking an engineering degree, whereas a low mean near 1.00 indicated strong disagreement. Based on the mean ratings, the 30 academic interests were ranked; the academic interest with the highest mean rating took rank 1, and the interest with the lowest mean rating took rank 30.

The percentages of responses in each response category, the mean ratings, and ranks for the 30 academic interests are shown in Table 4.4. As shown in the table, the mean ratings were above 3.00 for 29 of the 30 academic interests. The mean rating was under 3.00 for the academic interest **Assure me respect in society** (mean = 2.938, rank = 30). These observed mean ratings indicate that respondents agreed or strongly agreed that the 29 academic interests were reasons for their seeking an engineering degree. The highest mean ratings were observed on the academic interests **Increase my professional abilities** (mean = 3.637, rank = 1), **Give me a sense of accomplishment** (mean = 3.623, rank = 2), **Increase opportunities for employment** (mean = 3.617, rank = 3), **Help secure a well-paying job** (mean = 3.551, rank = 4), and **Give personal satisfaction** (mean = 3.551, rank = 5). On the other hand, the lowest mean ratings were observed for the following academic interests: **Assure me respect in society** (mean = 2.938, rank = 30), **Expand my world view** (mean = 3.042, rank = 29), **Equip me for facing life's difficulties** (mean = 3.057, rank = 28), **Help secure management positions** (mean = 3.146, rank = 27), and **Help me serve my community** (mean = 3.209, rank = 26).

Table 4.4.--Percentages, mean responses, and ranks of the academic interests of minority students seeking an engineering degree.

Academic Interest	Response (%)				Mean	Rank
	SD	D	A	SA		
Increase my professional abilities	-	-	36.3	63.7	3.637	1
Give me a sense of accomplishment	-	0.5	36.8	62.7	3.623	2
Increase opportunities for employment	-	2.3	33.6	64.0	3.617	3
Help secure a well-paying job	-	4.7	35.5	59.8	3.551	4
Give personal satisfaction	0.5	3.3	36.9	59.3	3.551	5
Help me earn good money	-	1.4	43.2	55.4	3.540	6
Assist in competing for employment	-	1.9	43.9	54.2	3.523	7
Enhance my chances of employment	-	2.8	43.5	53.7	3.509	8
Provide professional specialization	-	2.4	45.0	52.6	3.502	9
Prepare me for graduate studies	0.9	3.3	42.3	53.5	3.484	10
Provide opportunities for further education	-	2.3	47.2	50.5	3.481	11
Assure a comfortable standard of living	0.5	5.1	40.7	53.7	3.477	12
Expand my academic development	-	3.8	49.1	47.2	3.434	13
Offer stepping-stones to job promotions	1.4	4.3	45.5	48.8	3.417	14

Table 4.4.--Continued.

Academic Interest	Response (%)				Mean	Rank
	SD	D	A	SA		
Help assure the life-style I desire	0.5	5.7	47.2	46.7	3.401	15
Help me achieve a higher post in my profession	0.5	6.2	46.4	46.9	3.398	16
Lead to monetary advantage	0.5	3.3	53.1	43.1	3.389	17
Give concrete knowledge in my field	-	4.7	53.5	40.5	3.363	18
Increase my status in society	1.4	7.5	47.7	43.5	3.332	19
Lead to master's or Ph.D. degree	0.5	9.9	47.2	42.5	3.316	20
Develop abilities to serve minorities	1.9	8.4	53.5	36.3	3.242	21
Assure prestige	1.4	10.8	50.7	37.1	3.235	22
Provide escape from poverty	4.8	9.1	44.2	41.8	3.231	23
Give me confidence to face life	0.9	12.7	50.7	35.7	3.211	24
Develop skills for daily life	1.4	8.8	57.2	32.6	3.209	25
Help me serve my community	0.9	7.9	60.5	30.7	3.209	26
Help secure mgt. position	0.9	17.0	48.6	33.5	3.146	27
Equip me for facing life's difficulties	2.4	19.5	48.1	30.0	3.057	28
Expand my world view	-	23.1	49.5	27.4	3.042	29
Assure respect in society	4.3	25.6	42.2	28.0	2.938	30

Note: SD = Strongly disagree, D = Disagree, A = Agree, SA = Strongly Agree.

Research Question 2. What are the perceived motivational factors and influences of minority students to seek an engineering degree?

Respondents were presented with 31 situations or individuals who might have influenced their decision to study for an engineering degree. For each situation or individual, respondents were asked to rate the extent to which the situation or individual had influenced their decision, using the following five-point Likert-type scale:

1 = No influence (NI)
2 = Little influence (LI)
3 = Some influence (SI)
4 = Much influence (MI)
5 = Great influence (GI)

Percentages of responses to each option (NI, LI, SI, MI, GI) and the mean of the responses were computed for each of the 31 motivational factors and influences. As in Research Question 1, an ordinal-type scale was used. Thus, the mean rating took possible values ranging from 1.00 to 5.00; a low mean near 1.00 indicated a low influence, and a high mean near 5.00 indicated a high influence. The 31 influential factors were ranked in order of the magnitude of their means; the influence with the highest mean took rank 1, and the one with the lowest mean rating took rank 31.

Table 4.5 shows the percentages of responses to each response option, the mean rating, and the rank for each of the 31 influences. As shown in the table, the mean ratings ranged from a low of 2.308 to a high of 4.713. Mean ratings of 4.00 or higher were observed for the following motivational factors and influences: **My own interests/aptitudes** (mean = 4.712, rank = 1), **Myself** (mean = 4.681,

Table 4.5.--Percentages, mean responses, and ranks of the motivational factors and influences of minority students seeking an engineering degree.

Motivational Factors and Influences	Response (%)					Mean	Rank
	NI	LI	SI	MI	GI		
My own interests/ aptitudes	-	0.5	-	27.4	72.2	4.712	1
Myself	0.9	1.4	5.2	13.6	78.9	4.681	2
Salaries earned by engineers	-	-	4.2	26.9	68.9	4.646	3
Job opportunities in engineering	-	-	4.2	28.3	67.5	4.632	4
Prestige/status associated with engineers	0.5	-	13.9	36.4	49.3	4.340	5
A professional engineer	1.4	1.4	18.8	33.2	45.2	4.192	6
What I know about the value of a degree	1.4	1.9	22.1	32.9	41.8	4.117	7
Seeing how people without degrees live	5.7	6.6	15.6	23.1	49.1	4.033	8
Information received from a college	0.9	1.4	13.2	64.2	20.3	4.014	9
High school teacher(s)	1.4	1.9	21.7	49.1	25.9	3.962	10
A visit to a college campus	1.9	0.5	27.9	43.8	26.0	3.913	11
Contact with industry	2.0	2.0	34.3	37.3	24.5	3.804	12
Seeing how people with degrees live	5.6	11.7	21.0	22.0	39.7	3.785	13
High school counselor	4.3	3.8	26.1	41.2	24.6	3.782	14
Friends	2.8	2.4	28.8	51.9	14.2	3.772	15

Table 4.5.--Continued.

Motivational Factors and Influences	Response (%)					Mean	Rank
	NI	LI	SI	MI	GI		
Professional people	7.1	9.0	19.0	35.5	29.4	3.711	16
Participation in pre-college program	5.4	1.5	35.1	36.1	21.8	3.673	17
Parents	10.3	9.4	23.0	20.7	36.6	3.638	18
Media presentation (TV, magazines, etc.)	1.4	2.4	45.7	37.1	13.3	3.586	19
A member of the college faculty	3.8	2.4	44.0	35.9	13.9	3.536	20
Other factors	17.6	5.9	23.5	11.8	41.2	3.529	21
The need of my family	12.2	12.2	19.7	26.8	29.1	3.484	22
Participation in a science fair	4.9	2.4	56.6	26.8	9.3	3.332	23
Teachers	13.6	12.6	30.4	27.1	16.4	3.201	24
Friends	15.0	19.6	30.8	20.1	14.5	2.995	25
Help me serve my community	18.3	16.9	29.1	20.2	15.5	2.977	26
The need of my community	14.5	23.4	28.0	22.0	12.1	2.939	27
Brothers and/or sisters	26.8	17.7	24.9	14.4	16.3	2.756	28
The need of my country	23.5	24.5	24.0	18.6	9.3	2.657	29
Religious leaders	41.0	15.7	21.9	12.4	9.0	2.329	30
Community leaders	37.5	19.7	24.5	11.1	7.2	2.308	31

Note: NI = No influence, LI = Little influence, SI = Some influence, MI = Much influence, GI = Great influence.

rank = 2), **Salaries earned by engineers** (mean = 4.646, rank = 3), **Job opportunities in engineering** (mean = 4.632, rank = 4), **Prestige/status associated with engineers** (mean = 4.340, rank = 5), **A professional engineer** (mean = 4.192, rank = 6), **What I know about the value of a degree** (mean = 4.117, rank = 7), **Seeing how people without degrees live** (mean = 4.033, rank = 8), and **Information received from a college** (mean = 4.014, rank = 9).

Low mean ratings were observed for the influences of the following: **Community leaders** (mean = 2.308, rank = 31), **Religious leaders** (mean = 3.239, rank = 30), **The need of my country** (mean = 2.657, rank = 29), **Brothers and/or sisters** (mean = 2.756, rank = 28) and **The need of my community** (mean = 2.939, rank = 27).

Research Question 3. Do the academic interests of minority students vary with their parents' level of income?

Parents' level of income was collapsed into three levels: (a) less than $30,000, (b) $30,000-$49,999, and (c) $50,000 or more. A chi-square test of statistical significance was used to determine whether there was a statistically significant relationship between respondents' perceptions of academic interests and their parents' annual income level. Table 4.6 shows the chi-square values and their corresponding observed significance level for the relationship between respondents' perceptions of each of the 30 academic interests and their parents' educational level.

Table 4.6.--Chi-square results for the relationship between respondents' perceptions of each of the 30 academic interests and their parents' income level.

Academic Interest	Chi-Square Value	df	p-Value
Develop skills for daily life	5.750	6	.452
Increase my professional abilities	9.632	2	.008*
Help me serve my community	1.808	6	.936
Prepare me for graduate studies	9.072	6	.170
Assure prestige	4.349	6	.630
Develop abilities to serve minorities	4.886	6	.558
Increase my status in society	4.834	6	.565
Increase opportunities for employment	4.518	4	.340
Provide professional specialization	4.767	4	.312
Help secure a well-paying job	7.543	4	.110
Assure a comfortable standard of living	4.242	6	.644
Provide opportunities for further education	1.607	4	.808
Give personal satisfaction	7.043	6	.317
Provide an escape from poverty	10.826	6	.094
Lead to master's or Ph.D. degree	7.638	6	.266
Assist in competing for employment	3.208	4	.524
Lead to monetary advantage	5.861	6	.439
Enhance my chances of employment	2.512	4	.642
Assure respect in society	7.810	6	.252
Give concrete knowledge in my field	9.106	4	.059

Table 4.6.--Continued.

Academic Interest	Chi-Square Value	df	p-Value
Give me confidence to face life	11.572	6	.072
Help me earn good money	5.700	4	.223
Help me achieve a higher post in my profession	4.245	6	.644
Help assure the life-style I desire	1.359	4	.851
Expand my academic development	1.821	4	.769
Help secure management position	7.804	6	.253
Expand my world view	4.396	4	.355
Equip me for facing life's difficulties	2.965	6	.813
Give me a sense of accomplishment	2.692	4	.611
Offer stepping-stones to job promotions	7.276	6	.296

*Significant at the .05 level.

As shown in Table 4.6, a statistically significant relationship was found between parents' level of income and respondents' perceptions of the academic interest of **Increase my professional abilities** (chi-square = 9.632, $p < .05$). The data showed that significantly more respondents whose parents made less than $30,000 a year strongly agreed that **Increase my professional abilities** was a reason for seeking an engineering degree than did respondents whose parents made $40,000 or more a year. This trend was evident from

the cell frequencies and percentages; of the 74 respondents whose parents made less than $30,000 annually, 55 (74.3%) strongly agreed that **Increase my professional abilities** was a reason for seeking an engineering degree, compared to 28 (48%) of the middle income ($30,000-$49,999) earners and 43 (65%) of the high income ($50,000 or more) earners. No statistically significant relationship was observed between parents' income level and respondents' perceptions of the remaining 29 academic interests.

Research Question 4. Do the motivational factors and influences of minority students vary with their parents' level of income?

A chi-square test of statistical significance was used to determine whether there was a statistically significant relationship between respondents' perceptions of the motivational factors and influences and their parents' annual income level. The three levels of parental income shown under Research Question 3 were used in these cross-tabulations. Table 4.7 shows the chi-square values and their corresponding observed significance levels for the relationship between respondents' perceptions of each of the 31 motivational factors and influences and their parents' income level.

As shown in the table, statistically significant relationships were found between parents' income level and respondents' perceptions of the following motivational factors and influences: **Parents** (chi-square = 15.947, $p < .05$), **What I know about the value of a degree** (chi-square = 17.184, $p < .05$), and **The needs of my family** (chi-square = 32.00, $p < .05$).

Table 4.7.--Chi-square results for the relationship between respondents' perceptions of each of the 31 motivational factors and influences and their parents' income level.

Motivational Factors and Influences	Chi-Square Value	df	p-Value
Parents	15.947	8	.043*
Brothers and/or sisters	2.060	8	.979
Help me serve my community	2.951	8	.937
Friends	6.633	8	.621
Teachers	10.760	8	.216
Religious leaders	9.830	8	.277
Community leaders	3.044	8	.932
Professional people	7.590	8	.474
Myself	7.432	8	.491
Seeing how people with degrees live	7.354	8	.499
Seeing how people without degrees live	6.238	8	.621
What I know about the value of a degree	17.184	8	.028*
The need of my family	32.000	8	.000*
The need of my community	10.870	8	.209
The need of my country	10.539	10	.395
High school teacher(s)	7.900	8	.443
High school counselor	5.394	8	.715
Information received from a college	9.228	8	.323
Friends	6.936	8	.544
A professional engineer	11.372	8	.182

Table 4.7.--Continued.

Academic Interest	Chi-Square Value	df	p-Value
My own interests/aptitudes	2.677	4	.613
A visit to a college campus	9.483	8	.303
Job opportunities in engineering	1.412	4	.842
Salaries earned by engineers	2.452	4	.653
Prestige/status associated with engineers	3.337	6	.766
A member of the college faculty	4.533	8	.806
Media presentation (TV, magazines, etc.)	9.902	8	.272
Participation in a science fair	6.064	8	.640
Participation in precollege program	3.352	8	.910
Contact with industry	12.598	8	.126
Other factors	16.741	8	.033*

*Significant at the .05 level.

The data showed that more respondents whose parents earned less than $30,000 perceived **Parents** to have less influence than did respondents whose parents earned $30,000 or more annually. Also, as evidenced by the cell frequencies, a higher percentage of respondents (66.7% and 75%) whose parents earned at least $30,000 indicated that the influence of **What I know about the value of a degree** had less influence, whereas a higher percentage of respondents (51.2%) whose parents earned less than $30,000 perceived

this motivational factor to have a great influence. Furthermore, the motivational factor of **The need of my family** was considered to have great influence by the majority of respondents (72%) whose parents earned less than $30,000, whereas the majority of respondents (64%) whose parents earned at least $50,000 perceived the same motivational factor to have little influence. No statistically significant relationship was observed between parents' income level and the respondents' perceptions of the remaining 27 motivational factors and influences.

Research Question 5. Is there a statistically significant difference in motivational factors and influences between male and female respondents?

Separate mean ratings were computed for the respondents' perceptions of each of the 31 motivational factors and influences. An independent two-sample t-test was used to determine whether there was a statistically significant difference between male and female respondents' perceptions of the motivational factors and influences. The t-test results are presented in Table 4.8.

As shown in the table, statistically significant differences were found between male and female respondents' perceptions of the following motivational factors and influences: **My own interests/ aptitudes** ($t = 2.24$, $p < .05$) and **Media presentations** ($t = -2.04$, $p < .05$). Male respondents perceived **My own interests/aptitudes** to have greater influence than did female respondents. Female respondents perceived **Media presentations (TV, magazines, etc.)** to have greater influence than did male respondents. No statistically

Table 4.8.--T-test results for differences in males' and females' perceptions of the motivational factors and influences.

Motivational Factors and Influences	Male		Female		t-Value	p-Value
	Mean	SD	Mean	SD		
Parents	3.61	1.40	3.67	1.26	-0.32	.747
Brothers and/or sisters	2.88	1.38	2.62	1.44	1.31	.191
Help me serve my community	3.08	1.31	2.86	1.32	1.22	.225
Friends	3.14	1.21	2.83	1.30	1.81	.072
Teachers	3.25	1.28	3.14	1.22	0.67	.505
Religious leaders	2.43	1.43	2.21	1.26	1.14	.254
Community leaders	2.37	1.32	2.24	1.22	0.75	.457
Professional people	3.69	1.21	3.73	1.16	-0.22	.825
Myself	4.72	0.70	4.64	0.75	0.77	.439
Seeing how people with degrees live	3.81	1.19	3.76	1.30	0.28	.783
Seeing how people without degrees live	4.06	1.17	4.00	1.23	0.37	.710
What I know about the value of a degree	4.11	0.92	4.13	0.91	-0.21	.836
The need of my family	3.56	1.27	3.39	1.43	0.90	.367
The need of my community	2.96	1.28	2.92	1.19	0.21	.831
The need of my country	2.61	1.28	2.71	1.30	-0.55	.582
High school teacher(s)	3.96	0.84	3.97	0.82	-0.12	.908
High school counselor	3.80	1.04	3.77	0.96	0.23	.822

Table 4.8.--Continued.

Motivational Factors and Influences	Male		Female		t-Value	p-Value
	Mean	SD	Mean	SD		
Information received from a college	3.94	0.67	4.10	0.71	-1.72	.086
Friends	3.83	0.71	3.60	0.96	1.94	.054
A professional engineer	4.10	0.84	4.30	0.94	-1.62	.107
My own interests/ aptitudes	4.78	0.42	4.63	0.55	2.24	.026*
A visit to a college campus	3.85	0.87	3.99	0.84	-1.21	.220
Job opportunities in engineering	4.61	0.60	4.66	0.52	-0.74	.457
Salaries earned by engineers	4.65	0.56	4.64	0.56	0.08	.936
Prestige/status associated with engineers	4.34	0.80	4.34	0.69	-0.07	.943
A member of the college faculty	3.53	0.85	3.54	0.96	-0.09	.932
Media presentation (TV, magazines, etc.)	3.48	0.81	3.71	0.78	-2.04	.042*
Participation in a science fair	3.26	0.85	3.42	0.88	-1.37	.171
Participation in precollege program	3.55	0.95	3.83	1.06	-1.98	.049
Contact with industry	3.80	0.84	3.81	0.97	-0.13	.898
Other factors	3.83	1.53	2.80	1.48	1.28	.220

*Significant at the .05 level.

significant differences were observed between male and female respondents' perceptions of the remaining 29 motivational factors and influences.

Research Question 6. Is there a statistically significant difference in the perceived amount of influence between institutional and family/individual motivational factors and influences?

As indicated in Chapter III, 13 motivational factors and influences that were classified as being institutional were combined to form a measure of the respondents' perceptions of institutional motivational factors and influences. Similarly, seven factors that were classified as being family related were combined to form a measure of respondents' perceptions of family/individual motivational factors and influences. A paired t-test was used to determine whether there was a statistically significant difference in perceptions of influence between institutional and family/individual motivational factors and influences.

Institutional and family/individual motivational factors and influences had means of 3.514 and 3.615, respectively. These means were significantly different ($t = -2.55$, $p < .05$), indicating that family/individual factors were perceived to have a greater influence than institutional factors on minority students' seeking an engineering degree.

Research Question 7. To what extent do economic-related interests influence minority students to seek an engineering degree?

Of the 30 academic interests included in the questionnaire, nine were classified as economic-related interests. An overall

measure of economic interests was created by taking the average perceptions over all the nine economic-related interests. Table 4.9 presents the means and standard deviations of the perceptions of economic-related interests and the overall measure of economic-related interests.

Table 4.9.--Means, standard deviations, and overall ranks for respondents' perceptions of the economic-related interests for seeking an engineering degree.

Economic-Related Interest	Mean	SD	Rank
Increase opportunities for employment	3.617	0.533	3
Help secure a well-paying job	3.551	0.585	4
Help me earn good money	3.540	0.527	6
Assist in competing for employment	3.523	0.537	7
Enhance my chances of employment	3.509	0.554	8
Assure a comfortable standard of living	3.477	0.618	12
Offer stepping-stones to job promotions	3.417	0.645	14
Lead to monetary advantage	3.389	0.578	17
Provide an escape from poverty	3.231	0.807	23
Overall	3.472	0.422	

From Table 4.9 it can be seen that five economic-related interests were among the top-ten-ranked academic interests (see Table 4.4). These economic-related interests included **Increase opportunities for employment** (mean = 3.617, rank = 3), **Help secure a**

well-paying job (mean = 3.551, rank = 4), and Help me earn good money (mean = 3.540, rank = 6). The overall average for the nine economic-related interests was 3.472, with a standard deviation of 0.422.

Research Question 8. To what extent do role models influence minority students to seek an engineering degree?

Nine motivational factors and influences among the total 31 were classified as role modeling. An overall measure of respondents' perceptions of the influence of role modeling was determined by taking the average perceptions over all nine role-model motivational factors and influences. Table 4.10 shows the means and standard deviations of the role-model motivational factors and influences and the overall measure of role-model motivational factors and influences.

As shown in the table, two role-model-related motivational factors and influences were among the top-ten-ranked motivational factors and influences (see Table 4.5). These were A professional engineer (mean = 4.192, rank = 6) and Seeing how people without degrees live (mean = 4.033, rank = 8). On the other hand, three role-model-related motivational factors and influences were among the five lowest ranked motivational factors and influences. These were Community leaders (mean = 2.308, rank = 31), Religious leaders (mean = 2.329, rank = 30), and Brothers and/or sisters (mean = 2.757, rank = 27).

Table 4.10.--Means, standard deviations, and overall ranks for respondents' perceptions of the role-model motivational factors and influences for seeking an engineering degree.

Role-Modeling Factors and Influences	Mean	SD	Rank
A professional engineer	4.192	0.891	6
Seeing how people without degrees live	4.033	1.194	8
Seeing how people with degrees live	3.785	1.241	13
Professional people	3.711	1.186	16
A member of the college faculty	3.536	0.899	20
Teachers	3.201	1.249	24
Brothers and/or sisters	2.756	1.412	27
Religious leaders	2.329	1.356	30
Community leaders	2.308	1.275	31
Overall	3.317	0.690	

Research Question 9. Do the perceived academic interests of minority students vary with their parents' educational level?

Both the fathers' and mothers' levels of education were collapsed into three levels: (a) nondegree, (b) associate degree, and (c) degree. A chi-square test of statistical significance was used to determine whether there was a statistically significant relationship between respondents' perceptions of the 30 academic interests and their parents' educational level. Table 4.11 shows the chi-square results for the relationship between respondents' perceptions of each of the 30 academic interests and their fathers'

educational level. No statistically significant relationship was observed between fathers' educational level and respondents' perceptions of all 30 academic interests.

Table 4.11.--Chi-square results for the relationship between respondents' perceptions of each of the 30 academic interests and their fathers' educational level.

Academic Interest	Chi-Square Value	df	p-Value
Develop skills for daily life	3.890	6	.692
Increase my professional abilities	0.525	2	.769
Help me serve my community	3.908	6	.689
Prepare me for graduate studies	4.531	6	.605
Assure prestige	3.867	6	.695
Develop abilities to serve minorities	5.582	6	.472
Increase my status in society	4.986	6	.546
Increase opportunities for employment	3.553	4	.470
Provide professional specialization	1.356	4	.852
Help secure a well-paying job	0.552	4	.968
Assure a comfortable standard of living	2.744	6	.840
Provide opportunities for further education	2.598	4	.627
Give personal satisfaction	9.768	6	.135
Provide an escape from poverty	5.955	6	.428
Lead to master's or Ph.D. degree	4.935	6	.552
Assist in competing for employment	1.727	4	.786

Table 4.11.--Continued.

Academic Interest	Chi-Square Value	df	p-Value
Lead to monetary advantage	5.747	6	.452
Enhance my chances of employment	3.743	4	.442
Assure respect in society	2.843	6	.828
Give concrete knowledge in my field	1.930	4	.749
Give me confidence to face life	2.327	6	.887
Help me earn good money	4.067	4	.397
Help me achieve a higher post in my profession	5.695	6	.458
Help assure the life-style I desire	2.516	4	.642
Expand my academic development	1.430	4	.839
Help secure management position	2.659	6	.850
Expand my world view	2.970	4	.563
Equip me for facing life's difficulties	10.350	6	.111
Give me a sense of accomplishment	3.952	4	.413
Offer stepping-stones to job promotions	3.911	6	.689

Table 4.12 contains the chi-square results for the relationship between respondents' perceptions of each of the 30 academic interests and their mothers' level of education. As with fathers' level of education, no statistically significant relationship was observed between mothers' level of education and respondents'

perceptions of all the 30 academic interests. Thus, perceptions of the academic interests of minority students did not vary significantly with parents' educational level.

Table 4.12.--Chi-square results for the relationship between respondents' perceptions of each of the 30 academic interests and their mothers' educational level.

Academic Interest	Chi-Square Value	df	p-Value
Develop skills for daily life	11.612	6	.071
Increase my professional abilities	5.145	2	.076
Help me serve my community	10.008	6	.124
Prepare me for graduate studies	4.065	6	.668
Assure prestige	4.810	6	.568
Develop abilities to serve minorities	8.791	6	.186
Increase my status in society	10.444	6	.107
Increase opportunities for employment	1.176	4	.882
Provide professional specialization	1.230	4	.873
Help secure a well-paying job	2.261	4	.688
Assure a comfortable standard of living	5.308	6	.505
Provide opportunities for further education	0.405	4	.982
Give personal satisfaction	3.714	6	.715
Provide an escape from poverty	8.071	6	.233
Lead to master's or Ph.D. degree	6.577	6	.362
Assist in competing for employment	4.240	4	.375

Table 4.12.--Continued.

Academic Interest	Chi-Square Value	df	p-Value
Lead to monetary advantage	8.966	6	.176
Enhance my chances of employment	5.640	4	.228
Assure respect in society	4.474	6	.613
Give concrete knowledge in my field	3.620	4	.460
Give me confidence to face life	5.340	6	.501
Help me earn good money	7.692	4	.104
Help me achieve a higher post in my profession	2.927	6	.687
Help assure the life-style I desire	3.193	4	.784
Expand my academic development	1.621	4	.805
Help secure management position	5.068	6	.535
Expand my world view	3.931	4	.415
Equip me for facing life's difficulties	7.467	6	.280
Give me a sense of accomplishment	3.217	4	.522
Offer stepping-stones to job promotions	5.989	6	.424

Research Question 10. Do the motivational factors and influences of minority students vary with their parents' educational level?

Using the fathers' and mothers' levels of education as shown under Research Question 9 above, a chi-square test of statistical significance was used to determine whether there was a statistically

significant relationship between respondents' perceptions of each motivational factor and influence and their parents' levels of education. Table 4.13 shows the chi-square values and their corresponding observed significance level for the relationship between respondents' perceptions of each of the 31 motivational factors and influences and their fathers' educational level.

Table 4.13.--Chi-square results for the relationship between respondents' perceptions of each of the 31 motivational factors and influences and their fathers' educational level.

Motivational Factors and Influences	Chi-Square Value	df	p-Value
Parents	6.737	8	.565
Brothers and/or sisters	12.001	8	.151
Help me serve my community	8.470	8	.339
Friends	9.728	8	.285
Teachers	13.845	8	.086
Religious leaders	16.161	8	.040*
Community leaders	3.386	8	.908
Professional people	4.815	8	.777
Myself	5.587	8	.693
Seeing how people with degrees live	0.829	8	.999
Seeing how people without degrees live	11.119	8	.195
What I know about the value of a degree	12.492	8	.131

Table 4.13.--Continued.

Motivational Factors and Influences	Chi-Square Value	df	p-Value
The need of my family	6.984	8	.538
The need of my community	7.638	8	.470
The need of my country	9.101	8	.523
High school teacher(s)	8.499	8	.386
High school counselor	7.059	8	.530
Information received from a college	11.709	8	.165
Friends	7.262	8	.509
A professional engineer	6.581	8	.582
My own interests/aptitudes	2.851	4	.583
A visit to a college campus	12.690	8	.123
Job opportunities in engineering	1.910	4	.752
Salaries earned by engineers	0.820	4	.936
Prestige/status associated with engineers	3.267	6	.514
A member of the college faculty	1.901	8	.984
Media presentation (TV, magazines, etc.)	8.471	8	.389
Participation in a science fair	10.647	8	.223
Participation in precollege program	5.978	8	.650
Contact with industry	9.519	8	.300
Other factors	5.378	8	.717

*Significant at the .05 level.

As shown in the table, a statistically significant relationship was found between fathers' level of education and respondents' perceptions of the motivational factor and influence of **Religious leaders** (chi-square = 16.161, $p < .05$). Respondents whose fathers had no college degree perceived **Religious leaders** to have a greater influence on minority students to seek an engineering degree than did respondents whose fathers had a degree level of education. No statistically significant relationship was observed between fathers' educational level and respondents' perceptions of the remaining 30 motivational factors and influences.

Table 4.14 shows the chi-square values and their corresponding observed significance level for the relationship between respondents' perceptions of each of the 31 motivational factors and influences and their mothers' level of education.

As shown in the table, statistically significant relationships were found between mothers' level of education and respondents' perceptions of the following motivational factors and influences: **Seeing how people without degrees live** (chi-square = 16.236, $p < .05$), and **The needs of my community** (chi-square = 16.696, $p < .05$). For the former factor, the data indicated that respondents whose mothers had neither an associate degree nor a degree level of education perceived the factor to be of greater influence on minority students than did respondents whose mothers had at least an associate degree level of education. Similarly, with regard to the latter motivational factor, respondents whose mothers had neither an associate degree nor a degree level of education perceived the

motivational factor to have greater influence than did respondents whose mothers had at least an associate degree level of education. No statistically significant relationship was observed between mothers' level of education and respondents' perceptions of the remaining 29 motivational factors and influences.

Table 4.14.--Chi-square results for the relationship between respondents' perceptions of each of the 31 motivational factors and influences and their mothers' educational level.

Academic Interest	Chi-Square Value	df	p-Value
Parents	7.571	8	.476
Brothers and/or sisters	15.443	8	.051
Help me serve my community	4.732	8	.786
Friends	13.433	8	.098
Teachers	5.733	8	.677
Religious leaders	9.257	8	.321
Community leaders	7.123	8	.523
Professional people	4.608	8	.799
Myself	11.886	8	.156
Seeing how people with degrees live	9.010	8	.340
Seeing how people without degrees live	16.236	8	.039*
What I know about the value of a degree	4.302	8	.829
The need of my family	10.852	8	.210

Table 4.14.--Continued.

Academic Interest	Chi-Square Value	df	p-Value
The need of my community	16.696	8	.033*
The need of my country	16.039	8	.099
High school teacher(s)	6.477	8	.594
High school counselor	7.141	8	.521
Information received from a college	8.445	8	.391
Friends	5.512	8	.702
A professional engineer	5.278	8	.727
My own interests/aptitudes	2.891	4	.576
A visit to a college campus	15.071	8	.058
Job opportunities in engineering	4.892	4	.299
Salaries earned by engineers	2.757	4	.599
Prestige/status associated with engineers	6.113	6	.191
A member of the college faculty	5.887	8	.660
Media presentation (TV, magazines, etc.)	6.411	8	.601
Participation in a science fair	8.876	8	.353
Participation in precollege program	9.396	8	.310
Contact with industry	5.455	8	.708
Other factors	6.001	8	.647

*Significant at the .05 level.

Summary

The data analyses and findings of the study were presented in this chapter. Major academic interests and motivational factors and influences were identified, and certain relationships between respondents' perceptions and selected demographic characteristics were revealed. In Chapter V, a summary of the major findings and conclusions based on the study findings are presented, along with a discussion of recommendations for practice and further research.

CHAPTER V

SUMMARY, DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

Introduction

The researcher's purpose in this study was to examine the motivational factors and influences together with academic interests of minority engineering freshmen in seeking an engineering degree. In assessing the drive of minority freshman engineering students, the researcher attempted to identify ways of addressing the current underrepresentation of minorities in engineering and other scientific fields in education. The research design used a survey questionnaire developed by the researcher.

Summary

Review of the Literature

The review of literature centered on engineering as a profession of opportunity, recruitment and retention of minorities in engineering, the role of ethnic minority colleges, role modeling, the concept of academic motivation, and motivational factors and influences.

As a profession, engineering has been seen at the individual level as an avenue of upward mobility in corporations and high-technology companies. At the national level, it is through the work of engineering that an economy can be made more efficient. However,

a projected shortage of engineers in the United States was articulated in the literature. Researchers have projected that, during the 1990s, one-fourth of engineering faculty over age 55 will retire and that the supply in the pipeline will diminish substantially. Moreover, the few people in the engineering pipeline have been shown to be mainly foreign students. Although the country may seem to benefit by hiring foreign faculty from among the foreign graduates, primarily from developing countries, educators and policy makers must bear in mind that these intellectuals will return to their homes as their countries become more developed and need more engineers.

Researchers have pointed out that, to alleviate the projected shortage of scientists and engineers, three times as many women, minorities, and disabled individuals must be encouraged to earn bachelor's degrees and ten times as many must be encouraged to earn doctorates in these fields in the next decade, thereby developing greater pools of potential engineers and engineering technologists by involving all citizens of the United States. This issue was emphasized by writers who noted that minorities account for only 14.5% of all employed scientists and engineers, yet they represent 24.6% of the total population.

Researchers have recognized that the issue of increasing the representation of minorities in engineering is and has been a national effort involving corporate America, universities, colleges, school systems, and minority groups throughout the United States. Although these efforts have been reflected in the increased number

of minorities entering engineering colleges, retention of these minorities remains an issue. There was general agreement among researchers that the high attrition rate among ethnic minority students can be explained by their lack of role models, unreadiness for academia, inadequate counseling, unavailability of a strong support person, and alienation.

Landis (1976), in his research findings, also recognized that, although minority retention programs are doing a remarkable job of attempting to improve the representation of ethnic minority students in engineering, such programs should include a concerted motivational program, to set these students in motion to strive for excellence in the engineering profession.

Concerning the use of role models, researchers seemed to agree that ethnic minority students who establish a sense of psychological identification with scholarly mentors whom they value, and who receive rewarding interaction through either direct or vicarious reinforcement, are more likely to emulate the intellectual attributes of the model. As such, role models for minority student groups in engineering must be "successful models" in the engineering profession, for minority students to match the response of their models.

Population and Sample

The target population of the study comprised all minority freshman engineering students (blacks, Hispanics, and Native Americans) at Michigan State University for the 1989-90 academic

year. It was determined from the university records that there were about 324 minority freshman engineering students in the College of Engineering during the 1989-90 academic year.

A random sample of 250 freshman minority engineering students was selected for the study. Although follow-up procedures were not used, 215 minority freshman engineering students responded to the survey.

Instrumentation

The survey questionnaire used in the study was developed by the researcher, using selected motivational factors and influences identified in the literature. The questionnaire items included 30 statements expressing academic interests and 31 motivational factors and influences (people and situations). Respondents were asked to rate each motivational factor and influence or academic interest on an ordinal Likert-type scale. The questionnaire was also designed to collect respondents' demographic information and other general information such as the respondents' home background, the environment in which they were raised, whether respondents had participated in a precollege program (e.g., DAPCEP, Upward Bound, and ASPIRE) while in high school, and the approximate number of hours they spent studying each week.

Content validity of the questionnaire was established through a pilot test with a sample of 12 beginning sophomore minority students in the College of Engineering at MSU in April 1990. Pilot testing was done to check the clarity of the items. Responses from the

pilot test were used to develop the questionnaire further before it was sent to the study sample.

Cronbach's alpha reliability coefficient was used to estimate the internal consistency measure of the reliability of the questionnaire regarding the responses to the academic interests and motivational factors and influences. The overall Cronbach alpha coefficient for both academic interests and motivational factors and influences (61 items) was 0.93.

Data Collection

The list of all freshman minority engineering students developed with the help of the office of Engineering Equal Opportunity Program (EEOP), the Engineering Student Affairs Office, and the Registrar's Office at MSU constituted the sampling frame for the study. From the sampling frame, a simple random sample of 250 freshman minority engineering students was selected for the study. Survey questionnaires with stamped return envelopes were then mailed to all of these students through the EEOP office. Students were requested either to mail back the completed questionnaire through the U.S. mail or to drop it in any on-campus mail box. The survey was followed by frequent announcements at regular minority engineering students' meetings to encourage those who had received the questionnaire to respond. This procedure maximized the survey response rate without using conventional follow-up techniques.

Data Analysis

The study was primarily descriptive in nature, using simple descriptive statistics in the form of means, standard deviations, frequencies, percentages, and ranks. Because most of the questionnaire items used in the study were of the ordinal Likert-type scale variety, means, standard deviations, and ranks were used to determine the extent to which academic interests and influences motivated minority students to seek an engineering degree. The chi-square test of statistical significance was used to determine whether there was a statistically significant relationship between academic interests and certain demographic characteristics of the respondents. A two-sample t-test was also used to determine the significance of the difference in the amount of influence between institutional and family influences and the difference in perceptions between male and female respondents.

The Statistical Package for the Social Sciences (SPSS-X) was used in analyzing the data for this study. The .05 alpha level was used as the criterion for statistical significance.

Summary of Findings

Research Question 1. What are the perceived academic interests of minority students who seek an engineering degree?

In general, respondents agreed or strongly agreed that 29 of the 30 academic interests were reasons for seeking an engineering degree. The highest mean ratings were observed on the following academic interests: **Increase my professional abilities, Give me a sense of accomplishment, Increase opportunities for employment, Help**

secure a well-paying job, and Give personal satisfaction. The only mean rating that was under 3.00 was for Assure me respect in society.

Research Question 2. What are the perceived motivational factors and influences of minority students to seek an engineering degree?

Motivational factors and influences that were perceived to have much influence on minority students to seek an engineering degree included Myself, Seeing how people without degrees live, What I know about the value of a degree, Information received from a college, My own interests/aptitudes, Job opportunities in engineering, Salaries earned by engineers, A professional engineer, and Prestige/status associated with engineers. Low or no influence was observed for the motivational factors and influences of The need of my country, Brothers and/or sisters, The need of my community, Other relatives, and Friends.

Research Question 3. Do the academic interests of minority students vary with their parents' level of income?

A statistically significant relationship was found between parents' income level and respondents' perceptions of the academic interest of Increase my professional abilities. For this academic interest, more respondents whose parents made less than $30,000 a year strongly agreed that Increase my professional abilities was a reason for seeking an engineering degree than did respondents whose parents made $30,000 or more a year. No statistically significant

relationship was found between parents' income level and the respondents' perceptions of the remaining 29 academic interests.

Research Question 4. Do the motivational factors and influences of minority students vary with their parents' level of income?

A chi-square test revealed statistically significant relationships between parents' income level and respondents' perceptions of the motivational factors of: **Parents, What I know about the value of a degree,** and **The needs of my family.**

More respondents whose parents earned less than $30,000 perceived **Parents** to have less influence than did respondents whose parents earned $30,000 or more annually. A higher percentage of respondents whose parents earned at least $30,000 perceived **What I know about the value of a degree** to have less influence, whereas a higher percentage of respondents whose parents earned less than $30,000 perceived this motivational factor to have a great influence. Furthermore, the motivational factor **The needs of my family** was considered to have great influence by the majority of respondents whose parents earned less than $30,000, whereas the majority of respondents whose parents earned at least $50,000 perceived the same motivational factor to have little influence. No statistically significant relationship was found between parents' income level and the respondents' perceptions of the remaining 27 motivational factors and influences.

Research Question 5. Is there a statistically significant difference in motivational factors and influences between male and female respondents?

An independent two-sample t-test showed that statistically significant differences existed between male and female respondents' perceptions of the motivational factors and influences of **My own interests/aptitudes** and **Media presentations**. Male respondents perceived **My own interests/aptitudes** to have greater influence than did female respondents. **Media presentations (TV, magazines, etc.)** were perceived to have greater influence by female than by male respondents. No statistically significant differences were observed in the perceptions of the remaining 29 motivational factors and influences between male and female respondents.

Research Question 6. Is there a statistically significant difference in the perceived amount of influence between institutional and family/ individual motivational factors and influences?

A paired t-test showed that there was a statistically significant difference in perceptions of influence between institutional and family/individual motivational factors and influences. Family/individual factors were perceived to have a greater influence than institutional factors on minority students' seeking an engineering degree.

Research Question 7. To what extent do economic-related interests influence minority students to seek an engineering degree?

Five economic-related interests were among the top-ten-ranked academic interests in the order of the magnitude of their mean

ratings. These economic-related interests included **Increase opportunities for employment, Help secure a well-paying job,** and **Help me earn good money.**

Research Question 8. To what extent do role models influence minority students to seek an engineering degree?

Two role-model-related motivational factors and influences were among the top-ten-ranked motivational factors and influences in the order of the amount of influence they were perceived to have on minority students' seeking an engineering degree. The two role-model-related motivational factors and influences were **A professional engineer** and **Seeing how people without degrees live.** On the other hand, three role-model-related motivational factors and influences were among the five lowest ranked motivational factors and influences. These three factors were **Community leaders, Religious leaders,** and **Brothers and/or sisters.**

Research Question 9. Do the perceived academic interests of minority students vary with their parents' educational level?

A chi-square test of statistical significance revealed no statistically significant relationship between fathers' level of education and respondents' perceptions of the 30 academic interests. Similarly, the test showed no statistically significant relationship between respondents' perceptions of the 30 academic interests and their mothers' level of education. Thus, perceptions of the academic interests of minority students did not significantly vary with parents' educational level.

Research Question 10. Do the motivational factors and influences of minority students vary with their parents' educational level?

A chi-square test of statistical significant showed that a statistically significant relationship existed between fathers' level of education and respondents' perceptions of the motivational factor and influence of **Religious leaders.** Respondents whose fathers had no degree level of education perceived **Religious leaders** to have a greater influence on minority students' seeking an engineering degree than did respondents whose fathers had a degree level of education. No statistically significant relationship was observed between fathers' level of education and respondents' perceptions of the remaining 30 motivational factors and influence.

The chi-square test also showed that statistically significant relationships existed between mothers' educational level and respondents' perceptions of the following motivational factors and influences: **Seeing how people without degrees live** and **The needs of my community.** For the former factor, the data indicated that respondents whose mothers had neither an associate degree nor a degree level of education perceived the factor to have a greater influence on minority students than did respondents whose mothers had at least an associate degree. Similarly, in regard to the latter motivational factor, respondents whose mothers had neither an associate degree nor a degree level of education perceived the motivational factor to have a greater influence than did respondents whose mothers had at least an associate degree. No statistically significant relationship was observed between mothers' educational

level and respondents' perceptions of the remaining 29 motivational factors and influences.

Conclusions

The following conclusions were drawn from the study findings:

1. Respondents strongly agreed that increasing their professional abilities, giving them a sense of accomplishment, increasing opportunities for employment, helping to secure a well-paying job, and giving personal satisfaction were among the most influential academic interests of minority students in seeking an engineering degree.

2. Motivational factors and influences that respondents perceived to have much influence on minority students to seek an engineering degree included themselves, seeing how people without degrees live, what they know about the value of a degree, information received from a college, their own interests/aptitudes, job opportunities in engineering, salaries earned by engineers, a professional engineer, and prestige/status associated with engineers.

3. Expanding the world view and respect in society were perceived to have the least effect on minority students' seeking an engineering degree.

4. The needs of the country, brothers and/or sisters, the needs of the community, other relatives, and friends were the motivational factors and influences that were perceived to have the least influence on minority students' seeking an engineering degree.

5. Respondents whose parents made less than $30,000 a year agreed more strongly that increasing professional abilities was a reason for seeking an engineering degree than did respondents whose parents made $30,000 or more annually.

6. Male respondents perceived their own interests/aptitudes to have a greater influence than did female respondents.

7. Media presentations (TV, magazines, etc.) were perceived to have a greater influence by female than male respondents.

8. Family/individual factors were perceived to have a greater influence than institutional factors on minority students' seeking an engineering degree.

9. Five economic-related interests were among the top-ten-ranked academic interests of minority students in seeking an engineering degree.

10. Two role-model-related motivational factors and influences were among the top-ten-ranked motivational factors and influences. However, three role-model-related motivational factors and influences were among the five lowest ranked motivational factors and influences of minority students in seeking an engineering degree.

11. Perceptions of the academic interests of minority students did not vary significantly with parents' educational level.

12. Respondents whose fathers had no degree level of education perceived religious leaders to have a greater influence on minority

students' seeking an engineering degree than did respondents whose fathers had a degree level of education.

13. Seeing how people without degrees live was perceived to have a greater influence by respondents whose mothers had neither an associate degree nor a degree level of education than by respondents whose mothers had at least an associate degree.

14. The need of the community was perceived to have a greater influence by respondents whose mothers had neither an associate degree nor a degree level of education than by respondents whose mothers had at least an associate degree.

