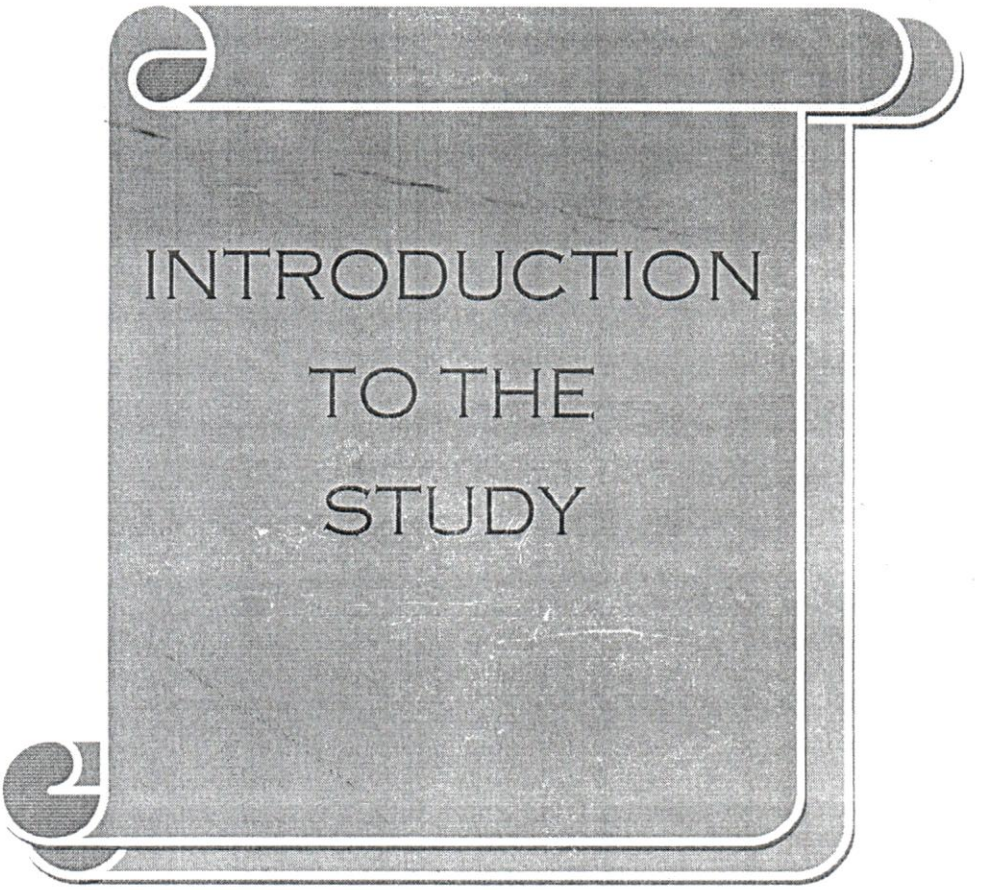
CHAPTER-1



CHAPTER 1

THE NATURE AND SIGNIFICANCE OF THE PROBLEM

1.1 Introduction

For many mathematics teachers, the textbook is the primary guide to implementing the curriculum. Textbook selection is a major philosophical and financial commitment by districts. Textbooks play a central role in influencing mathematics learning for all students. For students to learn important mathematics, the text guiding their learning and the teacher's instruction must contain appropriate depth of content, encourage effective instructional strategies, identify a clear sense of purpose, and promote student thinking (Kulm, 1999). Many of the popular commercial textbooks used in U.S middle schools do not meet these basic criteria. Often the content being taught and the standards being tested on state assessments do not align (Richardson, 2001). The academic performance of students suffer as a result.

1.2Background/Statement of the Problem

Students have experienced more hands on, inquiry-based, connection of mathematical concepts to real world and collaborative learning in math classes but have experienced the angst of change from what they previously have experienced in the mathematics classroom. Parents have been faced with mathematics that is significant, challenging and different from what they experienced as students. Some parents have found it

difficult to aid their children with math homework. Some parents have sought assurance that this change in curriculum and instruction will provide their children the mathematical foundation needed to succeed at the next level.

1.3 Rationale of the Study

The typical mathematics curriculum of a generation ago emphasized teaching facts, standard procedures, and skills to groups of passive recipients (Suydam, 1990). Students today must compete in a continually growing and technologically changing global economy in which science, mathematics, and technology skills are essential. The mathematics a person needs to know has shifted and a more integrated, child centered curriculum presented to more active, participating students has emerged in the past decade in response to deteriorating public confidence in the quality of American education (Brosnan, 1993).

Traditional mathematics provided a lecture style teaching methodology with only a slight chance for student interaction and low level student questioning. Traditional mathematics education is seriously inadequate for twenty-first century students (Schifter and Fosnot, 1993) and future taxpayers. These weaknesses have been reaffirmed in many states as seen in the results of math achievement in middle schools as measured by the said states' mathematics achievement test scores (Schifter and Fosnot, 1993). This study is significant, as it will examine the human aspect of adopting and implementing an innovative curriculum and examine the effect a standards based curriculum has on the

mathematical achievement of middle school students who have had the program for three consecutive years.

Research Questions

The quantitative analysis of this study focused on the following research questions:

1. Is there a significant difference in mathematics achievement among students ?

2. Is there a significant difference in the mathematics achievement of students according to their identified socioeconomic status ?

3. Is there a significant difference between the mathematics achievement of male and female students ?

Purpose

The purpose of this study was to investigate the subsequent impact on student achievement for various subgroups of the population.

1.5 Significance of the Study

In recent years, the students in our country have begun to show improvement in the area of mathematics. The 1997 average SAT scores were at the highest level since 1972 (Burrill, 1998). Scores on the National Assessment of Educational Progress (NAEP) in 1996 for fourth, eighth,

and twelfth grade students, in the area of mathematics, indicated an improvement over mathematics scores in 1990 and computation scores were higher for fourth and eighth grades than in 1973 (Burrill, 1998). Despite these improvements, there are still areas of great concern related to American students' mathematics achievement, particularly in the middle grades (Beaton, Mullins, Martin, Gonzales, Kelly, & Smith, 1997; Burrill; