This is to certify that the

dissertation entitled

AN ANALYSIS OF THE MATHEMATICS ACHIEVEMENT OF AFRO-AMERICAN AND EURO-AMERICAN FEMALES IN GRADES 3, 4, AND 5 BEFORE AND AFTER THE APPLICATION OF NONTRADITIONAL MATHEMATICS INSTRUCTION

presented by

Janys Roberson

has been accepted towards fulfillment
of the requirements for

Ph.D. degree in Teacher Education

Lois A. Baker
Major professor

Date July 1994

AN ANALYSIS OF THE MATHEMATICS ACHIEVEMENT OF AFRO-AMERICAN AND EURO-AMERICAN FEMALES IN GRADES 3, 4, AND 5 BEFORE AND AFTER THE APPLICATION OF NONTRADITIONAL MATHEMATICS INSTRUCTION

By

Janys Roberson

A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Teacher Education

1994

ABSTRACT

AN ANALYSIS OF THE MATHEMATICS ACHIEVEMENT OF AFRO-AMERICAN AND EURO-AMERICAN FEMALES IN GRADES 3, 4, AND 5 BEFORE AND AFTER THE APPLICATION OF NONTRADITIONAL MATHEMATICS INSTRUCTION

By

Janys Roberson

The primary purpose of this study was to investigate the underachievement in mathematics concepts and problem solving of Afro-American females in an elementary school in a small midwestern town. A comparison was made of the mathematics mean scores of Afro-American and Euro-American females in grades 3, 4, and 5 before and after the application of "nontraditional" mathematics instruction. In addition, 12 subjects from the total sample were interviewed regarding their attitudes and perceptions toward mathematics. In response to an identified need, the elementary teachers in this school, after extensive training, implemented an innovative "hands-on," conceptually based method of mathematics instruction.

A basic 2 x 4 format was used to analyze the mathematics achievement scores of Afro-American and Euro-American females in grades 3, 4, and 5 two years before and two years after the application of the "nontraditional"

mathematics. An F-test was used to compare the two subject groups, with a p level of significant at .05. Results indicated that there was a slight but significant difference (.04) in the mean mathematics scores of the total sample between Year 1 and Year 4 of the study. The comparison of between-group variability in mathematics mean scores indicated a strong main effect for race. Afro-American females continued to underachieve in mathematics using a "traditional" or "nontraditional" approach to instruction.

Twelve volunteers from the sample group were interviewed by local college students about their perceptions and attitudes about mathematics. Results seemed to indicate that the six Afro-American interviewees did not like mathematics, found it difficult and impractical in their daily lives, and tended to avoid it. The six Euro-American interviewees indicated that they liked mathematics, thought it was important, and denied their low achievement in mathematics.

Possible confounding variables in this study included the small sample size, adequacy of the test to measure innovative curriculum, the relationship of reading ability to mathematics achievement, and cultural/gender bias affecting the place of Afro-American females in desegregated classrooms. The attempt to solve a complex, systemic problem with a single methodological approach was not successful.

ACKNOWLEDGMENTS

Sincere appreciation is extended to Dr. Lois Bader, my committee chairperson, and Drs. Roger Niemeyer, Charles Blackman, Norman Bell, and Bill Cole, members of my doctoral committee, for their guidance and support. Thanks are also extended to the excellent professors at Michigan State University who encouraged me and challenged me to see this project through to completion.

A special thank-you is extended to Dr. John Chapman, at the Michigan Department of Education, whose mentoring has encouraged many educators to pursue a doctorate.

Finally, a heart-felt thank-you to Keith, Johannah, Colette, and Jonathan for their sustaining accompaniment on this journey.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

THE PROBLEM

Introduction

In the 1980s, it became apparent that many American youngsters had major deficiencies in and a lack of understanding of basic mathematics concepts and procedures, as well as basic mathematical problem-solving skills (Mathematical Sciences Education Board, 1990; National Council for Teachers of Mathematics [NCTM], 1980, 1981, 1989, 1991; National Educational Assessment Program [NEAP], 1980; National Research Council, 1989; Schoenfeld, 1987). Comparisons of the mathematics achievement of numerous students in the United States and those from other countries revealed that many American students were ill-prepared for the mathematical demands of a technological society.

A closer look at the mathematics achievement of American youngsters revealed not only deficiencies in basic mathematics understanding and problem solving, but also serious gender and ethnic inequities. Lightfoot's research in 1976 documented that girls tested either higher than boys (in general intelligence, verbal ability, and numerical ability) or the same as boys (in spatial

ability, analytic ability, and creativity) in their preschool years. However, by the middle of elementary school, boys scored consistently higher on all these tests (except grammar, spelling, and word fluency).

In their comprehensive study of more than 530 first graders enrolled in public schools in Baltimore, Maryland, Entwisle and Alexander (1989) found that ethnic differences in children's skills in mathematics and verbal composition at the point of school entry were very small to nonexistent but that significant differences by race on verbal skill, mathematics computation, and reasoning began to appear early in the schooling process. By the end of first grade, Afro-American boys equaled Euro-American boys and girls in terms of mathematics concepts on the California Achievement Test (CAT), but Afro-American girls were about one-quarter of a standard deviation lower than the other boys and girls in terms of mathematics concepts on the CAT (Ginsberg & Russell, 1981). By the end of high school, the difference in mathematics achievement that separated Afro-American females from the others amounted to one grade level (Dorsey, Mullis, Lindquist, & Chambers, 1988; Entwisle & Alexander, 1988).

If Afro-American and Euro-American youngsters begin school with virtually no measurable differences in mathematical ability, then to what can the steady decline in the mathematics achievement of Afro-American females be attributed? What elements are present in the schooling process and in the attitudes and perceptions of Afro-American females and others toward mathematics that might contribute to this underachievement?

The Study Setting

The setting for this study was an elementary school with an enrollment of approximately 425 students in preschool through grade 5. East Elementary School (a pseudonym) is located in a small town in south-central Michigan with a population of about 10,000 citizens. Before the 1980s, this community had a thriving economy, which was dependent primarily on the oil industry and several foundries related to the automobile industry. Between the 1980 census and that of 1990, however, the community lost 4,000 of its residents and fell upon hard economic times.

At the time of this study, East Elementary School reflected these changes in the community's economy. Approximately 72% of the school population received free or reduced-cost lunches. The ethnic composition of the total school population was as follows:

Euro-Americans	55%
Afro-Americans	41%
Others	4%

A large number of the children enrolled at East Elementary School were from single-parent or step-parent homes.

The need for this study became apparent in the 1990-91 school year when, as part of the state-mandated school improvement process and as a necessary component of Public Act 25 in Michigan, a disaggregation of CAT data for students at East Elementary School revealed significant disparities between

the mathematics achievement of Afro-American females and that of Euro-American females, Euro-American males, and Afro-American males in the school. The disparity in these students' scores on mathematics concepts and applications in 1990-91, before the implementation of the nontraditional mathematics instruction, was as follows:

Afro-American females	75% below the 50th percentile
Euro-American males	53% below the 50th percentile
Euro-American females	49% below the 50th percentile
Afro-American males	45% below the 50th percentile

Staff members questioned why an identifiable group, representing one-sixth of the total school population, exposed to the same teachers, teaching methods and materials, and school environment, should achieve significantly lower than their classmates. The need to understand this phenomenon and seek ways to rectify the problem became important to school personnel.

When the school district changed its focus from traditional mathematics instruction to nontraditional, conceptually based instruction, the superintendent gave the researcher permission to initiate this study. Both school-district and school-building personnel were interested in determining whether the nontraditional method of mathematics instruction would enhance the mathematics achievement of all female students, but particularly Afro-American females, at East Elementary School.

Purpose of the Study

Disaggregation of mathematics achievement data in this particular school setting revealed the underachievement of Afro-American females in mathematics concepts and problem solving. In this study, one dimension of schooling--an innovative mathematics curriculum--was examined to seek a better understanding of how the schooling process and other factors contribute to the underachievement of Afro-American females. The study findings might be helpful to educators attempting to raise the achievement levels of these youngsters through appropriate mathematics instructional practice.

The method used to better understand this underachievement was to investigate and compare the achievement in mathematics concepts and problem solving of Afro-American and Euro-American females in grades 3, 4, and 5 in a particular school setting before and after the application of "nontraditional" mathematics instruction. In addition to the analysis of mathematics achievement scores, the attitudes and perceptions toward mathematics of selected subjects from the total sample were explored through structured interviews.

Many studies have been conducted in which Euro- and Afro-American students' learning styles and other cognitive as well as social factors affecting learning have been examined and analyzed (Akbar, 1976; Comer, 1980; Entwisle & Alexander, 1989; Kerckhoff, 1989; Slavin & Karwelt, 1989). However, even though numerous educational studies on Afro-American youngsters were initiated as early as the 1950s, little specific research has been conducted on

Afro-American females as an identifiable group with particular characteristics and unique attitudes and perceptions. Afro-American females remain, as Lightfoot noted in 1976, "an ignored and invisible population" (p. 1) in educational research, practice, and policy making. It is unusual for educational researchers to examine differential academic outcomes of the genders within and between racial and ethnic groups in this country (Educational Testing Service [ETS], 1992). However, the underachievement of Afro-American females needs to be addressed in a technological society that is dependent on the full development of all its members.

Some educators believe that changes in mathematics instruction and curriculum may positively affect the mathematics achievement of Afro-American youngsters (Akbar, 1976; Gilbert & Gay, 1986; Hale-Benson, 1986; Morgan, 1980; Renzulli, 1973; Romberg, 1984; Slaven & Karweit, 1989). In this study, the writer measured the effects of a nontraditional method of mathematics instruction on Afro-American females in the third, fourth, and fifth grades. This approach was conceptually based and used "hands-on" mathematical activities for learning. However, this researcher went beyond the single "treatment" approach as being the sole factor in the improvement of mathematics achievement for Afro-American females. The case study approach also was used to investigate whether additional social factors might affect the mathematics achievement of young females, particularly Afro-American females.

The researcher examined the achievement of 19 Afro-American and 28 Euro-American females in the third, fourth, and fifth grades using a "traditional" method of mathematics instruction. The traditional method of mathematics instruction is consistent with the absorption theory, in which mathematical knowledge is impressed on the brain from *without*, using a collection of facts learned by memorization and practice with drill (Baroody, 1987). A common analogy for this approach to learning is to consider the youngster's mind as an empty slate upon which the teacher imprints selected knowledge. The learner's role is that of a passive receiver. This method does not rely primarily on the prior knowledge and experience of the learner, but rather on the teacher's ability to bring the learning to the learner. With the traditional method of instruction, youngsters are required to sit for long periods of time, concentrate alone, and observe and value organized time allotments and schedules.

In contrast, the nontraditional method of mathematics instruction, as it applies to this study, is based on cognitive theory, in which knowledge is constructed from within the learner's mind, using experience and insight, hands-on activities, and problem-solving process to build understanding. In this study, the researcher attempted to determine whether the nontraditional method of mathematics instruction would be more successful than the traditional approach with Afro-American females because it is more closely aligned with instructional strategies that have been found to be effective with Afro-American youngsters. Human interaction, an active environment, the use of bodily motion in the

learning process, a loosely constructed environment, cooperation, informality, and involvement in the instructional process have been documented as being effective instructional strategies for many Afro-American students (Comer, 1980; Entwisle & Alexander, 1988; Gilbert & Gay, 1985; Hale-Benson, 1986; Kerckoff & Campbell, 1977).

However, the researcher did not intend merely to determine the cognitive outcomes of mathematics instruction for females by comparing two ethnic groups with a single instructional treatment (e.g., the hands-on approach). Selected aspects of the affective and social environments of these young females also were studied, in order to understand why many competent Afro-American females are underachieving. Comer (1980) suggested using this approach to address human problems that are the result of multidetermined, interrelated factors. Thus, an in-depth case study of six Afro-American females and six Euro-American females from the study sample was conducted in the second portion of this research, to seek to discover additional variables that might be related to the subjects' attitudes and perceptions about mathematics and their achievement in the subject. These subjects had significant discrepancies between their mathematics scores and their reading scores; specifically, they had average to high reading scores but significantly lower mathematics problem-solving scores. The researcher sought to determine what might have contributed to this discrepancy.

Hypotheses

The following null hypotheses were formulated to analyze the data collected in this study:

> Hypothesis 1: There will be no significant difference in the mean mathematics scores of the total sample before and after the application of a nontraditional, conceptually based method of mathematics instruction.
>
> Hypothesis 2: There will be no difference between the Afro-American and Euro-American subjects in terms of their mean mathematics scores over the four-year period of study.

Research Questions

The following research questions guided the collection of data for the qualitative or descriptive portion of this study. The purpose of this part of the study was to discover additional variables and/or factors that may affect the mathematics achievement of young Afro-American females.

1. What are the perceptions and attitudes of young Afro-American females toward mathematics achievement?

2. What are the perceptions and attitudes of young Euro-American females toward mathematics achievement?

3. What perceptions and attitudes toward mathematics achievement do young Afro- and Euro-American females share?

4. What additional variables, perceptions, and attitudes revealed in the interviews affect, either positively or negatively, the mathematics achievement of young Afro-American females?

Need for the Study

This study is needed and important for the following reasons:

1. Many studies have been conducted on mathematics achievement using the traditional method of mathematics instruction. However, little research has been conducted on the effectiveness of the nontraditional method of mathematics instruction (referred to herein as conceptually based mathematics instruction) with female learners. The effectiveness of this method of mathematics instruction with a particular segment of the school population--females in grades 3, 4, and 5--was analyzed in this study.

2. There is little information on the academic outcomes of females from various racial and ethnic groups in this country. This research project focused on the underachievement of Afro-American females in a particular school setting in mathematics concepts and problem solving and examined the effectiveness of an innovative instructional approach to mathematics instruction. The researcher also sought to investigate the attitudes and perceptions about mathematics of selected female subjects in this school setting.

3. Little is known, as well, about the unique social factors and cultural messages that may affect the mathematics achievement of young Afro-American females. Educators need to know how Afro-American females learn mathematics, in order to raise the achievement levels of these youngsters. The findings from this study can have significant implications for policy and

instructional practice regarding the mathematics education of both Afro- and Euro-American females.

Assumptions and Delimitations

The statistical information for this study was obtained from the permanent cumulative record files (usually referred to by school personnel as CA-60 files) and general student information files at East Elementary School. The researcher assumed that the information contained in these files was accurate and current. Additional information on the 12 participants in the qualitative portion of the study was obtained through structured interviews. Because students at East Elementary School frequently are involved in studies originating at the small private college located in the community, the researcher assumed that the students were familiar and comfortable with participating in a study of this nature.

No attempt was made to study the long-range effects of the conceptually based mathematics curriculum on the mathematics achievement of the subjects. However, the researcher did examine in depth a particular method of instruction that was applied to a particular student population during a four-year period--1990-91 through 1993-94.

Subjects' scores on the mathematics concepts and applications subtest of the CAT were used in this study. The study was delimited in this way because the disaggregation of test data revealed that these students had significantly lower scores on mathematics problem solving than they did on mathematics computation.

Although the phenomenon of underachievement of Afro-American and Euro-American females in mathematics may occur in other settings, the study findings may not be generalizable to other communities. However, it is anticipated that the findings will provide insight into and help educators improve the mathematics achievement scores of Afro-American females in similar communities.

Definition of Terms

The following terms are defined in the context in which they are used in this dissertation:

Afro-American. An American citizen who traces his or her ancestry to an African nation or nations.

California Achievement Test (CAT). A standardized, norm-referenced achievement test with batteries for each subject area at all levels from kindergarten through grade 12.

Euro-American. An American citizen who traces his or her ancestry to a European nation or nations.

"Nontraditional" method of mathematics instruction. As used in this study, a method of teaching mathematics that is based on the concept that the student constructs his or her own mathematical learning by connecting concepts, skills, insight, and previous learning to concrete experiences such as using manipulatives and relating mathematical thinking and reasoning to "real life" activities.

"Traditional" method of mathematics instruction. As used in this study, a method of teaching mathematics that is characterized by direct instruction by the teacher to a student who practices learning with repetitive drill and worksheets and demonstrates understanding through rote memory.

Normal curve equivalent (NCE) scores. One of several types of scores used in reporting results on the CAT. The NCE score scale ranges from 1 through 99 and coincides with the national percentile scale at 1, 50, and 99. NCE scores are similar to percentile ranks but can also be used to compare scores of different groups and different subject areas.

Permanent record file (CA-60). A permanent school record folder that contains certain physical and educational data about a particular student. These data are arranged in chronological order and maintained by the school district throughout the student's K-12 school years.

Qualitative analysis. An analysis of attitudes and perceptions gathered through interviews with selected members of the study sample.

Quantitative analysis. Statistical analysis of numerical data, in this case the achievement test scores of members of the study sample.

Overview

Chapter I contained an introduction to the problem under investigation, a description of the study setting, the purpose of the study, the hypotheses and research questions, need for the study, assumptions and limitations, and definitions of key terms.

A review of literature and research related to the study is contained in Chapter II. Topics include: Culture and Learning, Cultural Factors Affecting Achievement in School, The Current "Place" or "Role" of the Afro-American Female in American Classrooms, Improving the Success in School of Afro-American Children, and Understanding How All Children Across All Cultures Learn Mathematics.

The research design and methodology used in carrying out the study are described in Chapter III. The data collected and analyzed in the research are presented in Chapter IV. The chapter is divided into two sections: quantitative and qualitative. The quantitative section contains the results of the statistical analyses of the math achievement scores of the subjects, and the qualitative section contains the information obtained from the case studies of 12 students selected from the study sample. A summary of the study, major results and discussion, implications, and recommendations for further research are presented in Chapter V.

CHAPTER II

REVIEW OF RELATED LITERATURE

Introduction

The researcher's primary purpose in this study was to investigate and compare the achievement in mathematics of Afro-American and Euro-American females in grades 3, 4, and 5 in a particular school setting before and after the application of nontraditional mathematics instruction. A second purpose was to investigate selected subjects' attitudes and perceptions toward mathematics.

The phenomenon of underachieving Afro-American females is highly complex, subtle, and underresearched. Although many studies have been conducted on the achievement and cognitive learning styles of Afro-American and Euro-American children (Ames, 1967; Blau, 1981), little research has been done on the achievement and cognitive learning styles of young Afro-American females. Similarly, images of Afro-American females have not been presented in the literature on teachers and children in classrooms. After conducting an extensive literature review, Lightfoot (1976) stated that young Afro-American girls are an ignored and invisible population.

In 1992, Nelson-LeGall, writing for the Educational Testing Service, stated that, in America, being female puts one at risk for gender discrimination, and

belonging to a racial minority group puts one at risk for racial discrimination. Thus, in this society, race, gender, and cultural factors must be included in any meaningful examination of educational opportunity. Blau (1981) provided strong evidence that the differences in academic competence among children are predominantly social in origin.

Differences in the mathematics skills of children from various ethnic groups at the time they enter school are small (Ginsberg & Russell, 1981). Entwisle and Alexander (1989) found no significant differences in the mathematics and verbal composite scores of Afro- and Euro-American first graders. Yet, by the end of first grade, the scores of these children differed significantly (especially the mathematics scores of Afro-American females), and the discrepancy by race had begun to develop. Thus, the rationale for the present study is the demonstrated need to understand and respond to the underachievement of a portion of the school population.

This chapter contains a review of current literature and research related to the following topics: Culture and Learning, Cultural Factors Affecting Achievement in School, Afro-American Females in American Classrooms, Improving the School Success of Afro-American Children, and Understanding How All Children Across All Cultures Learn Mathematics.

Culture and Learning

Culture influences learning as well as achievement (Ames, 1967; Banks, 1978; Beady, 1981; Blau, 1981; Hale-Benson, 1986; Jones, 1981; Ogbu, 1981). In America, if one's cultural style and cognitive style match those of the dominant middle-class Euro-American culture, that individual's cultural bonds will have a positive influence on his or her achievement. However, if one's cultural style and cognitive style differ greatly from those of the dominant middle-class Euro-American culture, the individual will experience some difficulties in academic achievement.

Rashid (1982) stated that children from lower-socioeconomic-status non-European cultural groups are at a disadvantage in American schools. This situation exists because the American educational system has evolved from a European philosophical, theoretical, and pedagogical context.

Historically, Thomas Jefferson envisioned the American educational system as being the vehicle for maintaining an informed electorate, which he considered a necessity for the survival of democracy. In reality, the American educational system became a kind of factory that "Americanized" huge groups of immigrants arriving from countries throughout the world. This factory was well tuned to select and sort those who accepted the value system of the dominant Euro-American class.

Today, more than 40% of the youngsters in America are at serious risk academically and are outside the cultural mainstream (Natriello, McDill, & Pallas,

1989). These children may experience learning difficulties because of differences between the culture in which they develop and learn and the culture they encounter in the public schools (Hale-Benson, 1986). Race and ethnicity, poverty status, family composition, mother's educational level, and language background are considered the five primary indicators of "educationally disadvantaged" children in America (Natriello et al., 1989). Any one of these factors, as well as combinations of the factors, can lead to serious learning deficiencies, primarily because of cultural differences.

Schools are influenced by, and help to maintain, the values and norms of the total society; one of these norms is sexism (Lightfoot, 1976). Females from all cultural groups must deal with gender bias at all levels of American society, including the schools.

Havighurst (1976) found that social class and ethnicity influence the shaping of human behavior. Each social class has a set of behaviors and attitudes that define it and separate it from other social classes. Each ethnic group forms a subculture with its own attitudes and behaviors. Cultural patterns are transmitted within all social classes and ethnic groups through the same mechanisms: family, peers, common literature, formal associations, in-group marriage, and residential segregation.

Sarason (1973) maintained that it is impossible to understand and evaluate the intellectual performance of particular groups without taking into account each group's attitude toward such performance. His point remains valid

when one investigates the relationship between the intellectual performance of particular groups and their historically rooted attitudes. People participate in a coherent culture that shapes their cognitive development and affects the way they approach academic tasks and behave in traditional academic settings.

Stodolsky and Lesser (1967) examined the rank-order patterns of various mental abilities among six- and seven-year-old youngsters from different social classes and ethnic backgrounds. Their major findings are shown in Table 2.1.

Table 2.1: Patterns of selected mental abilities among four ethnic groups.

Afro-American	Chinese	Jewish	Puerto Rican
Verbal ability	Space conceptualization	Verbal ability	Space conceptualization
Reasoning	Numerical ability	Numerical ability	Numerical ability
Space conceptualization	Reasoning	Reasoning	Reasoning
Numerical ability	Verbal ability	Space conceptualization	Verbal ability

Source: Stodolsky and Lesser (1967).

As can be seen in the table, subjects from the four ethnic groups differed markedly in the rank-order patterns of their mental abilities. Each culture shaped the cognitive development of its youngsters and, through its values, set the sequence of priority in the development of cognitive abilities.

Witkin (1967) defined cognitive style as the characteristic self-consistent modes of functioning found pervasively throughout an individual's cognitive, perceptual, and intellectual activities. After studying various ethnic and cultural groups in America, Cohen (1969) surmised that basically two styles of learning are present across all ethnic groups: analytical and/or relational. The analytical learner is a "splitter," or an individual who thinks that the attributes of a stimulus have significance in themselves. The relational learner is a "lumper," or an individual who thinks that the attributes of a stimulus are significant only in reference to some total context. Cohen maintained that current school practice uses only the analytical approach to learning. Requirements that the pupil learn to sit for increasingly long periods of time, to concentrate alone on impersonal learning stimuli, and to observe and value organized time-allotment schedules favor the analytical learner. Hence, it becomes necessary for relational learners continually to seek coherence from the learning environment on their own.

Cohen (1969) suggested that children develop their cognitive styles through the socialization they receive in their families and friendship groups. He discovered a relationship between structured families in "formal" styles of group functions and the analytical style. Fluid families that had the characteristic of "shared function" in their primary groups were identified with the relational style. Cohen's research indicated that the use of either style was not confined solely to any one ethnic group or class but that the analytical style was generally

associated with Euro-American families and the relational style was characteristic of the functioning of most Afro-American families.

Hilliard (1976) listed the following general characteristics of the Afro-American cultural style:

1. Response to the "whole" rather than the "parts."

2. Preference for inferential reasoning rather than deductive or inductive reasoning.

3. A tendency to approximate space, numbers, and time rather than to be precisely accurate.

4. Preference for focusing on people and their activities rather than on things.

5. A tendency to have a keen sense of justice.

6. A tendency toward altruism.

7. Preference for novelty, freedom, and personal distinctiveness.

8. Good at nonverbal communication; not word dependent.

The preceding characteristics most commonly considered to reflect the Afro-American cultural style are compatible with Cohen's interpretation of the relational cognitive style.

The strengths of the Afro-American family, according to Hill (1972), include sound kinship bonds, strong achievement orientation, adaptability of family roles, solid religious orientation, and strong work orientation. Hill contrasted the Afro- and Euro-American cultural styles in the following way:

Afro-American Ethos	Euro-American Ethos
Survival of the tribe	Survival of the fittest
Oneness with nature	Control over nature
Cooperation	Competition
Interdependence	Individualism
Collective responsibility	Independence

Benson-Hale (1986) projected that a Euro-American family's motto might be "I think, therefore, I am"; in contrast, an Afro-American family's motto might be "I feel, therefore, I think, therefore, I am." There is an inherent conflict in these two points of view. As stated earlier, the Euro-American value system is that which is considered to be "American" and is the one by which other systems are measured. Because Afro-American families want their children to be successful, they need to prepare their youngsters to live and function among Euro-American people without becoming Euro-American. The Afro-American family must mediate the "cultural conflict" that occurs when the values of the family differ from those of the dominant culture. The family must prepare its children to function in the culture in which they live and to assimilate those behaviors that are necessary to be upwardly mobile in the dominant culture.

Afro-Americans are the product of their own heritage and culture, yet they are shaped by the demands of the Euro-American culture. For this reason, DuBois (1903) described Afro-Americans in America as having "two warring souls."

The family group is the primary "teacher," and it is the family that strongly shapes the cognitive development of children and the way they approach

academic tasks. "Cultural difference" occurs when children have not had experiences that provide them with the kind of information that they need in school. "Cultural conflict" occurs when children have a learning style that differs from the analytical and behavioral styles reinforced in school (Cohen, 1969).

The results of Jones's (1981) study suggest that cultural conflict plays a significant role in the low school achievement of Afro-American students. Cultural conflict results in a serious mismatch between teachers' and students' cognitive styles and negatively influences the school achievement of Afro-American learners. Not only does the young Afro-American female face the cultural conflict of being outside the mainstream of the cultural majority, but she also must face gender bias and cultural messages, mythical and real, about being an Afro-American female in a Euro-American, male-centric society.

Hale-Benson (1986) asserted that the socialization of young Afro-American females begins early in their development with a strong motherhood orientation. Facial beauty is deemphasized in the Afro-American family, whereas there is a strong emphasis on personal uniqueness. The Afro-American family values and gives prestige to young females who demonstrate verbal ability, personality, wit, strength, intelligence, speed, and so on. There is an emphasis on the development of sexuality, personal style, and distinctiveness. An authoritarian child-rearing style often serves to develop toughness and self-sufficiency in Afro-American females, who may not interpret this style as restrictive or rejecting but rather as nurturing and caring. Afro-American females

are expected to contribute to the support of the family, and hence they develop a strong work orientation early in their lives. Hale-Benson further described the socialization process for young Afro-American females as an intense interpersonal interaction in the family, with a strong mother-child relationship. Lightfoot (1976) described the Afro-American female as being strong, patient, and enduring.

Summary

The literature reviewed in this section focused primarily on the influence of culture on learning and development. There is substantial evidence that culture does, indeed, shape learning as well as achievement (Ames, 1967; Banks, 1978; Beady, 1981; Benson-Hale, 1986; Blau, 1981; Jones, 1981; Ogbu, 1981). In America today, more than 40% of the youngsters may be at serious risk academically and are outside the cultural mainstream as defined by the Euro-American majority (Natriello et al., 1989).

Schools are influenced by, and help to maintain, the values and norms of the total society. People participate in a coherent society that shapes their cognitive development and influences the way they approach academic tasks. Cohen (1969) suggested that, although cultural influences may vary, most people are either analytical or relational in their learning styles. He maintained that current schooling practices tend to favor the analytical learner, who prefers formal and traditional learning situations. The relational learner is most comfortable in nontraditional, interactive, and informal learning situations.

Cohen's data suggest that most Euro-Americans prefer the analytical learning style, whereas most Afro-Americans tend to prefer the relational style of learning.

Cultural conflict occurs when a child has a learning style that differs from the analytical and behavioral styles being reinforced in school (Cohen, 1969). Afro-American children often experience serious cultural conflict in their schooling, which negatively affects their achievement (Benson-Hale, 1986; Gilbert & Gay, 1985; Jones, 1981).

Afro-American families are under tremendous pressure to maintain the strengths and characteristics of their own culture and to value these characteristics in their children, while at the same time preparing their children to function in the Euro-American school culture, which may or may not value those same characteristics. It is within the family that Afro-American females initially receive the cultural messages of socialization before entering school. After the age of five, Afro-American females often receive conflicting cultural messages in the school setting.

Cultural Factors Affecting Achievement in School

Although there is no precise mechanism for measuring or comparing the cultural factors that influence the school achievement of Afro- and Euro-American students, numerous researchers have provided evidence to explain and/or describe disparities in achievement between Afro- and Euro-American youngsters (Ames, 1967; Banks, 1978; Beady, 1981; Blau, 1981; Cadigan, Entwisle, & Alexander, in press; Jones, 1981; Ogbu, 1981; Pallas, Entwisle, &

Alexander, 1987; Rosser, 1980; Weikart, Bond, & McNeil, 1971). These investigators attempted to discover factors that are characteristic of or frequently are found among particular subgroups. These factors are not definitive but rather serve as generalizations that can aid in the understanding of a certain phenomenon.

According to Blau (1981), observed disparities in the measured intelligence of Afro-American and Euro-American children of each gender were not due to inherent racial differences. Rather, they were the result of social factors and complex interactions among these factors.

It is not until the first year of school and during the process of schooling that Afro-American children begin to underachieve (Ames & Ames, 1967; Entwisle & Alexander, 1989). Many minority-group children do not profit as much from school as majority-group students do. Likewise, minority-group children's test scores do not increase as much throughout the school year as do those of majority-group children (Entwisle & Alexander, 1989).

Coleman-Burns (1989) stated that the dual purpose of schooling is to foster cognitive development and to promote affective and social development. She concluded that schools bring little influence to bear on a child's achievement that is independent of his or her background and general social context. According to Hale-Benson (1986), the primary emphasis of traditional public school education in America for Afro-Americans is to mold and shape these

children so that they can fit into an educational process designed for middle-class Euro-American children.

One group of variables that influence a child's achievement and success in school comprises the individual and background factors that are present when the child starts school. These factors include gender, race, various parental and cultural influences, the child's own expectations, personal maturity, and/or special concerns that would apply just to that child (such as physical/mental/ social problems).

Entwisle and Alexander (1980) studied more than 500 first graders in Baltimore, Maryland. They found that Afro-American and Euro-American students were virtually equivalent in terms of computational and verbal skills, as measured by the California Achievement Test (CAT), at the start of first grade. Afro-American males equaled Euro-American males and females in terms of mathematics concepts (reasoning skills), but Afro-American females began first grade about one standard deviation lower than the others in terms of mathematical concepts on the CAT. In a similar study, Ginsberg and Russell (1981) found that ethnic differences in children's mathematics skills at the point of school entry were small to nonexistent. In her study of Afro- and Euro-American children, Blau (1981) stated that, when the full set of structural variables of the two cultures was taken into account, the difference between the races was reduced to 3.5 intelligence quotient (IQ) points.

Other researchers have found that few measurable differences exist in the cognitive development of children when they enter school (Rohwer, 1971). As a result of his research, Piaget (1952) verified that constants in language, maturation, mental operation, and universal interactions were more significant in a child's development than were transmissions of cultural lessons, which would vary from culture to culture. Piaget conceded, however, that the culture of the child will influence the chronology of the developmental stages but not the inevitability of the development.

The second phase of the child's cognitive development is influenced primarily by the youngster's school experiences. By the first or second grade, children as well as their teachers know how they measure up to their classmates in terms of their scholastic performance, even in the absence of IQ tests (Blau, 1981). Such factors as first-marking-period grades, popularity with peers, regularity of attendance, and conduct grades in the third marking period of the first year of school significantly influence the child's perception of success (Entwisle & Alexander, 1989). Once this generalized orientation toward the world is established, whatever its structural origins, it frequently operates as a self-fulfilling prophecy (Merton, 1948).

A disproportional lag in the development of verbal skills and abilities has been found among working-class Euro-American students and most Afro-American students. This lag increases as the youngsters advance from one grade to the next. As the curriculum content expands and spirals, that which the

children are expected to master becomes more difficult, and deficiencies in basic skills become an even greater impediment to learning. Often, the child's sense of efficacy is undermined, and discouragement and alienation follow (Blau, 1981). By the time they reach fifth grade, many Afro-American children have lower achievement scores than their second-grade IQ scores would predict. On the average, these students measure only at the fourth-grade level on their fifth-grade achievement tests. The data also suggest that underachievement stems, not from lack of competence, but from the failure of parents and teachers to provide effective instruction, encouragement, and support as children are required to master progressively more complex concepts and skills (Blau, 1981).

For Euro-American children, differences in achievement levels, as measured by standardized achievement tests, have been attributed to the following:

1. The parents' educational level.
2. The demographic origins of the family.
3. The parents' occupational status.

In contrast, differences in achievement levels of Afro-American children, as measured by standardized achievement tests, have been attributed to the following:

1. The social milieu of the parents (the mean educational level of the mother's three closest friends, and the social characteristics of neighbors).
2. The parents' educational level.

3. Differences in religious composition and religiosity (Blau [1981] established a negative relationship between fundamentalist religious affiliation and IQ development).

As a rule, parents who are economically and educationally advantaged have higher educational aspirations and expectations for their children than do parents who are less advantaged. In turn, these children average higher scores on all manner of school tests involving verbal and numerical skills. The youngsters' success reinforces their own and their parents' aspirations and expectations with regard to their future educational attainments (Gordon, 1972; Hyman, 1953; Kahl, 1957; Rosser, 1956, 1959; 1961; Simpson, 1962).

As noted earlier, the achievement test scores of many minority-group children do not increase as much over the school year as do those of majority-group children (Entwisle & Alexander, 1989). Critics of most standardized achievement tests have claimed that most of these tests:

1. Are highly loaded with items based on middle-class Euro-American values and experiences (Williams, 1970).

2. Penalize children with linguistic styles that differ from that of the dominant culture.

3. Sample cognitive styles that are different from those found in many children from low-income families (Cohen, 1969) or culturally diverse groups (Kleinfeld, 1973).

4. Have fostered the creation of a dual educational system by means of classifying and excluding some children from regular education programs (Winnikur & Wohle, 1984; Ysseldyke, 1983).

5. Are of little or no use in formulating instructional programs for children (Heller, Haltzman, & Messick, 1982; Winnikur & Wohle, 1984).

The most common criticism of standardized achievement tests is that they are culturally biased so as to discriminate against racial and ethnic minorities of low socioeconomic status (SES) (Jensen, 1980) and may endanger these individuals' futures (Williams, 1974). These tests are normed for the majority population and cannot measure the different talents that are derived from the unique cultural backgrounds of minority groups (Williams, 1974).

Summary

This section focused on cultural factors affecting the achievement of Afro- and Euro-American children in school. According to Blau (1981), observed disparities in the measured intelligence of Afro- and Euro-American boys and girls were not due to inherent racial differences but were the result of social factors and the complex interactions among them. Entwisle and Alexander (1989) found that Afro-American and Euro-American students were equivalent in computational and verbal skills when they entered school. Other researchers have further demonstrated that differences among ethnic groups in terms of mathematics and intelligence test scores at the onset of schooling are small to nonexistent (Blau, 1981; Entwisle & Alexander, 1989; Ginsberg & Russell, 1981;

Rohwer, 1971). Rather, it is within the first year of school that Afro-American children begin to underachieve. Blau suggested that this underachievement stems, not from lack of competence but rather from the failure of parents and teachers to provide effective instruction, encouragement, and support as children are require to master progressively more complex skills and concepts. It is important to remember that the achievement of youngsters in American public schools is measured through the use of standardized achievement tests. Various writers have asserted that standardized achievement tests, as presently used, are culturally biased, discriminating against racial and ethnic minorities and those from low-SES families.

Afro-American Females in American Classrooms

Schools are influenced by, and help to maintain, the values and norms of the total society; one of these norms is sexism. Structures and behaviors that reinforce traditional gender roles pervade the educational system, from preschool through the postdoctoral level.

During the preschool years, females test either higher than boys (in general intelligence, verbal ability, and numerical ability) or the same as boys (in spatial ability, analytical ability, and creativity). However, by the middle of elementary school, boys consistently score higher on all of these tests except grammar, spelling, and word fluency, and this trend continues throughout the school years (Lightfoot, 1976).

Until recently, Afro-American females were expected to assume a subordinate role to Euro-American males and females of all ages, as well as to Afro-American males. Similarly, Euro-American females were expected to play a subordinate role as "helpmates" to Euro-American males.

In the past, basic formal education for Afro-American females was thought to be a necessity only for producing disciplined domestics and blue-collar workers (Coleman-Burns, 1989). For Afro-American females, the process of socialization into the roles of womanhood begins at age seven or eight. It is the peer group that seems to be the most important agent in this process (Ladner, 1971).

The responsibilities assumed by adolescent Afro-American females are often those taken on by adult females in other social groups, as well (Ladner, 1970). In the past, most Afro-American females subtly were encouraged to assume stereotypical roles of Afro-American women in American society rather than strive for alternatives (Grant, 1984).

Afro-American children of both genders are socialized in their families for assertiveness, self-confidence, independence, and achievement (Lewis, 1975; Nelson-LeGall, 1989; Scott-Jones & Clark, 1986). These children are raised to be people-oriented (Benson-Hale, 1986).

Afro-American females tend to meet or exceed the attainment level of Afro-American males at all educational levels (Coleman-Burns, 1989). There is no firm evidence, however, that Afro-American parents encourage their

daughters' education at their sons' expense (Smith, 1982). Rather, the bulk of the research has indicated that Afro-American families are less likely to use gender as a basis for educational and occupational aspirations than are Euro-American families (Nelson-LeGall, 1991).

Nelson-LeGall (1991) stated that Afro-American families and communities now place an emphasis on education for Afro-American females, knowing that:

1. The Afro-American child's social status is determined by the mother's educational level.

2. Educational level is a critical factor in procuring employment.

3. Employment opportunities are more favorable for Afro-American females than for Afro-American males.

4. Afro-American females must work for the economic survival of their families, not self-fulfillment.

Schooling does not have the same economic payoff for Afro-American females as it does for other racial/gender groups, despite the positive association between years of schooling completed and earning levels. According to data collected by the U.S. Department of Labor, Bureau of Labor Statistics (1989), Afro-American females earned 69% of what Euro-American males earned, and Euro-American females earned 74% of what Euro-American males earned. The wages of Afro-American females were the lowest of any of the gender and racial/ethnic groups included in the comparison (National Center for Education Statistics, 1991).

Outcomes of schooling differ systematically across various racial and gender groups (Hare, 1985; Trent, 1984). One reason for this difference is that educators respond to children of various racial and gender groups in different ways.

Grant (1984, 1985) found that Afro-American females' experiences in school differed from those of other racial/gender groups, but that the differences could not easily be predicted. In Grant's study, teachers rated Afro-American females' academic skills and classroom performance more favorably than those of Afro-American males, less favorably than those of Euro-American females, and lower than but similar to those of Euro-American males. Euro-American teachers gave less attention to academic criteria when assessing Afro-American females' abilities than when rating the abilities of any other group. Teachers called on Afro-American females more than any other group for nonacademic tasks, whereas they offered reinforcement and recognition of intellectual competence to Euro-American females. The pattern of teachers' interaction with Afro-American females in desegregated classrooms was found to be relatively parallel to the pattern of treatment of Euro-American females in a segregated elementary school classroom (Dweck, Davidson, Nelson, & Enna, 1978).

Afro-American females have less contact than Euro-American females with the teacher, and such contact occurs only when necessary. These contacts are briefer, more task related, and more often on behalf of a peer than are those of Euro-American females. Euro-American females provide more help to Euro-

American males than they receive in return, whereas Afro-American females and males are mutually helpful to each other in academic and nonacademic ways (Grant, 1984; Nelson-LeGall & DeCooke, 1987; Nelson-LeGall & Glo-Scheib, 1985). In desegregated classrooms, Afro-American females are the most frequent targets of racist and sexist remarks, which are generally made by Euro-American males (Grant, 1984). Afro-American females in desegregated schools often demonstrate lower self-esteem than Afro-American females in segregated schools (Powell, 1970; Rosenberg & Simeon, 1972).

Afro-American females in desegregated schools usually have higher levels of academic performance than do Afro-American males (Crain & Mahard, 1978; Hare, 1978). However, the academic performance of Afro-American females is lower than that of Euro-American students (Crain & Mahard, 1978). Hare and Castenell (1981) found that Afro-American females had lower self-estimations of academic skills than did Afro-American males, in spite of higher performance.

Summary

This section was concerned primarily with the experiences of many Afro-American females in American classrooms. In preschool, females of all ethnic groups test higher than or the same as males on general intelligence, verbal ability, and numerical ability. However, by the middle of elementary school, males score higher than females in these areas. Thus, it would appear that the schooling process is not benefiting all females. Until recently, Afro-American

females were expected to assume a subordinate role to Euro-American males and females of all ages, as well as to Afro-American males. In the past, most Afro-American females were encouraged to assume the stereotypical (usually blue collar) roles of Afro-American women in society, rather than strive for alternatives (Grant, 1984). Afro-American females' experience in school seems to differ from that of other racial/gender groups. Euro-American teachers give less attention to academic criteria when assessing Afro-American females' abilities and tend to offer them conditional praise for academic work (Dweck et al., 1978). Afro-American females have less contact with the teacher than do others and seem to go to the teacher only when it is absolutely necessary (Grant, 1984; Nelson-LeGall & DeCooke, 1987; Nelson-LeGall & Glo-Scheib, 1985). In desegregated classrooms, Afro-American females are the most frequent targets of racist and sexist remarks, which generally are made by Euro-American males (Grant, 1984).

Public schools are considered to be critical agencies in the transmission of social-status arrangements from one generation to the next. Educators respond to children of different races and genders in ways that reinforce differentiation. Hence, Afro-American females must endure strong cultural messages that indicate both gender and racial discrimination in school settings.

Improving the School Success of Afro-American Children

The key to improving the school success of Afro-American children is to modify the *means* used to achieve the outcomes (Gilbert & Gay, 1985). Gilbert and Gay, as well as other writers, did not recommend altering the level of expected outcomes, but rather changing the means of achieving these outcomes so that the relational-style learner can be accommodated.

In 1976, on the basis of his study of Afro-American children, Akbar developed the following profile of the Afro-American learner. This learner:

1. Is highly affective.
2. Uses language with numerous interjections.
3. Uses considerable body language in communication.
4. Uses expressions with connotated meanings.
5. Uses nuances, intonation, and body language.
6. Prefers aural-oral learning communication.
7. Is highly sensitive to others' nonverbal cues.
8. Is people oriented.
9. Is sociocentric.
10. Uses internal cues for problem solving.
11. Is highly empathetic.
12. Is spontaneous.
13. Adapts readily to novel stimuli.

Effective instructional strategies for Afro-Americans include opportunities for human interaction in the learning process. Afro-American students tend to function better in cooperative, informal, and loosely structured environments. Positive teacher rapport, in an environment that focuses on working together to achieve common goals, is important to Afro-American youngsters. The effective learning environment for these students has an authority figure with high expectations and a sense of fairness. Gilbert and Gay (1985) described the learning style of Afro-American children as relational and field-dependent, with an active pace and a cooperative climate.

Gilbert and Gay (1985) also described the "stage setting" that precedes Afro-Americans' performance of a task as being atypical to the traditional school setting. Stage setting refers to the activities and/or behaviors that Afro-Americans need to perform to establish the proper context or setting before they can begin the task. These behaviors might include looking over the whole assignment before beginning; rearranging posture; elaborately checking pencils, paper, and writing space; asking the teacher to repeat directions; and checking the perceptions of nearby students. Although such activities seem to be necessary in order to begin a task, they often consume valuable work time and might account for a substantial cumulative loss of time on task.

For most Afro-American youngsters, spoken language is the primary mode of communication. They learn by listening and demonstrate their learning by speaking. The style of delivery of Afro-American communication is often

described as artistic and dramatic, with nonverbal nuances, word placement, and speech rhythm.

Afro-American children are more apt to talk simultaneously and to engage in several different activities at once than are their Euro-American peers. Most Afro-American youngsters are comfortable with this multimodal, multidimensional involvement. They tend to like to involve their total selves in the learning--cognitively, affectively, and physically. When they are unable to use this "whole self" in the learning process, many Afro-American youngsters experience withdrawal and frustration. An orderly environment may seem dull, stagnant, and unstimulating to these students. Afro-American students learn best when they are immersed in a system of interrelated learning encounters that minimize conflicts between the values and expectations of the school and those of the Afro-American culture (Benson-Hale, 1986; Gilbert & Gay, 1985).

Slaven, Karweit, and Wasik (1993) stated that it is clear that all children must successfully negotiate key developmental hurdles in their first decade of life. Educators can ensure that virtually all children can overcome these obstacles by providing:

1. High-quality preschool learning experiences, such as those found in high-scope preschools.

2. One-on-one tutoring for serious problems in first grade.

3. Continued curriculum improvement and long-term family support services.

If learning-climate conditions that favor both the relational and the analytic learner are included as a fourth provision, then it might be found that the active, cooperative type of learning environment that seems to work best for Afro-American students is also beneficial for many other students, as well.

Throughout their school years, Afro-American youngsters are assessed using standardized achievement tests, which have long been suspected of being culturally biased, discriminating against racial and ethnic minorities. Thus, it is imperative that Afro-American youngsters be taught systematically to be "test wise" (Henry & Henry, 1990).

Summary

This section focused on ways to improve the school success of Afro-American children. Gilbert and Gay (1985) believed that the key to improving Afro-American children's success in school is to modify the means of achieving outcomes so as to reflect the cognitive style of the learner. Benson-Hale (1986) referred to this modification as adding "soulfulness" to the instructional process. Keeping in mind the profile of the Afro-American learner developed by Akbar (1976), teachers should implement instructional strategies that provide these students with opportunities for human interaction during the learning process. Providing Afro-American learners with multimodal, multidimensional involvement during the learning process, and using the "whole self" in the process, may help minimize conflicts between the values and expectations of the school and those of the Afro-American culture (Benson-Hale, 1986; Gilbert & Gay, 1985). By using

information about how all youngsters learn, as well as what is known about how Afro-American youngsters learn, educators may be able to bring about higher achievement among this group of students.

Understanding How Children Across All Cultures Learn Math

Piaget and others have demonstrated that learning is a complex, creative, and intellectual process in which the learner literally constructs or builds knowledge based on what he or she already knows. All youngsters continually assimilate new information, which enters the frame of reference in their minds. With this information they form connections and seek relationships. Children invent strategies for making these connections, and the strategies may change as the concept grows. When such a connection is made, the structure will change to accommodate the new learning into the whole idea. (An example is the conceptual realization that whenever one multiplies any number by zero, the answer will be zero. Acceptance of this concept frees youngsters from memorizing a large number of facts.)

These connections are based on where the child is developmentally and experientially. In his studies of youngsters, Piaget (1952) identified the developmental stages young learners must progress through in order to reach the formal operational stage (maturity). These stages, or periods, in which the child's thinking reflects a particular mental structure, are not predictably chronological but sequential and developmental. Various cultural factors can

influence the timing of the developmental stages but not their sequencing and inevitability.

From birth to about two years of age, youngsters are in the *sensi-motor* developmental stage. That is, they learn entirely from sensi-motor input. Reflex actions gradually are integrated into exploratory and experimental activities. Even infants have some numerical sense at this early stage. They can distinguish between some classes of amount, such as "big" and "little," but they cannot arrange things in order. Number words such as "more" and "another" appear in their language, and they form some intuitive, informal notions about addition and subtraction (Baroody, 1987). Even infants are capable of perceiving numerical differences between small quantities (Starkey, Spelke, & Gelman, 1980). They can perceive differences in number and see correlations among different numbers of events.

The ages from two to seven are referred to as the *preoperational* stage. During this stage, children learn to use image and language. They are very centered and find it difficult to take another's point of view and/or accept that another's way of life is different. They cannot conserve; that is, they cannot accept the notion that amount may not change when the arrangement changes.

In an experiment with his four-year-old daughter, Binet (1969) observed that she could count no higher than three, but she could identify the greater of two sets. She always chose the set that took up more space as the greater one.

Children in the preoperational stage continue to develop quantitative concepts such as "more," "less," "order," and "same." They can begin to count but do not understand one-to-one correspondence. At about four years old, children can learn the number words and count up to nine objects. At about five, children can count about ten objects; they may be able to write the numbers but do not really understand the abstraction of the symbols. Many six year olds can count up to 28, can write the numbers, and have some understanding of the concept but not the ability to explain it. By the age of seven, most youngsters can count, write the numerals, and explain the connection with place and value (Ginsberg, 1987).

Piaget (1952) described children from ages 7 to 12 as being in the *concrete operations* stage of development. Upon reaching this stage, children can think logically and apply such operations as classification, ordering, reversibility, and conservation. They can de-center but have not yet reached formal operational thought, which deals fully with abstractions and hypotheses that have no direct connection to the real world (Ginsberg, 1987).

Baroody (1989) found that an understanding of mathematics grows from concrete experiences with objects. "Real mathematics," he stated, is representational and highly abstract. Children's mathematics is the necessary first step in the direction of abstraction. Abstract ideas cannot be taught; they must emerge from concrete experiences.

The traditional method of teaching mathematics provides few opportunities for youngsters actively to explore, experiment, and discover representational relationships. Writing and memorizing number facts are abstract processes and are irrelevant to most young learners.

In the 1950s, Piaget recommended that teachers provide children with objects and ideas to manipulate that would help them become more conscious of problem solving and would encourage them to find answers for themselves. Piaget thought that teachers should be less providers of information and more organizers of engaging, problematic situations. Young learners must essentially rediscover and reinvent mathematical knowledge for themselves. They can do so in guided opportunities of discovery and exploration.

Typically, mathematics instruction tends to be a process based on the "absorption theory." That is, the valued knowledge is impressed on the student from outside by means of the teacher. The learner is considered to be an "empty vessel" to be filled with a collection of facts. This process depends on repetitive drill and practice until the student has memorized the desired level of information. The thinking process involved is associative; that is, mastery of a particular level depends on successful mastery of the previous level. The learner is both passive and receptive in this process. The teacher serves as the external controller, punishing and correcting students for wrong answers and rewarding them for correct ones. The role of the teacher is to transmit information in a "lock-step" manner. Strategies of the teacher include direct instruction using a

textbook, workbook, and/or worksheet. Students are expected to listen, learn, and practice decoding the abstract symbols of mathematics with large amounts of drill, homework, seatwork, and worksheets (Baroody, 1987).

With the traditional method of mathematics instruction, little or no credence is given to learners' informal understanding of mathematics. Indeed, learners are not expected to use any of their natural strategies and/or intuitions in the learning process. Teachers rarely ask students how they are thinking but seem to be interested only in the "right" answer. This way of learning mathematics is predictable and efficient until the learner runs into a problem that outstrips his or her capacity for memorization. (This predicament is especially difficult for girls, who use their verbal skills to memorize and compute but are later bewildered by the application of problem-solving and geometric relationships in algebra and geometry [Clement, 1989].) These teaching and learning practices may not be based on sound developmental and cognitive learning theory and may not serve the needs of many youngsters.

In 1980, the National Educational Assessment Program stated that American students were experiencing major deficiencies in mathematics understanding and achievement. Specifically, they lacked understanding of basic mathematics concepts and procedures, as well as basic problem-solving skills. In international comparisons as well, American students made a poor showing. In response to this grim report, the National Council of Mathematics Teachers recommended that teachers change their instructional practice and

teach mathematics so that students would be actively engaged in learning. Teachers were encouraged to provide opportunities for students to experiment, explore, and communicate about math. Also, teachers were asked to create an environment that would encourage problem solving and risk taking. As a result, the hands-on or nontraditional method of mathematics instruction, which focuses on conceptual development based on concrete experiences, has become more evident in elementary school classrooms across America.

This nontraditional method of mathematics instruction is based on the cognitive theory that knowledge must be worked out from within the learner, using insight, previous learning, and/or understanding and building relationships with what is being learned. The essence of knowledge essentially is that which is formed when elements of mathematics information are connected by relationships to form an organized and meaningful whole concept. This active construction of knowledge by the learner is based on the discovery of the relationships of mathematics concepts. The role of the teacher is that of facilitator/guide and creator of an environment that is fertile with opportunities for youngsters to experiment and to discover these important mathematical relationships (sorting, predicting, counting, grouping, graphing, adding, building, subtracting, classifying, ordering, and so on). The teacher may provide games and concrete materials in a setting that is active with small-group, large-group, and one-on-one opportunities for interaction and exchange of ideas (Baroody, 1987). Using this method of instruction, the classroom teacher is challenged to

consider how all children learn (cognitive) and what they need and feel (affective) so that they can be successful in mathematical problem solving.

Summary

This section focused on understanding how all children learn mathematics, as well as the two methods of mathematics instruction that are used in American schools today: traditional and nontraditional. Learning mathematics is a complex, creative, and intellectual process in which the learner literally constructs or builds knowledge based on what he or she already knows. Mathematics connections occur developmentally and experientially. Children of all cultures must progress through specific sequential developmental stages that reflect a particular mental structure. Piaget (1952) identified these stages as sensi-motor, preoperational, concrete operations, and formal operations. Instructional strategies provide opportunities for youngsters to reinvent or rediscover numerical relationships. Traditional mathematics instruction tends to be a formal process, in which the valued knowledge is transmitted to the child through such activities as repetitive drill, memorization, and rote learning. Nontraditional mathematics instruction, which was developed in response to a public outcry over children's poor achievement in mathematics, is in closer alignment with Piaget's developmental stages and relies more heavily on the learner's natural numerical sense and experience. It is anticipated that this closer alignment of mathematics instructional opportunities and natural learning will enhance children's achievement in mathematics.

Chapter Summary

The phenomenon of underachievement among Afro-American females is highly complex, subtle, and underresearched. Nelson-LeGall (1992) observed that being female puts one at risk for gender discrimination, and belonging to a racial minority group puts one at risk for racial discrimination. Race, gender, cultural factors, and the school setting are among the complex, interacting variables that affect the achievement of Afro-American females in American schools.

Culture influences children's learning and achievement. In America, children whose cultural and cognitive styles differ greatly from those of the dominant middle-class Euro-American culture often experience significant difficulties in academic achievement. Today, more than 40% of the youngsters in America are outside the cultural mainstream and are seriously underachieving academically (Natriello et al., 1989).

Cohen (1969) found that basically two cognitive styles--analytical and relational--are present in all ethnic and cultural groups in America. The cognitive style most frequently used by Afro-Americans is relational, whereas that used by Euro-Americans is analytical. Cohen believed that the analytical approach to learning is the one that is primarily used in schools today.

The strengths and values of the Afro-American family contrast sharply with those of the Euro-American family. The Afro-American family serves as a mediator for its children; family members attempt to teach the children how to

survive and be successful in the dominant culture without losing their own cultural identity.

Young Afro-American females face the cultural conflict of being outside the mainstream of the cultural majority. They also encounter gender bias and negative cultural messages, mythical and real, about being an Afro-American female in a male-centric, Euro-American society.

It is not until the end of the first year of school that Afro-American children begin to underachieve (Ames, 1967; Entwisle & Alexander, 1989). They are virtually equivalent to Euro-American children in terms of computational and verbal skills at the beginning of first grade (Entwisle, 1989). Blau (1981) discovered that, when she considered a comprehensive range of variables, the difference in IQ scores between the races was only 3.5 points. However, even though Afro-American children are relatively equal to their Euro-American classmates when they start school, they begin to fall behind by the first marking period and continue to do so throughout their schooling. The literature reviewed for this study indicated that underachievement of Afro-American children stems not from their lack of competence but rather from the failure of parents and teachers to provide effective instruction, encouragement, and support as the children are required to master progressively more complex concepts and skills.

The experiences of Afro-American females in school seem to differ from those of other racial/gender groups. Afro-American females seem to occupy a "role" or "place" in the classroom that deemphasizes academic achievement.

They are frequently the target of racist and sexist remarks, which usually are made by Euro-American males, and they often demonstrate lower self-esteem than other identifiable groups in the desegregated school setting (Grant, 1984).

The key to improving the success of Afro-American children, particularly Afro-American females, is to modify the means used to achieve the desired outcomes (Gilbert & Gay, 1985). Much is now known about the cognitive style and learning characteristics of many Afro-American children. It is anticipated that the use of effective instructional strategies, based on this knowledge and a better understanding of the socialization process experienced by young Afro-American females, could enhance the achievement of all Afro-American students.

According to Piaget (1952), children of all cultures progress through certain developmental stages in their learning. Mathematical knowledge grows as youngsters move through these stages. By using the nontraditional method of mathematics instruction, which is based on known learning characteristics of these stages and relevant cognitive learning theory, teachers might be able to improve the mathematics achievement of many children, including Afro-American youngsters. This method focuses on active, informal learning and takes into account the physical, mental, and emotional needs of youngsters. It is compatible with instructional strategies that have been found to be effective with young Afro-American learners.

CHAPTER III

METHODOLOGY

Introduction

The methodology used in carrying out the study is described in this chapter. The problem and purposes of the study are stated first, followed by a discussion of the study population. The two instruments used to collect data for the study are discussed next. The data-gathering procedures for both the quantitative and qualitative portions of the study also are described, as are the data-analysis techniques.

The Problem and Purposes of the Study

In 1991, when the achievement test data for East Elementary School were disaggregated, the disparity between the mathematical problem-solving and applications scores of Afro-American and Euro-American females in grades 2, 3, and 4 became apparent. Whereas 49% of the Euro-American females scored below the 50th percentile, 74% of the Afro-American females scored in that range. The question arose, why was there such a great discrepancy in the mathematics achievement of the Afro-American females? Thus, the problem to be researched in this study became evident to the writer.

In the fall of 1992, the school district introduced an innovative, nontraditional approach to mathematics instruction, which focused on a conceptually based approach to learning mathematical concepts and applications. This new method of mathematics instruction is based on the educational theory developed by Piaget and others, that children must be the architects of their own learning. In learning a particular concept, youngsters must have many and varied opportunities to experiment with and/or "act" on the concept before they can attempt to use an abstract symbol, such as employing this number concept in a paper-and-pencil activity. For example, youngsters may work with manipulatives and counting objects in a variety of ways before the concept of 3 + 1 = 4 is established in their minds. Eventually, as they arrange objects, children build a relationship in their own minds about the congruity of that number concept.

This "acting-upon" and "relationship-building" approach to learning is enhanced by the insertion of mathematical thinking into real-life situations. For school-age children, real-life situations occur at home, at school, at play, and at work. Quantification activities are employed at every opportunity in school, from record keeping to game playing. Frequent problem solving using mathematical and logical thinking occurs throughout the school day. Youngsters do not move to the abstraction until they demonstrate that they understand the concept and have had multiple opportunities to "act" upon it. The teacher seeks every

opportunity to use a real-life situation for quantifying and for mathematical thinking and logic.

Educators in the district anticipated that the use of a nontraditional approach to mathematics instruction would enhance the mathematics achievement of both Afro-American and Euro-American females. Teachers also anticipated that the nontraditional type of instruction would improve these youngsters' attitudes and perceptions about mathematics.

Implementation of this new method of mathematics instruction, based on sound educational pedagogy, provided a baseline for comparing and contrasting the effects of this treatment on a sample group of young learners. The Afro-American females in this school population were not achieving at a satisfactory level when teachers used the traditional approach to teaching mathematics. Hence, one of the researcher's purposes in conducting this study was to determine whether achievement would improve as a result of the application of a nontraditional method of mathematics instruction.

The researcher compared Afro-American and Euro-American females' achievement in mathematics concepts and applications two years before and two years after the application of a nontraditional, conceptually based method of instruction. The subjects were third, fourth, and fifth graders in one elementary school.

Responding to the literature stating that perceptions and attitudes about mathematics may affect children's achievement in mathematics, the researcher

expanded the study to also include interviews with 12 members of the sample group. The purpose of this portion of the study was to investigate these subjects' attitudes and perceptions toward mathematics.

The Study Sample

The sample for this project comprised 28 Euro-American and 19 Afro-American females in grades 3, 4, and 5 in one elementary school. East Elementary School was chosen as the setting for the study primarily because of the disparities in the achievement test scores of its students in 1991. These disparities were discovered during the building's school improvement process. Before the implementation of the nontraditional mathematics instructional program, 74% of the Afro-American females scored below the 50th percentile on the mathematics concepts and applications portions of the CAT, whereas 49% of the Euro-American females scored below the 50th percentile.

Each female in grades 3, 4, and 5 at East Elementary School was assigned a student number, in order to protect her anonymity. NCE scores for math applications and problem solving for the years 1990, 1991, 1992, and 1993, as well as recent mathematics computation and reading comprehension scores, were gathered. The researcher used the school computer to select those females in grades 3, 4, and 5 for whom complete test-score data were available for the years 1990-91 through 1993-94. From a pool of approximately 70 Euro-American females in the school, 28 were selected for the sample. Likewise, from a pool of approximately 35 Afro-American females, 19 subjects were selected.

It was not necessary to obtain parental permission for this portion of the study because the identities of the youngsters being studied would not be revealed.

From the initial group of 47 sample members, 26 responded to the request for interviews and returned permission notes from their parents. Of that number, 12 (six Afro-Americans and six Euro-Americans) were chosen for the interviews. The researcher endeavored to select for the interviews those subjects who had a significant disparity between their total reading scores and their mathematics concepts and application scores. The other primary characteristics shared by the 12 interviewees was their interest in the project, their willingness to be interviewed, and their inclusion in the study sample.

The interviews took place two years after the inception of the nontraditional mathematics instruction. Because the interviewees were not randomly selected from the sample group, their perceptions and attitudes about mathematics may not be generalizable to the total population, but they do provide insight into the subjects' perceptions and attitudes concerning mathematics.

Instrumentation

Two instruments were used to gather the data for this study: the California Achievement Test (1984 edition) and the interview guide developed by the researcher. Students' scores on the CAT, a series of norm-referenced, objective-based tests for kindergarten through twelfth grade, were used for the quantitative portion of the study. The test series was designed to measure

achievement in the basic skills commonly found in state and district curricula. Because the tests combine the most useful characteristics of norm-referenced and criterion-referenced tests, they provide information about the relative ranking of students against a norm group, as well as specific information about the instructional needs of students.

The subject areas measured by the CAT were reading and mathematics. These scores were used to provide a measure of test performance and to make direct comparisons of achievement between the two subject groups. For the purposes of this study, only the mathematics concepts and applications, reading, and mathematics computation NCE scores were collected.

The structured interview was designed to explore the 12 interviewees' perceptions and attitudes about mathematics. The first five questions were designed to put the student at ease and to gain some demographic data about her. Questions 6 and 7 were designed to gain insight into how the student perceived herself as a grown up. Questions 8 through 17 were intended to gather information on the interviewee's perceptions and attitudes about mathematics. The final section, which was adapted from a sentence-completion questionnaire developed by Sandra Davis at the University of Minnesota, sought additional information on the subjects' attitudes and perceptions about mathematics.

The interview was field tested on a group of 12 second graders who were not included in this study. One change was made in the instrument after the field

study. Question 17, item 3, was changed from "When I think about math, I. . . ." to "Doing math makes me feel. . . ." The revised instrument provided the information sought for the qualitative portion of the study. A copy of the interview questions may be found in Appendix B.

Data-Collection and Data-Analysis Procedures

The superintendent of the school district involved in the study granted the researcher permission to conduct this study. Both school-district and school-building personnel were interested in determining whether the nontraditional method of mathematics instruction would enhance the mathematics achievement of all female students, and particularly Afro-American females, at East Elementary School. The researcher also obtained approval from the Michigan State University Committee on Research Involving Human Subjects (UCRIHS) to carry out the study.

The Quantitative Portion of the Study

The quantitative data for this study were obtained from the subjects' permanent cumulative records (CA-60s). Subjects' scores on the Math Applications and Problem-Solving portion of the CAT for the years 1990, 1991, 1992, and 1993 were used in this study. Computation scores and total mathematics scores were not used in the analysis of variance portion of the study because mathematics concepts and applications was revealed in the test-aggregation process as being the area of most significant underachievement.

Normal curve equivalent (NCE) scores on the CAT of the sample members were used in the quantitative portion of the study. The scores from two years before and two years after the application of the nontraditional approach to mathematics instruction were compared to determine whether the subjects' scores had improved after the application of the nontraditional mathematics instruction. The NCE score scale, ranging from 1 through 99, coincides with the national percentile scale at 1, 50, and 99. NCE scores are similar to percentile ranks but also have an equal-interval scale. That is, the difference between two successive scores on the scale has the same meaning throughout the scale. For example, if a youngster in the study had an NCE score of 65, this means that this youngster did better than 65% of the children in the country who took the test. NCE scores, unlike percentile or stanine scores, allow meaningful comparisons to be made between different groups of students on the same test. Comparisons can be made by averaging the scores for the groups.

In the quantitative portion of the study, the statistical analysis of the CAT data was set up in a 2 x 4 format, the 2 representing the two groups of subjects (Afro-American and Euro-American) and the 4 representing the four years of test data being analyzed (two years before and two years during and after the application of the nontraditional mathematics instruction). The mean mathematics scores of the sample groups, presented in the 2 x 4 format, are shown in Table 3.1.

Table 3.1: Mean mathematics scores of the total sample.

Group	1990	1991	1992	1993
Afro-Americans	37.3	35.0	41.3	41.5
Euro-Americans	49.3	60.6	58.0	61.2

An F-test was used to measure variance within and between the two groups on their mathematics concepts and applications achievement scores two years before and two years after the application of the nontraditional method of mathematics instruction. A p-value was computed to indicate the probability of the outcome. The .05 alpha level was established as the criterion for statistical significance.

The following null hypotheses were formulated for this study:

Hypothesis 1: There will be no significant difference in the mean mathematics scores of the total sample before and after the application of a nontraditional method of mathematics instruction.

Hypothesis 2: There will be no difference between the Afro-American and Euro-American subjects in terms of their mean mathematics scores over the four-year period of study.

The Qualitative Portion of the Study

For the qualitative portion of the study, interviews were conducted with 12 females selected from the sample. The interviews were designed to explore these subjects' perceptions and attitudes about mathematics. The researcher met with all of the female students in grades 3, 4, and 5 at East Elementary School and explained the interview process. She told the youngsters that this

was a study about how they felt about mathematics. They were informed that the research was being conducted by a student from Michigan State University with the help of two female college students--an Afro-American and a Euro-American. They were not told that their principal was the person conducting the study, in order to avoid any subtle coercion implied in the principal-student relationship. The students had participated in various studies before, so this was not an unusual situation for them.

Consent letters explaining the study were sent home with those students who expressed an interest in participating in the interviews (see Appendix A). Interviewees were selected from a list of students who returned permission slips if there was a substantial discrepancy between their reading and mathematics achievement scores.

The subjects' responses to the interview questions were recorded on a single data sheet for each question. The following codings were used to allow the researcher to look for variables that might be associated with the question, as well as the interaction between a subject and the interviewer.

Interviewer/Interviewee

AA/AA	Afro-American/Afro-American
AA/EA	Afro-American/Euro-American
EA/AA	Euro-American/Afro-American
EA/EA	Euro-American/Afro-American

A sample page showing the coding of the responses may be found in Appendix B.

Description of the Nontraditional Approach to Mathematics Instruction

Beginning in the fall of 1992, the school district changed to a nontraditional, conceptually based approach to mathematics instruction. Every teacher at East Elementary School participated in the Michigan Mathematics Inservice Project (M^2IP). This staff-development project was the result of the cooperative efforts of the Michigan Council of Teachers of Mathematics and the Michigan Department of Education. The purpose of this project was to help Michigan's kindergarten through ninth-grade teachers of mathematics to prepare their students for the challenges of the twenty-first century. Specific objectives for the elementary school portion of the M^2IP inservice project were as follows:

1. To extend and update the mathematics background of Michigan's K-6 teachers.

2. To shift the emphasis of K-6 teachers from teaching rote skills to that of developing concepts and higher-level thinking skills.

3. To foster the development of problem-solving abilities.

4. To include probability and statistics, geometry, measurement, and algebraic ideas in the K-6 curriculum.

5. To identify strategies for encouraging underrepresented and underserved groups in the study of mathematics.

This training model consisted of approximately 40 hours of teacher inservice at the K-2 and 3-6 grade levels. Teachers were taught by project leaders to be "teachers of teachers." The teachers for this project at East Elementary School were from a nearby school district. The inservice sessions were held after school from 3:30 to 6:00 p.m. once a week for approximately 16 weeks. Hands-on instructional materials such as attribute blocks, tangrams, counting and sorting manipulatives, cubes, blocks, geometric solids, fraction kits, measurement devices, calculators, and other kinds of appropriate materials were purchased, and the teachers were taught to use them in the classroom.

Mathematics instruction gradually was changed from a traditional approach using pencil, paper, and computation to an interactive, cooperative, problem-solving approach. Instruction was provided in small groups, one to one, and in large groups. Mathematics and problem solving were integrated throughout the whole school day, across all subject areas. Problem solving and graphing were used in such classroom issues as who had hot lunch and who had cold lunch, or who wore tennis shoes and who did not. Computers were used for drill and practice and for higher-level thinking and problem solving. Students continually were predicting, using mental math, graphing, sorting, and so on.

Mathematics learning evolved from a passive to an active, ongoing, and integrated part of the school day. The interactive activities involved young people in mathematics problem solving all day rather than in an isolated segment of the school day. On a typical day, time spent on mathematics now totaled 90

minutes, spread throughout the day, rather than a single session of 35 minutes a day. Children had opportunities to work in small, cooperative groups, as well as to explore the mathematics materials on their own.

The focus of the nontraditional mathematics instruction was on active learning, based on developmental theory. Teachers remained with the concrete materials to build the theory or concepts and moved to the abstract (paper and pencil) only when the children had had many concrete experiences. A typical day in a nontraditional classroom is described in the following section, followed by a description of a typical day in a traditional classroom before the instructional change.

A Typical Day in a "Nontraditional" Classroom

A typical day in a "nontraditional" second-grade classroom at East Elementary School begins with taking attendance and lunch count and noting the calendar day, the number of days left in the school year, and the number of permission slips that have been returned. The teacher seizes every opportunity to form quantification activities out of the daily record keeping. As the teacher moves into the morning's language arts lesson, such activities as collecting and distributing instructional materials, locating the correct page in the textbook, and voting on favorite characters from the story are used to encourage mathematical and logical thinking. During spelling, health, social studies, and reading, opportunities for quantification are sought. The teacher frequently asks questions such as "Does everybody agree?" "How many do we need without

bringing extras?" and "Pass out just enough for our group." Such questions encourage the development of relationships of numbers and problem solving to actual daily living.

In the formal mathematics instructional period of the day, the teacher has the children work in small, cooperative groups after a large-group demonstration of a number concept such as set theory. Much group discussion takes place during the small-group problem-solving process. The teacher asks questions that encourage logical thinking and processing but avoid eliciting a "right" answer.

In the afternoon, approximately 45 minutes are set aside for the youngsters in this second-grade class to plan and do an activity of their choice. The class is divided into interest areas. The mathematics area draws two boys and three girls as they construct all kinds of things from building blocks, tangrams, unifix cubes, fraction kits, measurement devices, calculators, and various collections of objects to count and arrange in this center. Some youngsters select mathematics activities on the computers; others are busy in the writing center or the art center. Four youngsters are playing games such as *Hi-Ho! Cherry-O* and *Concentration*, which provide ample opportunities for quantification.

The teacher moves about the room and converses with individual groups of children. She may ask the youngsters focusing questions but spends much more time listening to what they want to tell her about their projects. She

occasionally takes notes if she observes that a particular youngster is demonstrating an understanding of an important academic concept, such as the logic of a particular measuring device to determine the relationship of size. As she moves about, the teacher also notes evidence of students' social growth, such as cooperation in the group.

The final part of the day involves writing and sharing a review of the activity period. Once again, as the teacher passes out folders, messages, and notes at the end of the day, she uses every possible opportunity to quantify the tasks of dismissal. Mathematics and logical thinking are integrated throughout the curriculum and throughout the school day.

A Typical Day in a "Traditional" Classroom Before the Instructional Change

The day in this traditional second-grade classroom begins with greetings and record keeping. After the teacher and students greet each other, the teacher takes attendance, counts the hands raised for hot lunch and cold lunch, and asks the children to turn in their permission slips for an upcoming field trip. After these initial activities are completed, the teacher gives the children directions for finishing their morning seatwork, which consists of five sheets of paper that are already on their desks. The teacher explains to the students that they have one page of handwriting practice; one letter-sounds phonics drill page; one cut, paste, and color mathematics "match the set" worksheet; one page of blank, lined paper on which to write a story; and one sheet of 9" x 12" art paper on which to draw

a picture to accompany their story. The teacher reminds the children that this is their morning work, which they are to complete while she meets with each of the four reading groups.

Each reading group comes to the teacher when she calls them. The teacher asks that they bring their books, workbooks, and pencils with them. After their reading group, the students return to their desks with an additional page of reading-related seatwork. These reading groups take most of the morning. The teacher might do some whole-group instruction on compound words or sentence structure to complete the language arts block of instruction before lunch.

After lunch, the teacher announces that it is time for mathematics. Today's task for the mathematics block of instruction is to learn the number-fact family of 8 + 6 = 14. The teacher chooses to use 14 red blocks at her teaching station to demonstrate the number set of 8 + 6 = 14, 6 + 8 = 14, 14 - 6 = 8, and 14 - 8 = 6. After demonstrating the number set with the blocks, she has the children recite the equations written on the chalkboard. Initially, the teacher has the whole class recite as she points to the chalkboard. Eventually, she calls on youngsters who seem hesitant to recite alone to check for mastery. As a game, she now begins erasing parts of the equations and asks the children (first as a large group, then individually) to fill in the blank spaces. She then assigns a worksheet with this number family, which has a total of 14 teddy bears on it, illustrating the number family of 6 + 8 = 14. Several "complete the blank" equations are on this worksheet. An additional worksheet containing 15 drill-and-

practice problems, including the new number family students have just learned, is assigned. The students are allowed to use the number line that is taped to their desks if they need to do so.

Students take their papers to the teacher when they are finished, and the teacher gives gold stars to students who have provided the correct answers on their papers. After most of the children have completed this task, the teacher announces that it is time for recess. The children who have not successfully completed their worksheets must remain in the room so that they can finish. After recess, the teacher may conduct a science or social studies activity if there is time.

Chapter Summary

The methodology used in conducting the study was explained in this chapter. The problem and purposes of the study were set forth. Next, the selection of the sample was described, followed by a discussion of the instruments used in the study. Data-collection and data-analysis procedures used in the quantitative and qualitative portions of the study were explained, as was the nontraditional method of mathematics instruction with which the study was concerned. Finally, typical days in both nontraditional and traditional classrooms were presented. Results of the quantitative and qualitative data analyses are presented in Chapter IV.

CHAPTER IV

RESULTS OF THE DATA ANALYSES

Introduction

The researcher's primary purpose in this study was to investigate and compare the achievement in mathematics of Afro-American and Euro-American females in grades 3, 4, and 5 in a particular school setting before and after the application of nontraditional mathematics instruction. A second purpose was to investigate selected subjects' attitudes and perceptions toward mathematics.

In this chapter, the data gathered in an attempt to fulfill the study purposes are presented. Results of the quantitative analysis are presented first; included are the outcomes of the hypothesis testing. Next, the qualitative data are presented. Each interview question is stated, followed by the responses to that question.

Results of the Quantitative Analyses

The mathematics concepts and applications scores of the sample members two years before and two years after the application of the nontraditional mathematics instruction were analyzed for this portion of the study. An F-test was used to compare the two subject groups' (Afro-American and

Euro-American) mean achievement scores before and after the application of the nontraditional instruction. An analysis was carried out to determine whether there were significant differences in the mean mathematics scores of the total sample before and after the application of the nontraditional method of mathematics instruction. Between-group variability in mean scores also was analyzed using race as a factor. In this section, each null hypothesis is restated, followed by the results for that hypothesis.

Null Hypothesis 1

> There will be no significant difference in the mean mathematics scores of the total sample before and after the application of a nontraditional method of mathematics instruction.

The nontraditional mathematics instruction at East Elementary School began in 1992. The mean CAT mathematics scores of the sample over the four-year time period covered in this study are shown in Table 4.1.

Table 4.1: Mean CAT mathematics scores of the total sample, 1990 through 1993 (N = 47).

Year	Test Mean	Std. Dev.	Std. Error
1990	44.468	19.090	2.785
1991	50.234	26.604	3.489
1992	51.277	20.348	2.968
1993	53.255	16.857	2.459

A

mathem

study (1

overall n

F = 2.78

instructi

sample

appeare

the nor

preced

signifi

Furthe

A significant difference was found between the total sample's mean CAT mathematics score for the first year of the study (1990) and the last year of the study (1993). When the overall mean of 44.468 in 1990 was compared with the overall mean of 53.255 in 1993, the main effect was found to be significant, with $F = 2.78$ and $p = .04$. These data suggest that the nontraditional mathematics instruction had a slight overall positive effect on the achievement level of the total sample over the four-year period under investigation. The positive effect appeared in the fourth year examined, or two years after the initial application of the nontraditional method of mathematics instruction. On the basis of the preceding data, Null Hypothesis 1 was not accepted. A slight but statistically significant difference was found between Year 1990 and Year 1993 of the study. Further discussion of these data can be found in Chapter V.

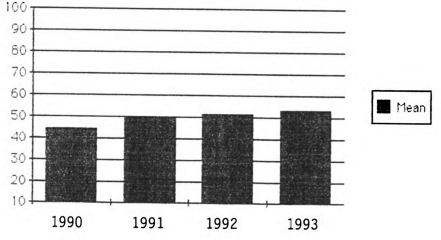

Figure 4.1: Mean CAT mathematics scores of the total sample, 1990 through 1993.

Null Hypothesis 2

There will be no difference between the Afro-American and Euro-American subjects in terms of their mean mathematics scores over the four-year period of study.

The mean mathematics achievement of the two racial groups was compared for the four-year period under investigation. The mean CAT mathematics score for the Afro-American females over the four-year period was 38.789, whereas the mean for Euro-American females over the same period was 57.286, as shown in Table 4.2. The difference between the two subject groups over the four-year period was significant, with $F = 20.705$ and $p = .001$. The very low p-value reflects a significant main effect for race over the four-year period. Afro-American females scored significantly lower than Euro-American females both before and after the application of the nontraditional method of mathematics instruction (see Figure 4.2).

Table 4.2: Mean CAT mathematics scores of the Afro-American and Euro-American subjects, 1990 through 1993 (N = 47).

Subject Group	1990	1991	1992	1993
Afro-American	37.316	35.000	41.316	41.526
Euro-American	49.321	60.571	58.036	61.214

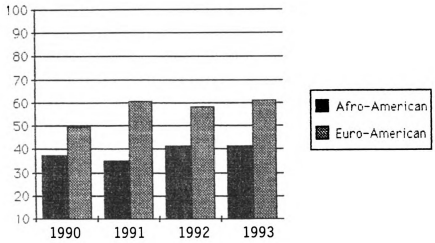

Figure 4.2: Mean CAT mathematics scores of the Afro-American and Euro-American subjects, 1990 through 1993.

Further analysis was conducted to determine whether there was an interaction between the two subject groups. A high p-value of .686 indicated that there was little interaction between groups. That is, neither the Afro-Americans nor the Euro-Americans experienced significant gains as a result of the application of the nontraditional method of mathematics instruction. The clarity of the noninteraction and the flatness of the growth of both groups from 1990 through 1993 are shown in Figure 4.3. There was little variance in the mean CAT mathematics scores of these two groups. The gap between the two groups remained about the same over the four-year period.

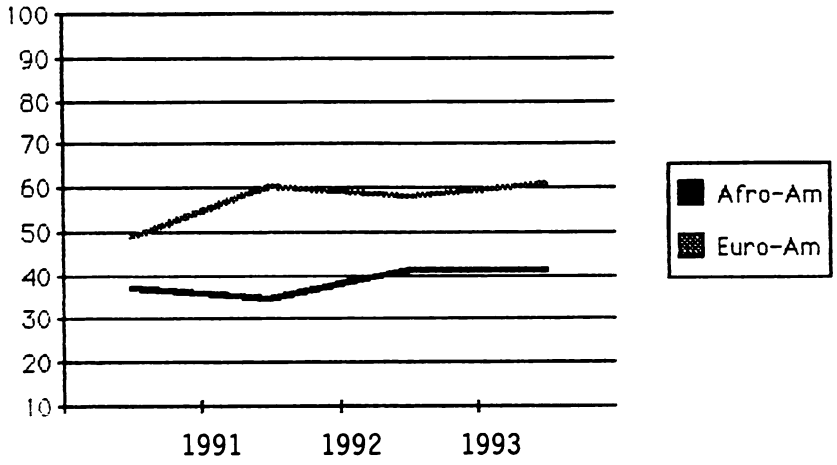

Figure 4.3: Mean CAT mathematics scores of the two subject groups over the four-year period, 1990 through 1993.

The scores of the Afro-American females dipped from a mean of 37.316 in 1990 to a mean of 35.000 in 1991. However, their mean score rose to 41.316 after the first year of the nontraditional mathematics instruction. The second year of that instruction, the Afro-Americans' score remained about the same (41.526).

In contrast, the Euro-American females in this study started in 1990 with a mean score of 49.321; their mean score rose to 60.571 in 1991 (both years were before the application of the nontraditional mathematics instruction). In 1992, the mean of this group dipped slightly, to 58.036, with the inception of the nontraditional mathematics instruction, and moved back up to 61.214 in 1993, following the second year of that instruction. Again, little difference in

achi

insta

A si

the

sig

ma

nor

mu

sig

ma

si

at

g

fe

fa

d

achievement was apparent as a result of the nontraditional mathematics instruction.

On the basis of the preceding data, Null Hypothesis 2 was not accepted. A significant difference was found between the two racial groups with regard to their mean scores on mathematics concepts and applications. However, no significant interaction was found between the two groups with regard to mathematics achievement. Based on the mean scores from this sample, the nontraditional method of mathematics instruction did not appear to have had much influence on the achievement of either group. Neither group seemed to be significantly influenced, either positively or negatively, by the nontraditional mathematics instruction.

Results of the Qualitative Analyses

In the qualitative portion of this study, 12 subjects (six Afro-Americans and six Euro-Americans) from the study sample were interviewed regarding their attitudes and perceptions about mathematics. The following research questions guided the development of the interview schedule:

1. What are the perceptions and attitudes of young Afro-American females toward mathematics achievement?

2. What are the perceptions and attitudes of young Euro-American females toward mathematics achievement?

3. What perceptions and attitudes toward mathematics achievement do young Afro- and Euro-American females share?

4. What additional variables, perceptions, and attitudes revealed in the interviews affect, either positively or negatively, the mathematics achievement of young Afro-American females?

The 12 subjects selected for the interviews shared the common characteristic of a substantial discrepancy between their total reading scores and their mathematics concepts and application scores on the CAT. In the researcher's view, low-average to high-average reading scores indicated a normal ability to learn. A discrepancy in a subject's reading and mathematics scores was an indication that the individual had a normal ability to learn but was having less success with mathematics than with reading. It should be noted that some of the Afro- and Euro-American females with the greatest discrepancies between their reading and mathematics scores did not return permission slips and seemed uninterested in participating in the interviews.

The mean reading score of the 12 interviewees was 47.583. The interviewees' mean score on the mathematics concepts and applications portion of the CAT was 34.916. The mean reading scores for the Afro-American and Euro-American interviewees were 48.0 and 46.5, respectively. The mean mathematics concepts and applications scores for the Afro-American and Euro-American interviewees were 36.0 and 33.0, respectively (see Table 4.3).

The subjects' responses to the interview questions are presented on the following pages. In reporting the findings, the researcher made every effort to

refrain

young

Table

Do

for

fem

abs

not

con

me

An

ea

An

refrain from interpreting the subjects' responses. Rather, she chose to let the youngsters' comments speak for themselves.

Table 4.3: Mean mathematics and reading scores of the 12 interviewees.

Subject Group	Mean Score	
	Mathematics Concepts and Applications	Reading
Afro-Americans	36.0	48.0
Euro-Americans	33.0	46.5
Total group	34.916	47.583

Do you have brothers and sisters?

All 12 of the interviewees had siblings. The average number of siblings for all of the respondents was three. However, several of the Euro-American females indicated their siblings lived away from home with grandparents, an absent father, or a boyfriend. One Euro-American female indicated that she did not know her two step-siblings because they lived in Texas with their dad. In contrast, the Afro-American females who reported having siblings or step-siblings mentioned no estrangements between siblings or relatives.

The most obvious difference between the Afro-American and Euro-American subjects was that the Afro-Americans had extended families who were easily accessible, with little estrangement, whereas several of the Euro-Americans reported unique and estranged family relationships. When the Euro-

American females spoke of the siblings and relatives from whom they were separated, it was with anxiety.

Do you belong to any clubs such as Girl Scouts, Campfire Girls, church, etc.?

All six of the Afro-American subjects indicated a range of activities, from cheerleading to choir to Girl Scouts. Most frequently, however, they mentioned a strong church affiliation. Five of the six Afro-American interviewees reported going to church every Sunday with their families. In contrast, the Euro-American females had significantly fewer outside activities. Only one indicated participating in Girl Scouts and baseball; just three reported any church affiliation.

There was an obvious difference between the Afro-American and Euro-American subjects in the use of support systems outside their families. The Afro-Americans were involved in many more activities that placed them in extended social support systems than were the Euro-Americans. Almost all of the Afro-American interviewees reported a strong church affiliation. The Euro-American interviewees seemed to be socially isolated.

When you grow up, who would you like to be?

Responses to this question were typical of youngsters in this age group. The Euro-American females reported that they would like to be a business person, teacher, police officer, singer, secretary, and preschool teacher. The Afro-American females said they would like to be a baby nurse, teacher, veterinarian, lawyer, artist, and Spanish teacher.

Some children's responses to this question seemed to relate to the present occupations or interests of their parents, such as "business person and work where people come and get video tapes and tan like Mom does" or "a police officer" because the subject's grandparents frequently watched *Rescue 911.* One Euro-American female indicated an interest in being a bartender like her mom.

The reasons the subjects gave for their chosen occupations were typical of elementary school children. For example, one youngster wanted to be "a baby nurse because I like kids and I like to be around little babies because they are cute." The Afro-American female who wanted to be a veterinarian said that if she could not be a veterinarian, she would be a doctor; if she could not be a doctor, she would be a pediatrician. However, each subject was able to think of something she would like to do when she grows up.

What do you think girls are supposed to do when they grow up?

In responding to this question, all six of the Afro-American interviewees reflected a practicality that seemed to be summed up in one subject's answer: "clean the house, grocery shop, shop for the kids--can be nurses, lawyers, car dealer, cook, or a waitress. That's not a good job, but they can do it if they want to." The Euro-American females' responses were similar but less professionally oriented; they mentioned being cheerleaders, working in a day care center, and being a waitress, cook, singer, or dancer. One Euro-American female could only

think of being a model. Almost all of the other respondents offered multiple answers to this question. One Euro-American female's surprising response to what girls are supposed to do when they grow up was "be on the street."

The next portion of the questionnaire contained questions designed to elicit the subjects' perceptions and attitudes about mathematics.

What is your most favorite subject in school?

Seven of the 12 interviewees indicated that spelling was their favorite subject in school. Not one of the Afro-American females reported that mathematics was her favorite subject, whereas three of the six Euro-American females indicated that mathematics was their favorite subject in school.

The fact that none of the Afro-American females indicated mathematics was their favorite subject, whereas three Euro-American females did so, is especially interesting when one considers that the average mathematics score of the Afro-American interviewees was 36 (based on a percentile rank of 100, which means that 64% of the other females in the United States who took the CAT did better on the mathematics test) and that of the Euro-American interviewees was 33. Neither score is strong, but those females who indicated they liked math best did not score any higher than those who did not mention math as their favorite subject.