Discussion

The factors of employability, better pay, and professional upward mobility all relate to students' perceptions of the standard of living they believed their degree education would afford them. The fact that these economic-related interests and factors were ranked very high is itself a strong indication of the source of motivation for these students.

Factors related to service to others (family, community, country, minorities) were generally rated low. It might be argued, therefore, that minority students gave service-to-others factors such low ratings because they felt obligated to themselves first, before serving others. It is those who feel assured about their ability to find satisfactory employment opportunities who have the luxury of contemplating altruistic goals of service to others.

Such a self-serving component of internal motivation can be a powerful tool for a student striving for academic heights in engineering. Thus, it might not be very difficult for school counselors to make students aware that sacrifice and hard work now in undertaking a difficult course of study will pay off in terms of success later on in their careers. Minority students should have a clear perspective early in their college careers of the opportunities and rewards associated with an engineering career early enough and should be well acquainted with the costs involved in pursuing a demanding academic program. Having a clear understanding of the costs and rewards involved is particularly important because most minority engineering students often interact socially with minority students majoring in less rigorous disciplines.

Also closely related to self-serving motives are life-style factors and influences. The influences of seeing how people with and without degrees live were both ranked high among the factors and influences. These factors are also related to the concept of role modeling. However, the life style in this case might not have anything to do with the economic status of how people with or without degrees live. The students have seen enough evidence that not having a college degree does not necessarily mean making less money. It can be argued, therefore, that there are other aspects of the life style of a person with a college degree whom the students admire and whose life style they hope to achieve.

The factors that were clearly underrated among the minority students' academic interests and influences were those related to

further education. As with service to others, further-education factors and influences were perceived to have less influence on minority students' seeking an engineering degree. This finding supports the view articulated in the literature--that more foreign students than American students pursue advanced engineering degrees since graduate colleges have to compete with industry. It is well known in America that engineers can do so well economically with just a baccalaureate degree that there is no incentive for students to pursue a graduate degree in engineering. Thus, the finding may not be unique to minority engineering students but to young American engineers as a whole.

Family motivational factors and influences (parents, brothers and/or sisters, and other relatives) were generally perceived to have a greater influence on minority students than those factors and influences associated with the institution (teachers, professional people, a professional engineer, participation in a precollege program, and a visit to a college campus). However, consultation with a professional engineer, information received from a college, contact with industry, and high school teacher(s) were perceived to have a great influence on minorities to seek an engineering degree. On the other hand, brothers and/or sisters, other relatives, and community and religious leaders were perceived to have a relatively lower influence on minority students seeking an engineering degree.

As might be expected, parents' income level was found to have an effect on students' perceptions. Respondents whose parents made

at least $30,000 a year perceived the influence of parents and what they know about the value of a degree to have a greater influence than did respondents whose parents earned less than $30,000 a year. Students from high-income families ($30,000 or higher) perceived the needs of their families as well as increasing their professional abilities to have a greater influence than did those from low-income (less than $30,000) families.

An examination of the data seemed to indicate that respondents whose fathers did not have a degree beyond the high school diploma perceived religious leaders to have a greater influence on minority students than did respondents whose fathers had a baccalaureate degree. Thus, religious leaders appear to have a great influence on minorities, particularly those whose parents do not have a college degree. Respondents whose mothers had neither an associate degree nor a baccalaureate degree perceived the factor of seeing how people without college degrees live to have a greater influence on minority students than did respondents whose mothers had at least an associate degree.

Recommendations

Based on the study findings, the following recommendations are offered.

Recommendations for Practice

1. Self-serving motivational factors and influences were perceived to be highly influential on minority students to seek an engineering degree. It is therefore recommended that school

counselors and minority-program implementers emphasize this area in addition to providing enrichment programs.

2. Factors pertaining to the influence of the family were perceived to have a greater influence on minority students than institutional factors and influences. At the same time, an examination of the data revealed that a high proportion of these students came from single-parent homes. If the family, in fact, positively influences the student, the one parent is overburdened. It is recommended that seminars and programs involving parents be implemented to determine ways and means for families to have a positive effect on students, and in particular with single-parent families.

3. Precollege engineering programs and other enrichment programs will need to emphasize concerted motivational components such as self-esteem and positive self-concept in addition to close academic advisement, orientation and adjustment to the environment, and career development.

4. An examination of the previous findings showed that contact with industry was perceived to have a high influence on minority students to seek an engineering degree. It might therefore be recommended that engineering colleges and minority-program implementers regularly organize visits to industries for engineering students so that these students can meet other engineers in the field and see what their profession entails.

5. Corporate America, engineering colleges, and educators will need to find ways of encouraging minority engineering students as well as majority students to pursue studies beyond the baccalaureate degree. This may involve providing certain incentives to encourage students to pursue graduate degrees in engineering.

Recommendations for Further Research

1. This study involved a sample of freshman minority engineering students for the 1989-90 academic year. Longitudinal motivational studies to monitor the changes students go through from the beginning of high school until they enter college may be deemed necessary to determine the best ways and time to motivate students.

2. Because of the effect of the family on minority engineering students, it is recommended that further research be conducted on the role of parents and significant others of minority students, to determine ways of maximizing the positive effects of the family and significant others on these students.

3. There appears to be a need for program-evaluation studies to investigate the success of existing minority precollege engineering programs and ways of improving them.

4. High attrition rates have been shown among minority engineering students at Michigan State University. Knowledge of where these students actually go and why they go there is nonexistent. A study involving tracking students to determine who benefits from internal transfer/leaving the engineering program before graduation is recommended.

5. A study involving minority engineering professionals who have completed their degrees might give minority engineering program faculty and staff an idea of how best to assist the minority engineering students who are currently in the pipeline. Researchers should be able to determine the kinds of problems these professionals encountered while in college and methods they used to solve these problems. Some of the problem-solution data obtained from such studies could be translated for the benefit of students in the pipeline.

6. It has been articulated in the literature that governmental policies that were designed to solve the problem of racial segregation in higher education might have resulted in shifting racial segregation from between to within colleges and universities. It has been hypothesized that whereas, in the past, segregation involved "all white" and "predominantly black" colleges and universities, the current segregation is that of minority students clustering in certain university departments. Studies to investigate this issue need to be undertaken, using such indices of segregation as the gini coefficient and the index of dissimilarity (Darden & Tabachneck, 1980).

7. Minority engineers who have completed their undergraduate degrees and who are currently employed in industry also need to be part of minority engineering students' undergraduate experience. These individuals can serve as valuable role models and provide advice and counsel to their younger counterparts. The dialogue

between these practitioners and the undergraduate population can help students avoid mistakes and learn from those who have "traveled the road before."

APPENDICES

APPENDIX A

COVER LETTER AND SURVEY INSTRUMENT

Engineering Equal Opportunity Programs
A-200 Engineering Building
College of Engineering
Michigan State University
East Lansing, Michigan 48824-1208

Dear Minority Engineering Student:

The attached questionnaire is designed to seek and identify some of the influences and interests of minority engineering students in the College of Engineering at Michigan State University. While the completion of this questionnaire is not mandatory, I will deeply appreciate your taking time to respond to all items as thoroughly as possible. The information you provide in this questionnaire will be confidential and used only for research purposes. To ensure confidentiality, please do not write your name or student number on this questionnaire. Enclosed please find a self-addressed stamped envelope for you to use in returning the completed questionnaire. Drop the completed questionnaire in a U.S. mail box or in any on-campus mailbox. Thank you very much for participating in this survey.

Sincerely,

Gerald, O. Thompkins, Director
Engineering Equal Opportunity Programs (EEOP)

SECTION A: ACADEMIC INTERESTS

For each of the following, circle one answer that best describes how strongly you agree or disagree with the reasons for seeking an engineering degree. Please respond to every statement using the following scale:

SD = Strongly Disagree D = Disagree A = Agree SA = Strongly Agree

In my opinion, to have a degree in engineering will . . .