The interviewees' failure to cite mathematics as a favorite subject is consistent with the overall average mathematics score of this group of females,

which was 34.5--barely above the lowest quartile. Not only did they not like mathematics, they also did not achieve well in the subject.

When you have free time at school, what do you choose to do?

At first glance, both the Afro-American and Euro-American females' use of free time at school was similar. Afro-American females' responses to this question were as follows: "go out for recess," "jump rope," "play games," "draw," "play kickball or baseball," "go to the library," "read to younger kids," and "spell words and find other words." Euro-American females' answers included the following: "play with my friends," "write stories and play at different centers in the room like math and language," "run outside on the playground," "color," "draw," "read," "enjoy World Book Anthology," and "play games on the computer."

Upon closer examination, it seems that the activities chosen by the Afro-American females were more active and interactive in nature than those chosen by the Euro-American females. Many of the activities mentioned by the Euro-American females were introspective and ones they could do alone, whereas the Afro-American females seemed to choose more social activities. One Euro-American female mentioned that she liked to play games on the computer because she did not have many friends.

Only one of the 12 interviewees even mentioned mathematics as something she chose to do in her free time. This Euro-American youngster mentioned mathematics in the context of going to one of the activity centers such

as mathematics and language in the classroom. It is clear that these females were not interested in selecting mathematics activities during free time. Language arts, communication, art activities, and active play were favorites of these interviewees.

How do you feel about doing math?

Responses to this question revealed some major differences between the Afro-American and Euro-American females. Only one of the six Afro-American females indicated that she felt good while doing mathematics. Five of the six Euro-American females stated positive feelings about doing mathematics, such as "[it's] kinda fun," "it's easy," "I like graphing," "I like math," and "it's fun." The one Euro-American female who expressed negative feelings poignantly stated: "Sometimes I don't understand it, and they just make us do it by ourselves. One day I had homework, and there was this question I didn't understand. It was a hard one, and my mom didn't even know it. I don't like math because I get mixed up (like the times table) and I do really bad--I just don't like math."

The five Afro-American females who expressed negative feelings about doing mathematics used such phrases as "weird," "hard," "confusing," "it's OK but I sometimes don't like it," "sometimes hard to understand," and "don't like plus, minus, and fractions." The prevailing negative feeling for the one Euro-American female and the five Afro-American females was that math is "hard" or "confusing."

The responses to this question expressed much more feeling and intensity than did those to the earlier question about the interviewees' favorite subjects or even their choices of activities during free time. It would seem that the females in this study had strong feelings about doing mathematics.

It is surprising that five of the six Afro-American females had negative feelings about doing mathematics, even though their mean mathematics score was slightly higher than that of the Euro-American females, who indicated positive feelings about doing mathematics. Thus, it can be seen that the interviewees' feelings about mathematics did not necessarily relate to their mathematics achievement.

Are you good at math?

The Afro-American females responded tentatively to this question, expressing such qualified responses as: "I'm OK," "a little bit," "kind of, a little," "I don't know," "sometimes, it depends on the material," and "I have trouble with division and fractions." In contrast, five of the six Euro-American females gave positive responses to this question: "yes," "a little," "good because it is easy," "yes, get good grades," and "good in math."

However, whatever their perceptions, these young females were not achieving well in mathematics. The mean mathematics score for the total group of interviewees was 34.9, which means that 65.1% of all the other females in America who took the CAT math test achieved higher scores. The Afro-

American interviewees seemed to have a more realistic assessment than did the Euro-Americans about their mathematics achievement.

Do you think math is important?
Why or why not?

All 12 of the interviewees stated that mathematics was important. Nine of the 12 females related the importance of mathematics to counting money for shopping or for working in a supermarket. Three of the 12 indicated that mathematics is important for advancement in school and a good education. One stated, "It's hard to live without numbers." The responses to this question were related to those noted earlier concerning what these youngsters thought girls are supposed to do when they grow up. At this stage in their lives, the subjects imagined themselves as money handlers in the supermarket, which is related to their perception of themselves as mothers and caregivers when they grow up and also reflects how they saw their mothers using mathematics in their lives.

The one subject's observation that it is hard to live without numbers was the most abstract response and probably indicated that her developmental maturity was higher than that of the other interviewees. The other 11 females still based their opinions on what they experienced and knew--women shop in order to care for their families.

Does your mother think math is important? Why or why not?

The responses to this question were all positive. Each interviewee believed that her mother thought mathematics was important. Several of the answers suggested that the subjects' mothers had talked with them about being better in mathematics and the importance of mathematics in getting a good education. About half of the girls related their mothers' attitudes about the importance of mathematics to their jobs, such as working in a store, using mathematics to count cards, and paying the family bills.

There was a strong sentiment among the interviewees that their mothers valued mathematics and encouraged them to work hard to understand mathematics. One youngster reported that she got grounded if she did not do her mathematics homework.

Can you think of any ways math could be useful to you?

The responses to this question were consistent with those to earlier questions. The interviewees saw the primary use of mathematics as aiding them in shopping and paying bills. This response seems logical in that counting money at the check-out counter was a common experience for all of the youngsters. The association with money was a strong rationale for the usefulness of mathematics. One interviewee did respond, however, that she could not think of any ways that mathematics could be useful to her. It is clear that these young females had a limited perception of how mathematics is used

in everyday situations, as well as potential vocations that might require knowledge of mathematics for success.

Which would you rather do, math worksheets or count and build things?

Of the 12 interviewees, only two Afro-Americans reported that they would rather count and build things than do worksheets. The other ten subjects indicated that they would rather do worksheets. Several said that counting and building things is for little kids and that "one should do stuff that's right for your own age." One respondent said that worksheets are better because they are quicker.

The strong preference of these subjects for the worksheets was probably related to their comfort with "doing the familiar" and not taking risks. It also seemed to support current learning theories, which suggest that many females learn in a linear fashion. That is, they memorize the model or configuration and then apply the model when it reappears. This process of learning works well as long as they are doing computation, but when the need for abstract problem solving arises, the linear model will not work for them because they have no previous models or configurations at hand to use in solving a new problem.

This question was posed to elicit information from the subjects about their learning modalities. Their responses seemed to support Tobias's (1978) theory that many female learners prefer to take no risks in learning mathematics. Handling and manipulating the counters or building units was not familiar practice

to most of the subjects in this study. It would seem from their responses that this group of females preferred to practice mathematics in the more traditional manner.

The last group of items comprised open-ended statements about mathematics, which were adapted from Davis's questionnaire. These statements were designed to aid in analyzing people's feelings toward mathematics.

When I get bad grades in math. . . .

As expected, the responses to this open-ended statement were negative. All of the participants indicated sadness, disappointment, upset feelings, anger, and so on, when they received bad grades in mathematics. However, five of the six Afro-American females indicated that they just tried harder and did their work over in order to pass. Two of the Euro-American females indicated that they would try again and do their work over.

One respondent stated that she felt like crying when she received bad grades in mathematics. All responses to this question were related to feelings of lower self-esteem. All of the responses reflected a high intensity of negative feeling.

Math is. . . .

Four of the Afro-American students responded positively to this statement with such comments as "a little easy," "fun and exciting," "one of my favorite subjects," "very fun," and "fun." One Afro-American interviewee simply said that

math was "hard," and the other responded similarly, saying that "math is very hard, but I try to learn." The Euro-American females' responses were more varied. One indicated that "math is terrible," whereas three said that mathematics is important because it will be needed in the future. Two Euro-American interviewees indicated that "math is fun."

Doing math makes me feel. . . .

The responses to this open-ended statement were varied. The Euro-American females said that doing mathematics made them feel "important," "confused," "happy," "good," "depends on the grade--happy if the grade is good," and "like I am helping someone in the future." There was no apparent consistency in these responses. However, the one Euro-American female who reported feeling confused about doing mathematics consistently communicated these kinds of feelings throughout the interview. Although she had reported confusion and difficulty with mathematics, she identified mathematics as her favorite subject.

Two of the Afro-American females reported negative feelings such as "dizzy, like . . . confused" and "kind of mad because I don't understand." The other four reported more positive feelings, such as "pretty happy," "real good about myself" "like I am just getting higher and higher in math and my grades are getting better," and "kind of important because I know I am succeeding."

When I think about math. . . .

All six Afro-American interviewees indicated an attitude of resignation in their responses to this open-ended statement. One of them responded by stating that she cringed when she thought about mathematics because she had to do it and there might be something else she would rather be doing. Another Afro-American stated that when she thought about mathematics she did not like it because when she did not know how to do it, the teacher just said, '"Read the directions yourself,' and then doesn't do stuff with us." The other four Afro-American interviewees simply said something to the effect that they got the piece of paper and pencil, started to work, and tried to understand. One said that she thought she knew what she was doing in addition, subtraction, multiplication, and division.

Five of the six Euro-American females responded with positive remarks like "I feel good about myself," "I think about numbers and stuff like that," "I feel happy because I am good at it," "I try my best," and "I am ready to do it." The remaining Euro-American stated that she initially said to herself, "Aw, man," but then she got her things out and the mathematics became fun.

The attitudes of the Afro-American and Euro-American females, as reflected in their responses to this open-ended statement, were quite different. The Afro-American females stated clearly that they did not like mathematics, that they were not good in mathematics, but that they tried hard to understand

mathematics and do the work. In contrast, this group of Euro-American females seemed to have more positive thoughts about doing mathematics.

My most fun at math was when. . . .

Five of the 12 respondents indicated that their most fun at mathematics occurred when the learning activity was group oriented and included manipulatives such as the following: "When we did adding fractions last year using M & M's, and when we got one right, we ate an M & M." "When we did the money thing using play money." "When we worked with big blocks and little ones [unifix cubes], and they taught us how those blocks could help on the worksheets and we would know the answer easier." "When we did graphs and located the points." "Last year when we got to measure stuff." The remaining seven interviewees responded in a more traditional way to referring to worksheets, learning times tables, adding and subtracting, and checking other people's work. The animation expressed in the descriptions of the five hands-on activities indicated those five subjects' high interest in interactive mathematics exercises.

Comfort Level During the Interviews

Although the interviews were tape recorded, the interviewers were asked to write a brief description of the body language and perceived comfort level of the young females who were being interviewed. Only one of the six Afro-American subjects communicated some anxiety during the interview. She was described as being nervous and fidgeting throughout the interview. The other

five Afro-Americans, whether they were being interviewed by the Afro-American or the Euro-American student, were described as being excited, smiling, relaxed, and having good eye contact.

Three of the Euro-American females were described as smiling and as having good eye contact, bodies erect, and speaking freely. The other three seemed embarrassed, anxious, soft-spoken, and hesitant, whether the interviewer was an Afro-American or a Euro-American. One Euro-American female initially spoke with her hands over her mouth.

The two questions that seemed to be somewhat difficult for several of the respondents were:

1. What do you think girls are supposed to do when they grow up?
2. Can you think of any ways that math would be useful to you?

For these two questions, the interviewers used follow-up queries to encourage the youngsters to think about and respond to the question. Apparently, the abstract nature of the questions was confusing to these young subjects. A summary of the interview responses is contained in Table 4.4.

Chapter Summary

Results of the statistical analysis of the mathematics achievement scores of the subjects before and after the application of a nontraditional mathematics curriculum were presented in the first part of this chapter. The first hypothesis stated that there would be no significant difference in the mean mathematics scores of the total sample before and after the application of a nontraditional

Table 4.4: Summary of interview responses.

Question	Afro-American Females	Euro-American Females
Do you have any brothers and sisters?	Yes. We fight a lot; Mom has to break it up. Yes; older. Get along with sister that is 29. Two step-brothers and two step-sisters. Yes. Four. She's the oldest and likes being the oldest. Three siblings; she's the oldest. Has to clean up after others.	Yes, one brother. He's a pain, but they get along sometimes. Two brothers. All live together and get along. One brother and one sister. Doesn't know them; they live in Texas with Dad. She lives with grandparents. Four older siblings. She is youngest and is spoiled. One brother and four sisters; gets along with all of them. Middle child. One is adopted; two were by a boyfriend and now live out of state with him.
Do you belong to any clubs such as Girl Scouts, Campfire Girls, church, etc.?	Cheerleading; choir; goes to church every Sunday. Goes to church every Sunday. Girl Scouts; cheerleading; goes to church every Sunday with Mom and Dad. Pentecostal church; likes it; it's fun. Missionary outreach at Grace Temple. Learns about the Bible and sings in the choir.	Girl Scouts; played baseball in summer; goes to church every Sunday. No. Sings in church choir and goes to church every Sunday. No. No; has been to church once. No.

Table 4.4: Continued.

Question	Afro-American Females	Euro-American Females
When you grow up, who would you like to be?	A baby nurse because I like kids and I like to be around little babies because they are cute and I like to play with kids. A teacher. I want to be like a student teacher and go to college. Vet. If that doesn't work out, I want to be a doctor. If that doesn't work out, then I'll be a pediatrician. Lawyer; finds it fun; likes trials. Artist. Teacher of language; Spanish or spelling.	A businessperson and work where people come and get videotapes and tan (like Mom). A teacher. A police officer because her grandparents watch Rescue 911 a lot. Singer. Secretary or teacher. Preschool teacher.
What do you think girls are supposed to do when they grow up?	Clean the house, grocery shop, shop for the kids. Can be nurses, lawyers, car dealer, cook, or waitress. That's not a good job, but they can do it if they want to. Be a maid. Whatever they want to do as long as they believe in it. They can do things that boys do. It doesn't necessarily have to be girl things. Go to college; become a nurse, teacher, doctor. Model, movie star, or just anything. Lawyer, teacher, policeman, principal.	Cheerleading, play sports and tennis. Women should have a good job like... (couldn't think of anything). Artist, doctor, teacher, coach. I don't know...a model. Work in a day care, waitress, cook singer, dancer. Anything--teacher, actress, secretary, principal. Teachers, moms, "be on the street."

Table 4.4: Continued.

Question	Afro-American Females	Euro-American Females
What is your most favorite subject in school?	Spelling, language, and a little bit of math. Spelling. Science. Reading, mysteries. Spelling. Spelling.	Math. Spelling. Math. Math. Spelling. Math and spelling.
What is your least favorite subject in school?	Social studies and science. Math. Spelling. English and science--boring! Science. Math--but get lowest grades!	Language. Math. Language. Social studies. Reading. Social studies and reading.
When you have free time at school, what do you choose to do?	Go out for recess, jump rope. In classroom, I play games or draw. Play games. Play games such as kickball or baseball. Draw; go to the library; read to younger kids. Play games (Life, 4 Corners, and Up). Likes to spell words and find other words.	Play with my friends. Write stories and play at different centers like math and language. Run outside on the playground. Color, draw, or read. Draw, read World Book Anthology. Play games on the computer (not many friends).

Table 4.4: Continued.

Question	Afro-American Females	Euro-American Females
How do you feel about doing math?	I like most of it, like times tables--that's the best in math. I know all my times tables and some parts of dividing and rounding. Do not like plus or minus or fractions. Weird, hard. I feel good. Sometimes it is confusing (times tables). It's OK, but I sometimes don't like it. Don't like it at all. Sometimes it's hard to understand.	It's kinda fun. Sometimes I don't understand it, and they just make us do it by ourselves. One day I had homework, and there was this question that I didn't understand. It was a hard one--even my mom didn't know it. I don't like math because I get mixed up (like the times table) and I do really bad. I just don't like math. It's easy. It's fun because it is easy. I like graphing. I like math but don't always do good in it.
Are you good at math?	I'm OK. A little bit. Kind of, a little. I don't know. I get A's and B's on tests. Sometimes; it depends on the material. I don't really have to work hard at it. I have trouble with division and fractions. I know my times table better.	Yes. A little. Yes. Good, because it is easy. Yes, I get good grades. I feel like I am good at math.

Table 4.4: Continued.

Question	Afro-American Females	Euro-American Females
Do you think math is important? Why or why not?	Yes. math and reading are important because when you get a job, you have to know how to read, spell, and add. Yes. Yes, because if you grow up and work at a grocery store or something like that, you have to know how to give change to people. Yes. Shopping, understanding how to spend money. Learn a lot from math. Yes; when you grow up, you are going to need to know how to count money. Yes, because you need to know how to count money.	Probably. Might help you get a good education. You need to know math so you can advance to the next grade. Sometimes you'll have homework and you'll need to know the answer to a math question. Yes. It is hard to live without numbers. You need numbers to count things. Yes, because you have to know how to count money. Yes, because you need it for shopping. Yes; if you get a job at a store, you need to know how to count change.
Does your mother think math is important?	Yes; she tells me lots of times that I should know my math...that math is good. Yes, because if I don't get my work done, she grounds me and makes me stay in the house. Yes, because she is always telling me to work on my times tables. Yes. Mom adds well. My sister thinks so, too. Mom helps with homework. She doesn't really know, except her mom pays the bills. Yes, because she knows hers and she wants her children to know theirs.	I don't know; she probably uses it in her job. My mom didn't ever get her math done. She knows how to do it now, but she says I need to know everything about math so I can get a good education. I don't know about mothers...but grandmother does because she counts cards and she has to have numbers. Yes, so her daughter can get a good education. Yes; needs to use it for bills. Yes, because she works at a store.

Table 4.4: Continued.

Question	Afro-American Females	Euro-American Females
Can you think of any ways that math would be useful to you?	I can use it in the future and now--especially when you get a job. I can't think of anything. If I become a vet, customers will have to pay when they get their dog, and I'll have to give them the change back. Shopping; helping children with math. Bankers need math to count money. Paying bills.	Probably in a job you can use it. If you have a swimming class or something, you can count the people who swim at one time or another. You have to know math because some teachers don't check their books and when the class has to do it, you'll need to know the answer to make sure they get a good grade. It helps me to know how to do subtraction, addition, and division. To buy clothes; to count money; cost of instrument. Add bills, shopping with money. As a mother, helping children with their homework.
Which would you rather do—math worksheets or count and build things?	Math worksheets because counting and building is for little kids. You should do worksheets. You should do stuff for your age. Math worksheets. Count and build things because counting is quicker and you can do it. Math worksheets. Count and build things. Math worksheets.	Math worksheets because you get done faster. Worksheets because they have easy directions, and it's like things that we've already done on a sheet of paper. Worksheets because they help me better than counting and building. Math worksheets. Math worksheets. Math worksheets.

Table 4.4: Continued.

Question	Afro-American Females	Euro-American Females
When I get bad grades in math, I....	I get disappointed. I do it over. I have to do my papers over. I feel like crying; I get mad; I get in trouble; I try harder. I feel low, and I do it over to do better. I do the papers over so I can learn in order to pass.	I'm sort of upset. I'll study at home. I feel bad. I feel sad and I try again for practice. I feel bad; I do them over. I get mad, and my mother doesn't say anything.
When I think about math, I....	When I finish it, I know all of it, but I have to ask some questions. I don't like it because when you first get to it, you don't know it, and then the teacher says, "Read the directions yourself," and she doesn't do stuff with us. I listen to the directions and do what the teacher says in math. I think I know what I am doing. Addition, subtraction, times, and division are easy. I cringe because I have to do it, and there could be something else I would rather be doing. I get a piece of paper and a pencil and try to understand.	I start saying, "Aw, man," and then I get my stuff out and it's fun. Try my best. I'm ready to do it. I feel happy because I'm good at it. I feel good about myself. I think about numbers and stuff like that.

Table 4.4: Continued.

Question	Afro-American Females	Euro-American Females
My most fun at math was when....	I did my times tables. I was doing the money thing...like counting money. When we did adding fractions last year. We used pieces of M & M's, and every time we got one right, we got the chance to eat one. We checked other people's papers. Lots of math problems to do. I learned my times tables. I did times worksheets.	I do problems--like addition and subtraction--where I think of the answer and write it down. We worked with big blocks and little blocks; they taught us how those blocks could help on the worksheets. We'll know the answer easier. I do adding and subtracting and division. When I started dividing in first grade. Doing graphs and locating the points. Last year, when we got to measure stuff.
Math is....	A little easy. Hard. Fun and exciting. One of my favorite subjects. Very fun. Fun. Very hard, but I try to learn.	Fun and I like it. Terrible. Fun. Important, because you need it in the future. Important, because you need it in the future. Important, because you have to know how to count before you can do math.

Table 4.4: Continued.

Question	Afro-American Females	Euro-American Females
Doing math makes me feel....	Pretty happy.	Important.
	Dizzy like...confused.	Confused.
	Real good about myself.	Happy.
	Like I am just getting higher and higher in math--and my grades are getting better.	Good because when I help my mom, I get my share.
	Kind of important because I know I am succeeding.	I am helping someone in the future.
	Kind of mad because I don't understand.	Depends on the grade; I am happy if it is good.

method of mathematics instruction. A significant difference was found between the subjects' mathematics achievement the first year of the study and their achievement the last year of the study, with means of 44.468 in 1990 and 53.255 in 1993. The data suggest that the nontraditional mathematics instruction had a slight, overall positive effect on the mathematics achievement of the total sample of females in this study over the four-year period. Thus, Null Hypothesis 1 was not accepted.

Null Hypothesis 2 stated that there would be no difference between the Afro-American and Euro-American subjects in terms of their mean mathematics scores over the four-year period of study. A significant main effect for race was found over the four-year period. The Afro-American females (mean = 38.789) scored significantly lower than the Euro-American females (mean = 57.286)

throughout the four years of the study. The high p-value (.686) strongly suggests that there was no interaction between the two subject groups. Neither the Afro-American females nor the Euro-American females demonstrated significant gains following the application of the nontraditional method of mathematics instruction. The gap in mathematics achievement between the two subject groups remained the same throughout the four years of the study. Null Hypothesis 2 was not accepted.

The qualitative portion of the study consisted of interviews with six Afro-American and six Euro-American females from the sample to discover their attitudes and perceptions about mathematics. The participants were volunteers from the sample who had a large disparity between their reading and mathematics achievement scores. The mean mathematics score for the Afro-American interviewees was 36; the mean mathematics score for the Euro-American interviewees was 33.

The perceptions and attitudes of the 12 interviewees were generally ones of math avoidance and limited perception of the importance of mathematics in their lives and the world of work. Only three interviewees indicated that mathematics was a favored subject. The subjects interpreted the importance of mathematics in terms of money management and family shopping. Not only did these subjects not like mathematics, they did not achieve well in mathematics. They expressed feelings of confusion about and inadequacy in mathematics.

The primary difference in attitudes between the Afro-American and Euro-American females was the Afro-Americans' acceptance that mathematics was hard for them and their declaration that it was not a favored subject. They indicated a resigned willingness to do the required work but little else. In contrast, the Euro-Americans seemed to deny their low achievement by maintaining that they were good at mathematics.

The results of this study demonstrated that the young Afro-American females did not like mathematics, found it difficult, and tended to avoid it. The method of mathematics instruction did not seem to influence their mathematics achievement appreciably. Hence, factors other than the instructional approach influenced the underachievement of the Afro-American females in this study.

A summary of the study, major results and discussion, reflections, and recommendations are presented in Chapter V.

CHAPTER V

SUMMARY, MAJOR RESULTS AND DISCUSSION, REFLECTIONS, AND RECOMMENDATIONS

Summary

The researcher's primary purpose in this study was to investigate and compare the achievement in mathematics of Afro-American and Euro-American females in grades 3, 4, and 5 in a particular school setting before and after the application of nontraditional mathematics instruction. A second purpose was to investigate selected subjects' attitudes and perceptions toward mathematics.

Nineteen Afro-American females participated in the quantitative portion of the study; they represented approximately one-half of the total Afro-American female population in grades 3, 4, and 5 at East Elementary School. Twenty-eight Euro-American females were selected from the same elementary school population, representing approximately one-third of the total number of Euro-American females in the identified grades. The researcher used student CA-60 files to gather achievement test data on all of the subjects in the areas of mathematics problem solving and applications, mathematics computations, and reading comprehension. Other information such as birth date, grade, and ethnic

identity also was gathered from the files. The computer was used to select subjects for the sample for whom complete test data were available.

In the qualitative portion of the study, 12 subjects from the sample were interviewed to discover their attitudes and perceptions about mathematics that might affect their mathematics achievement. Six Afro-American females and six Euro-American females who had a significant discrepancy between their reading comprehension and mathematics problem-solving scores were selected for the interviews.

In this chapter, the major results of the study are discussed. The writer's reflections and recommendations for further research also are presented.

Major Results and Discussion

Quantitative Analyses

The results of the statistical analyses of the mathematics achievement scores of the 47 subjects who participated in this study are discussed in this section. A significant difference was found between the subjects' mean mathematics achievement scores for the first year of the study (1990) and the last year of the study (1993). These data suggest that the nontraditional approach to mathematics instruction had a slight overall positive effect on the achievement of the total sample over the four-year study period. The p-value of .044, with a .05 confidence level, indicated slight growth between the first and fourth years of the study. The significance of the difference in achievement

between the first and fourth years of the study must be viewed with caution because the p-value of .044 is very close to the .05 confidence level and a rise in total group mathematics scores in 1991, which was before the change in instructional method. This unanticipated rise in scores, as reflected in the 1991 data, is attributed primarily to the Euro-American females, as seen in Figure 4.2 (p. 73). This explanation of the increase in 1991 for Euro-American females cannot be attributed to any factors within the scope of this study.

The data also indicated a significant main effect for race over the four-year period. The Afro-American females scored significantly lower than the Euro-American females both before and after the application of the nontraditional method of mathematics instruction. The gap between the groups remained about the same throughout the four years of the study.

Further analysis indicated that there was no interaction between the two subject groups ($p = .686$). Neither the Afro-American females nor the Euro-American females made significant gains with the application of the nontraditional method of mathematics instruction in the two years following its inception. A significant gap remained between the two subject groups in their mathematics CAT scores throughout the four years of the study.

Discussion. The researcher anticipated that significant increases in mathematics achievement would take place with the nontraditional mathematics instruction for both subject groups but, more particularly, for Afro-American females. That is, it was anticipated that Afro-American females' mathematics

achievement would be significantly higher with the change in instructional method. It was also anticipated that there would be significant interaction between the two groups of subjects with the application of this instruction. The anticipated increases in mathematics achievement using the innovative mathematics instruction did not occur. By itself, a methodological solution to a systemic problem did not bring about a change in achievement. This finding was disappointing to the researcher, who, like many of her teaching colleagues, was seeking a single solution to a complex problem.

The study revealed larger gaps in mathematics concepts and applications scores between the Afro-American and Euro-American subjects than originally were anticipated. These gaps in achievement remained about the same throughout the study period, regardless of the instructional strategy that was used. Hence, the researcher concluded that a combination of other complex factors contributed to the underachievement of many of the Afro-American females in this study, such as the adequacy of the test instrument, the relationship of reading ability to mathematical problem solving, the small sample size, and teacher behaviors in classrooms.

Although the CAT is nationally normed and is used throughout the United States to measure achievement, the researcher questions its ability to measure the results of a nontraditional approach to mathematics instruction. As noted in Chapter II, scores on achievement tests are of little or no value in formulating instructional programs for children; neither can they be used to measure a

program. Rather, they can only be used to compare one child's performance to that of another child. The researcher's original assumption was that the subjects' low mathematics achievement scores were a result of traditional mathematics instruction may well have been erroneous. The overall objective for using the nontraditional instructional approach was to develop students' mathematical and logical thinking ability. The focus of this new approach to instruction was on constructing mathematical concepts and relationships within students. The CAT does not seek to measure "process" or what may be happening in students' minds.

An additional problem with the use of the CAT is that test takers need adequate reading skills to understand the directions and information specific to each task measured on the test. The reading scores of both groups in the sample were comparable to their mathematics achievement scores. The relationship between reading development and mathematics problem solving on the CAT was strong, as shown below:

	Reading Test Mean	**Mathematics Problem-Solving Mean**
Afro-Americans	37.3	38.8
Euro-Americans	56.7	57.3

Another variable that the researcher believes significantly influenced the results of this study was the small sample size. In setting up the original project, the researcher had in mind a 2 x 3 format that would include a sample of 30 Afro-American females and 30 Euro-American females studied one year before and

two years after the application of the nontraditional mathematics instruction. Instead, she chose a 2 x 4 format (two subject groups two years before and two years after the application of the nontraditional mathematics instruction) as a stronger format. Complete four-year test data were available on only 28 Euro-American females and 19 Afro-American females. This sample size was too small for the findings to be generalizable to a large segment of the school population. In addition, choosing a 2 x 4 format eliminated the youngest females in the school from the study because they began first grade with the nontraditional method of instruction.

Another confounding variable that might have affected the underachievement of these Afro-American females was teacher behavior. During the teachers' extensive inservice education in the nontraditional approach to mathematics instruction, only one hour was devoted to equity and gender issues. This hour-long session focused on encouraging underrepresented and underserved groups in the study of mathematics. It is possible that certain teacher behaviors, as described in the literature review, reinforced the Afro-American females' social place or role in the classroom. No effort was made to increase teachers' awareness of the complex social and cultural interactions that often take place in integrated classrooms. These interactions frequently give strong cultural messages to Afro-American females not to deviate from their ascribed social positions in school.

Daily observation of these females in the school environment indicated that more risk-taking and higher-level learning in mathematics were taking place for these females than was reflected by the test data. It was common to see males and females working and building in the mathematics area of the classroom and for both males and females to be busily interacting and developing patterns with geoboards and attribute blocks in their free time. The reduction of mathematics anxiety and the integration of mathematics problem solving into the learning process was apparent.

The significant underachievement in mathematics of the Afro-American females in this study was evident. The findings indicated the high probability that an innovative curriculum, as a single factor, will not produce academic growth. Consideration of and response to the complex social factors present in the classroom is essential in order to realize the full potential of an innovative curriculum. Thus, the need to search for and respond to the combination of variables that negatively affect the achievement of Afro-American females in the classroom was clearly supported by the results of this study.

Qualitative Analyses

Twelve subjects from the sample were interviewed to discover their perceptions and attitudes about mathematics. The interviews were conducted in an attempt to discover the perceptions and attitudes of young Afro-American and Euro-American females toward mathematics achievement, as well as the perceptions and attitudes they share. In addition, the interviews were conducted

to discover any additional variables, perceptions, and attitudes that might affect the mathematics achievement of young Afro-American females.

Perceptions and attitudes of the Afro-American females. The young Afro-American females who were interviewed in this study were resigned and practical about mathematics and their mathematics achievement. These six subjects did not appear to have mathematics anxiety or to fear risking failure if they tried mathematics activities. They simply saw no immediate use for mathematics, except as shoppers, and tended only to "do math" as required by the teacher. The six Afro-American interviewees did not necessarily like mathematics but diligently went to work when they were given mathematics assignments. Not one of them identified mathematics as their favorite subject in school. Although the average total reading achievement score for this group was 48, the average mathematics concepts and applications score was 36. Not only did they not like mathematics, these subjects did not achieve well in it. Not one of the Afro-American females indicated that she would choose a mathematics activity at free time.

When asked how they felt about doing mathematics, five of the six Afro-American females used such words as "weird," "hard," and "confusing." None of them indicated that they thought they were good in mathematics. The six Afro-American subjects indicated a cautious and practical response concerning to whether they were good at mathematics. They seemed to have an appropriate self-assessment of their mathematics competence.

All six of the Afro-American females indicated that mathematics was important but tended to think of its immediate value in terms of shopping and taking care of the family. All of these subjects indicated that their mothers valued mathematics and encouraged them to work hard at it. Yet none of the Afro-American females saw much value to mathematics other than as shoppers and managers of the family money.

Two of the six Afro-American females indicated that they would rather learn mathematics in an active way, such as counting and building things. However, the other four Afro-American subjects seemed to prefer the more traditional form of learning mathematics--doing worksheets. Five of the six Afro-American females stated that, when they received bad grades in mathematics, they just tried harder and did their work over. Four of these six youngsters said that, when thinking about doing mathematics, they just got out their work and did it. This response of acceptance of responsibility was typical of the Afro-American subjects in this study. Two of them indicated frustration with the unhelpfulness of the teacher when it came to doing mathematics.

In general, the Afro-American interviewees seemed animated, relaxed, and candid during the interviews, whether they were being interviewed by a Euro-American or an Afro-American. All six Afro-American females were very involved in activities such as Girl Scouts, sports, and church. They all had siblings and were part of extended families that included aunts and grandmothers; they had positive relationships with each other and with their families.

Perceptions and attitudes of the Euro-American females. Even though their average achievement score on the CAT test was only 33, the Euro-American interviewees indicated that they liked mathematics. They shared such positive feelings about doing mathematics as "[it's] kinda fun," "it's easy," and "it's fun." However, even though they indicated that they liked mathematics, these subjects did not choose mathematics activities at free time.

One Euro-American subject consistently expressed frustration with the teacher, who "just makes us do the work by ourselves." Her responses tended to reflect negative feelings about herself while doing mathematics. Interestingly, she indicated that mathematics was her favorite subject and that during free time she might choose an activity in the mathematics center.

All six Euro-American females thought that mathematics was important and said that their mothers considered mathematics to be important as well. They saw the importance of mathematics in their lives primarily as money handlers for their families while shopping. All six of the Euro-American interviewees indicated that they would rather do mathematics worksheets than count and build things. That is, they preferred passive, abstract computation to active, concrete manipulation of objects in their learning. All six Euro-American females expressed feeling disappointed or sad when they received bad grades in mathematics.

When completing the open-ended statement "Math is. . . ," five of the six Euro-American females said mathematics was important. They said their

success in mathematics determined how doing mathematics made them feel. Also, these subjects said they felt happy if their grade was good and terrible if their grade was bad.

Five of the six Euro-American females completed the open-ended statement "When I think about math. . . ." with such positive responses as "I feel good about myself." However, although these subjects gave positive responses, their mathematics achievement was not strong. Three of them cited a mathematics activity such as graphing, working with unifix cubes, and measuring "stuff" as being the most fun in mathematics. This recollection was in contrast to their previously stated preference for mathematics worksheets.

These six Euro-American females seemed to be anxious youngsters whose attitudes did not reflect their achievement in mathematics. All six of them were experiencing estrangement from siblings and family and lacked extended support systems to help them with their loneliness and frustration. They did not have accurate perceptions of their ability to achieve in mathematics.

Shared attitudes and perceptions of Euro-American and Afro-American females. The six Euro-American and six Afro-American females who were interviewed shared some perceptions and attitudes about mathematics. Seven of the 12 interviewees stated that spelling was their favorite subject in school. Only three said that mathematics was a favorite subject. Eleven of the 12 said they would not choose a mathematics activity at free time, but they mentioned a range of other activities they would choose. These included speaking,

listening, reading, writing, socializing, doing art activities, and playing. Only one subject suggested that a mathematics-center activity would be her choice.

All 12 interviewees acknowledged that mathematics was important to their futures. Nine of the 12 related the importance of mathematics to shopping and taking care of the family's budget. The remaining three indicated that mathematics was important for such reasons as advancing in school and receiving good grades.

All 12 interviewees said their mothers thought math was important. Each said her mother and/or grandmother encouraged her to work hard in mathematics.

Most of the interviewees indicated that they preferred worksheets over counting and building activities when doing mathematics. This preference for worksheets is consistent with the research, which has suggested that females learn how to do mathematics much like they learn to read--by memorizing a model or configuration and then applying the familiar model when it reappears.

The interviewees felt about the same when they received bad grades in mathematics. All 12 of them had negative feelings when they were not successful in mathematics. Their responses suggested that they had lower self-esteem when they did not do well in mathematics.