1.	develop skills for daily life.	SD	D	A	SA
2.	increase my professional abilities.	SD	D	A	SA
3.	help me serve my community.	SD	D	A	SA
4.	prepare me for graduate studies.	SD	D	A	SA
5.	assure prestige.	SD	D	A	SA
6.	develop abilities to serve minorities.	SD	D	A	SA
7.	increase my status in society.	SD	D	A	SA
8.	increase opportunities for employment.	SD	D	A	SA
9.	provide professional specialization.	SD	D	A	SA
10.	help secure a well-paying job.	SD	D	A	SA
11.	assure a comfortable standard of living.	SD	D	A	SA
12.	provide opportunities for further education.	SD	D	A	SA
13.	give personal satisfaction.	SD	D	A	SA
14.	provide an escape from poverty.	SD	D	A	SA
15.	lead to master's or Ph.D.	SD	D	A	SA
16.	assist in competing for employment.	SD	D	A	SA
17.	lead to monetary advantages.	SD	D	A	SA
18.	enhance my chances of employment.	SD	D	A	SA
19.	assure me respect in society.	SD	D	A	SA

20.	give concrete knowledge in my field.	SD	D	A	SA
21.	give me confidence to face life.	SD	D	A	SA
22.	help me earn good money.	SD	D	A	SA
23.	help me achieve a higher post in my profession.	SD	D	A	SA
24.	help assure the life-style I desire.	SD	D	A	SA
25.	expand my academic development.	SD	D	A	SA
26.	help secure management positions.	SD	D	A	SA
27.	expand my world view.	SD	D	A	SA
28.	equip me for facing life difficulties.	SD	D	A	SA
29.	give me a sense of accomplishment.	SD	D	A	SA
30.	offer stepping-stones to job promotions.	SD	D	A	SA

SECTION B: INFLUENCES

Different people or situations influence us in how we make decisions. Please circle the one answer that best describes how strongly each of the following has influenced your decision to study for an engineering degree, using the scale:

NI = No Influence LI = Little Influence SI = Some Influence
MI = Much Influence GI = Great Influence

1.	Parents	NI	LI	SI	MI	GI
2.	Brothers and/or sisters	NI	LI	SI	MI	GI
3.	Other relatives	NI	LI	SI	MI	GI
4.	Friends	NI	LI	SI	MI	GI
5.	Teachers	NI	LI	SI	MI	GI
6.	Religious leaders	NI	LI	SI	MI	GI
7.	Community leaders	NI	LI	SI	MI	GI
8.	Professional people	NI	LI	SI	MI	GI

9.	Myself	NI	LI	SI	MI	GI
10.	Seeing how people with degrees live	NI	LI	SI	MI	GI
11.	Seeing how people without degrees live	NI	LI	SI	MI	GI
12.	What I know about the value of a degree	NI	LI	SI	MI	GI
13.	The needs of my family	NI	LI	SI	MI	GI
14.	The needs of my community	NI	LI	SI	MI	GI
15.	The needs of my country	NI	LI	SI	MI	GI
16.	High school teacher(s)	NI	LI	SI	MI	GI
17.	High school counselor	NI	LI	SI	MI	GI
18.	Information received from a college	NI	LI	SI	MI	GI
19.	Friends	NI	LI	SI	MI	GI
20.	A professional engineer	NI	LI	SI	MI	GI
21.	My own interests/aptitudes	NI	LI	SI	MI	GI
22.	A visit to a college campus	NI	LI	SI	MI	GI
23.	Job opportunities in engineering	NI	LI	SI	MI	GI
24.	Salaries earned by engineers	NI	LI	SI	MI	GI
25.	Prestige/status associated with engineers	NI	LI	SI	MI	GI
26.	A member of the college faculty	NI	LI	SI	MI	GI
27.	Media presentation (TV, magazines, etc.)	NI	LI	SI	MI	GI
28.	Participation in a science fair	NI	LI	SI	MI	GI
29.	Participation in a precollege program	NI	LI	SI	MI	GI
30.	Contacts with industry	NI	LI	SI	MI	GI
31.	Other _____	NI	LI	SI	MI	GI

SECTION C: GENERAL INFORMATION

Please check the appropriate response:

1. a. What is your sex?

   1. ____ Male
   2. ____ Female

   b. What is your age? _____

   c. What is your marital status?

   1. ____ Single
   2. ____ Married
   3. ____ Other Specify: _____

   d. Do you have any children?

   1. ____ Yes
   2. ____ No

   e. Which category(ies) best reflect(s) your ethnic background?

   1. ____ Black
   2. ____ Chicano
   3. ____ Hispanic
   4. ____ Native American
   5. ____ Other Specify: _____

   f. Which size of community do you come from:

   1. ____ Large metropolitan area (500,000 people or more)
      (Also check one of the following):
      ____ inner city
      ____ other city area
      ____ suburb
   2. ____ Small city (50,000-499,999)
   3. ____ Large town (10,000-49,999)
   4. ____ Small town, rural area, reservation (1-9,999)
   5. ____ Uncertain

   g. What is your current class level?

   1. ____ Freshman
   2. ____ Sophomore
   3. ____ Junior
   4. ____ Senior
   5. ____ Graduate student

h. Are you a ...

1. ____ Full-time student
2. ____ Part-time student

i. Were do you live, while attending MSU?

1. ____ On campus (dormitory)
2. ____ University housing
3. ____ Fraternity/sorority
4. ____ Off-campus (with family)
5. ____ Off-campus (independent)

j. Please estimate your parental annual income:

1. ____ Less than $10,000
2. ____ $10,000-$19,999
3. ____ $20,000-$29,999
4. ____ $30,000-$39,999
5. ____ $40,000-$49,999
6. ____ $50,000-$59,999
7. ____ $60,000-$69,999
8. ____ $70,000 and over

2. Were you raised in a single-parent household?

a. ____ No
b. ____ Yes If yes, which parent?
____ mother ____ father ____ both ____ other

3. What is the highest educational level completed by your <u>father</u>?

a. ____ Eighth grade
b. ____ High school graduate
b. ____ GED
d. ____ Trade/technical degree
e. ____ Associate degree
f. ____ College graduate
g. ____ Graduate degree
h. ____ Other Specify: _____

4. What is the highest educational level completed by your <u>mother</u>?

a. ____ Eighth grade
b. ____ High school graduate
b. ____ GED
d. ____ Trade/technical degree
e. ____ Associate degree
f. ____ College graduate
g. ____ Graduate degree
h. ____ Other Specify: _____

5. How much expectation do you think your father has that you will graduate?

   a. ____ Low expectations
   b. ____ Average expectations
   c. ____ High expectations
   d. ____ Very high expectations

6. How much expectation do you think your mother has that you will graduate?

   a. ____ Low expectations
   b. ____ Average expectations
   c. ____ High expectations
   d. ____ Very high expectations

7. What is your engineering major? _____

8. What is your cumulative GPA? _____

9. Approximately how much time (on average) do you spend studying each week?

   a. ____ Less than 5 hours
   b. ____ 5-10 hours
   c. ____ 11-15 hours
   d. ____ 16-20 hours
   e. ____ 21-25 hours
   f. ____ More than 25 hours

10. What is your present employment status?

    a. ____ Employed on-campus
    b. ____ Employed off-campus part-time
    c. ____ Employed off-campus full-time
    d. ____ Seeking employment
    e. ____ Unemployed

11. While in high school, did you attend any program designed to prepare you for college (i.e., Upward Bound, ASPIRE, DAPCEP, etc.)?

    a. ____ No
    b. ____ Yes Specify: _____

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