Additional variables, perceptions, and attitudes, that uniquely affect the mathematics achievement of Afro-American females. Several variables that were unique to the Afro-American interviewees became apparent in the interview

process. All six of these subjects seemed to be happy, productive, practical, and social youngsters. Throughout the interviews, they appeared to be self-confident and maintained a balanced attitude about themselves and others.

A prevailing attitude among the Afro-American females was one of practicality. They identified the primary purpose of mathematics as handling money and shopping for the family. They saw little additional practical value to mathematics other than money management. They did not choose a mathematics activity during free time but rather chose interactive, social activities with their friends. None of the Afro-American females named mathematics as a favored subject. They did not particularly like mathematics and did not choose mathematics activities for fun. While they were doing mathematics, if they ran into problems they just tried harder.

The Afro-American females in this study had a mean reading score of 48, as compared to a mean mathematics score of 36. Their reading scores placed them within the average range of reading achievement. Yet these same females scored significantly lower in mathematics. It is possible that the Afro-American interviewees' negative feelings about mathematics and their failure to see its importance and practicality in their lives and in their future work were factors in their underachievement.

The young Afro-American females had a close and supportive relationship with their Afro-American peers and families. All six of these youngsters' responses to the questions, body language, and communication strategies were

similar. Their cultural compatibility may have been reinforcing negative cultural messages about mathematics achievement. At no time did the Afro-American students venture beyond the notion that mathematics is for counting money and shopping. They did not like mathematics, saw no need for mathematics beyond self-maintenance, and had the notion that mathematics was something they did because they had to, but other subjects were more fun.

Reflections and Recommendations for Practice

An important finding of this study is that the Afro-American females in the sample were continuing to underachieve in mathematics in spite of this method of mathematics instruction. They scored significantly lower than the Euro-American females both before and after the application of the nontraditional mathematics instruction. It is apparent that a single innovative instructional strategy, such as the nontraditional mathematics approach, cannot reverse the complex problems of many of these young females. The underachievement of the Afro-American females in the sample was systemic, not methodological.

The results of this study should be shared with the administrators, teachers, and parents at this school. These groups must work together to reduce the effects of a social-economic system that may be reflected in some public schools, which too often assigns children to certain roles and then keeps them there.

School districts must begin addressing equity, gender, and racial issues that are a part of the social/cultural make-up of the community. Teachers should

have opportunities to expand their own perceptions and attitudes about these issues. In addition, teachers should have the opportunity to assess their behaviors and attitudes in a nonthreatening manner that provides insights and alternative behaviors.

The underachievement of the Afro-American females in this study is a reality. However, to know these youngsters as individuals and to see and enjoy their warmth and intelligence is the strongest reason of all to continue to seek ways to make it possible for all students to learn and be successful.

Gilbert and Gay (1985) stated that the key to improving the success of Afro-American children is to modify the means used to achieve the outcomes. This modification must extend beyond adopting innovative methods of mathematics instruction to establishing such achievable objectives as unbiased testing, sensitized teacher expectations and behaviors, working partnerships between schools and parents, and a realistic appraisal of social and cultural factors in the classrooms that are blocking the progress of some children. The primary implication of this study is clear: Educators and communities must develop the resources of all children.

Recommendations for Further Research

The following recommendations are made for additional research:

1. A longitudinal study should be conducted, using the same sample and statistical format from the present study, to substantiate whether the slight increase in mathematics achievement from Year 1 to Year 4 would continue, thus

supporting the belief that the nontraditional method of mathematics instruction is in closer alignment with good educational pedagogy than is the traditional method.

2. A study should be carried out, comparing the mathematics achievement of the sample from the present study with that of a similar sample who have not been exposed to the nontraditional mathematics instruction.

3. The mathematics achievement scores of the Afro-American and Euro-American females who participated in this study should be compared to the mathematics achievement scores of the Afro-American and Euro-American males in the same population, to discover whether Afro-American males are underachieving to the same degree as Afro-American females.

4. Further research should be conducted on the variables affecting the overall achievement of Afro-American females. A combination of complex factors, thus far elusive, is negatively affecting the achievement of Afro-American females in the schooling process. Racial, ethnic, and gender issues must be identified, understood, and addressed so that Afro-American females can reach their full potential throughout the schooling process.

5. Teachers' attitudes and perceptions about mathematics achievement must be studied and recommendations made for staff development that focuses on the recognition and reduction of behaviors that negatively influence females' achievement in mathematics. Teachers must be part of the solution to underachievement in mathematics, not part of the problem.

6. Teacher preparation and training for an innovative curricular approach such as a "nontraditional" method of mathematics instruction must be studied. "Teachers teaching teachers" at the end of a long school day with no release time for planning and with little follow-up and support for the individual teacher may significantly influence the effectiveness of the implementation process.

APPENDICES

APPENDIX A

PARENTAL PERMISSION LETTER

September 1, 1993

Dear Parents,

_____ Elementary School has been invited to participate in a study examining the math achievement of young females before and after the application of our "hands on" math curriculum. We are going to carefully analyze the math scores of about 60 randomly selected females in grades 3, 4, and 5, of whom will be Afro-American and 30 will be Euro-American. In addition, we will be seeking to interview approximately 12 of these young females in order to explore for additional and contributing factors that affect math achievement. Again, we will divide our focus between six Afro-American females and six Euro-American females. We will be particularly interested in females who have a significant discrepancy between their reading scores and their math scores. We want to know why some young females at _____ School are not succeeding in math and whether our new math curriculum is making a difference in their success.

These interviews will be audio-taped for the benefit of the researcher, but the student's name will not be revealed on the tape. If selected, approximately 1 and 1/2 hours of interview time will be required for the in-depth interviews. The interviews will take place during the school day at _____. All participating students will be assigned student numbers, and the results will remain anonymous.

We are writing to request your permission to allow your daughter to participate in this project. However, participation in this project is completely voluntary. You can be assured that any wish to not participate is entirely respected, and no penalty for nonparticipation will be directed toward your child. Your child may withdraw from this study at any time without penalty.

The study is being administered by students from Michigan State University and Albion College. However, if you have any questions or concerns about your daughter's participation in this project, please call Ms. Janys Roberson (629-2435) at the school.

Your daughter has been informed about the project. If you wish to give permission for your daughter to participate in this study, please sign the form below, detach, and return to the school. Thank you for your consideration of this request.

Sincerely,

Ms. Janys A. Roberson

_____ has my permission to participate in the study on math achievement of elementary-age females. I indicate my voluntary agreement to participate in this project by completing and returning this form.

_____ (Parent) _____ (Date)

APPENDIX B

INTERVIEW SCHEDULE

STRUCTURED INTERVIEW

1. Student number _____
2. Age _____
3. Birth date _____
4. Do you have brothers and sisters? Tell me about them.
5. Do you belong to any clubs such as Girl Scouts, Campfire Girls, church, etc.?
6. When you grow up, who would you like to be?
7. What do you think girls are supposed to do when they grow up?
8. What is your most favorite subject in school?
9. What is your least favorite subject in school?
10. When you have free time at school, what do you choose to do?
11. How do you feel about doing math?
12. Are you good at math?
13. Do you think math is important? Why or why not?
14. Does your mother think math is important? Why or why not?
15. Can you think of any ways that math would be useful to you?
16. Which would you rather do?

    _____ math worksheets
    _____ count and build things

17. Finish these sentences in a few words:*

When I get bad grades in math _____.

Math is _____.

Doing math makes me feel _____.

When it comes to math, I _____.

My most fun at math was when _____.

*Adapted from Sentence Completion Questionnaire by Sandra L. Davis, University of Minnesota.

STRUCTURED INTERVIEW

QUESTION:

RESPONSE:

Afro-American/Afro-American
AA/AA

Afro-American/Euro-American
AA/EA

Euro-American/Afro-American
EA/AA

Euro-American/Euro-American
EA/EA

REFERENCES

REFERENCES

Akbar, N. (1978). Cultural expressions of the African American child (A position paper). (ERIC Document Reproduction Service No. ED 179 633)

Ames, L. B., & Ames, F. L. (1967, June). Search for children showing academic promise in a predominantly Negro school. Journal of Genetic Psychology, 110, 217-231.

Banks, C., McQuarty, G., & Hubbard, J. (1978). Toward a reconceptualization of the social-cognitive basis of achievement orientations in blacks. Review of Educational Research, 48, 381-397.

Baroody, A. J. (1987). Children's mathematical thinking: A developmental framework for preschool, primary, and special education teachers. New York: Teachers' College Press.

Beady, C. H., & Hansel, S. (1981). Teacher race and expectations for student achievement. American Educational Research Journal, 18, 191-206.

Binet, J. (1973). The development of intelligence in children. New York: Arno Press.

Blau, Z. S. (1981). Black children/white children: Competence, socialization, and social structure. New York: Macmillan.

California achievement tests, Forms E and F: Reports and scores. Monterey, CA: CTB/McGraw-Hill.

Children's Defense Fund. (1974). Children out of school in America. Washington, DC: Author.

Clements, D. H. (1989, December). Hands-on math: Vol. 1. Arithmetic Teacher, 37, 58.

Cohen, R. A. (1969). Conceptual styles, culture conflict, and nonverbal tests of intelligence. American Anthropologist, 71, 828-856.

Coleman-Burns, P. (1989). African-American women: Education for what?" Sex Roles, 21, 145-160.

Comer, J. P. (1972). Beyond black and white. New York: Quadrangle Books.

Comer, J. P. (1980). School power: Implications of an intervention project. New York: Free Press.

Crain, R. L., & Mahard, R. (1978, Summer). Desegregation and black achievement: A review of the research. Law and Contemporary Problems, 42, 17-56.

Dorsey, A. G. (1988, Winter). Art and creative development for young children. Childhood Education, 65, 123.

Dweck, C. S., Davidson, W., Nelson, T., & Enna, F. (1978). Sex differences in learned helplessness. Developmental Psychology, 14, 268-276.

Entwisle, D. R., & Alexander, K. L. (1988, May). Factors affecting achievement test scores and marks of black and white first graders. Elementary School Journal, pp. 449-471.

Entwisle, D. R., & Alexander, K. L. (1989, March). Beginning school math competence: Minority and majority comparisons (Report No. 34). Baltimore, MD: Center for Research on Elementary and Middle Schools.

Gelman & Gallistell. (1986). The child's understanding of number. Boston: Harvard University Press.

Giddings, P. (1984). When and where I enter: The impact of black women on race and sex in America. New York: William Morrow.

Gilbert II, S. E., & Gay, G. (1985, October). Improving the success in school of poor black children. Phi Delta Kappan, pp. 133-137.

Ginsberg, H. P. (1989). Children's arithmetic: How they learn it and how you teach it. New York: Teachers' College Press.

Grant, L. (1984). Black females' "place" in desegregated classrooms. Sociology of Education, 57, 98-111.

Hale-Benson, J. E. (1986). Black children" Their roots, culture and learning styles. Baltimore, MD: Johns Hopkins University Press.

Hare, B. (1985). Reexamining the achievement central tendency: Sex differences within race and race differences within sex. In H. McAdoo & J. McAdoo (Eds.), Black children. Beverly Hills, CA: Sage.

Havighurst, R. J. (1976, November). Human characteristics and school learning. Elementary School Journal, 77, 101-109.

Heller, K. A., and others. (1982). Placing children in special education: Equity through valid educational practices. Final report. Washington, DC: Office of Civil Rights.

Henry, P., Brazen, S., & Henry, C. A. T. (19). Black student attitudes toward standardized tests: Does gender make a difference? College Student Journal, 23, 346-354.

Hill, R. A. (1972). The strengths of black families. New York: Emerson Hall.

Hilliard, A. G. (1973). The intellectual strengths of black children and adolescents: A challenge to pseudo science. New York: Institute of African Research.

Hilliard, A. G. (1974, September). Restructuring teacher education for multicultural imperatives (Research report). Research in Education.

Johnson, K. R., & Simons, H. D. (1972, January). Black children and reading: What teachers need to know. Phi Delta kappan, 53, 288-290.

Kahl, W. C. (1957, March). State aid for education. Wisconsin Journal of Education, 89, 10-13.

Kamii, C. (1990). Number in preschool and kindergarten: Educational implications of Piaget's theory. Chicago: University of Illinois.

Kerckhoff, A. C., & Campbell, R. T. (1977, January). Black-white differences in the educational attainment process. Sociology of Education, 50, 15-27.

Kleinfeld, J. S. (1973a, Summer). Intellectual strengths in culturally different groups. Educational Research, 43, 341-359.

Kleinfeld, J. (1973b). Using nonverbal warmth to increase learning: A cross-cultural experiment. Fairbanks: Institute of Social, Economic, and Government Research, Alaska University.

Ladner, J. A. (1971). Labeling black children: Social-psychological implications. Journal of Afro-American Issues, 3, 43-52.

Lewis, H. (1974). Black families: Sociological profiles. Atlanta, GA: Atlanta University Press.

Lightfoot, S. L. (1976, December). Socialization and education of young black girls in school. Teachers' College Record, 78, 239-262.

Moore, E. G., & Smith, A. W. (1987). Sex and ethnic group differences in mathematics achievement. Journal for Research in Mathematics Education, 18, 25-36.

Morgan, H. (1980, January-February). How schools fail black children. Social Policy, 10, 49-54.

Munroe, R. H., Munroe, R. L., & Whiting, B. B. (1981). Handbook of cross-cultural human development. New York: Garland.

National Council of Teachers of Mathematics. (1989). Curriculum and evaluation standards for school mathematics. Reston, VA: Author.

National Research Council. (1985). Mathematics, science, and technology education: A research agenda. Washington, DC: National Institute of Education, National Research Council.

Natriello, G., McDill, E. L., & Pallas, A. M. (1990). Schooling disadvantaged children: Racing against catastrophe. New York: Teachers College, Columbia University.

Nelson-LeGall, S. (1989). Same sex and cross-sex help exchanges in the classroom. Journal of Educational Psychology, 79, 67-71.

Nelson-LeGall, S. (1991). The condition of sex equity in education: Sex, race, and ethnicity. Sex equity in educational opportunity, Achievement and testing. Princeton, NJ: Educational Testing Service.

Nelson-LeGall, S., & Glo-Scheib. (1985). Help seeking in elementary classrooms: An observational study. Contemporary Educational Psychology, 10, 58-71.

Ogbu, J. U. (1981). Origins of human competence: A cultural-ecological perspective. Child Development, 52, 413-429.

Piaget, J. (1952). The child's conception of number. London: Routledge & Kegan Paul.

Powell, G. J. (1970). School desegregation and self-concept. South Hadley, MA: Mt. Holyoke College.

Powell, G. J., Yamamoto, J., Romero, A., & Morales, A. (1983). The psychosocial development of minority group children. New York: Brunner/Mazel.

Rashid, H. M. (1981, Fall). Early childhood education as a cultural transition for African-American children. Educational Research Quarterly, 6, 55-63.

Renzulli, J. (1973). Talent potential in minority group students. Exceptional Children, 39, 437-444.

Rodgers-Rose, L. F. (Ed.). (1980). The black woman. Beverly Hills, CA: Sage.

Rohwer, W. D. (1971). Learning, race, and school success. Review of Educational Research, 41, 191-210.

Romberg, T. A. (1983). A common curriculum for mathematics. Yearbook (National Social Studies Education), 82(Part 1), 121-159.

Rosenberg, N. (1972). The younger minority boy as a clue to the source of achievement orientation. Bethesda, MD: National Institutes of Health.

Rosser, P. L., & Oyemade, U. J. (1981). Development in black children: Advances in behavioral pediatrics.

Rowntree, D. (1981). Statistics without tears. New York: Charles Scribner's Sons.

Rystrom, R., & Cowart, H. (1972, January). Black reading errors or white teacher biases. Reading Journal, 15, 273-276.

Sarason, I. G. (1973, June). Test anxiety and social influence. Personal Journal, 41, 261-271.

Scott-Jones, D., & Clark, M. L. (1986). The school experience of black girls. Phi Delta Kappan, 67, 520-526.

Simpson, T. (1962, March). Study, through biographies, of the history of the elementary concepts of probability. School Science and Mathematics, 62, 172.

Slaven, R. E., Karweit, N. L., & Madden, N. A. (1989). Effective programs for students at risk. Boston: Allyn & Bacon.

Spencer, M. B., Brokens, G., & Allen, W. (Eds.). (1985). Beginnings: The social and affective development of black children. Hillsdale, NJ: Erlbaum.

Starkey, P. (1981, March). Young children's performance in number conservation tasks: Evidence for a hierarchy of strategies. Journal of Genetic Psychology, 138, 103-110.

Stodolsky, S., & Lesser, G. (1967). Learning patterns in the disadvantaged. New York: Ferkauf Graduate School of Humanities and Social Sciences, Yeshiva University.

Tobias, S. (1978). Overcoming math anxiety. Boston: Houghton-Mifflin.

Travers, K. T., & McKnight, C. C. (1985, February). Mathematics achievement in U.S. schools: Preliminary findings from the second NAEP mathematics study. Phi Delta Kappan, pp. 407-413.

Trent, W. (1984, May). Equity considerations in higher education: Race and sex differences in degree attainment and major field from 1976 through 1981. American Journal of Education, 92, 280-305.

Ward, S. H. (1972, July). Self-esteem and racial preferences in black children. American Journal of Orthopsychology, 42, 644-647.

Washington, V., & LaPoint, V. (1988). Black children and American institutions. New York: Garland.

Weikart, D. P. (1980). Young children grow up: The effects of the Perry preschool program on youths through age 15. Ypsilanti, MI: High Scope Press.

Williams, M. M. (1972, September). Race, poverty, and educational achievement in an urban environment. Paper presented at the American Psychological Association Annual Convention, Honolulu, Hawaii.

Witkin, H. A. (1979). Socialization, culture and ecology in the development of group and sex differences in cognitive style. Human Development, 22, 358-372.

Ysseldyke, J. E. (1983, April). Current practices in making psychoeducational decisions about learning disabled children. Journal of Learning Disabilities, 16, 226-233.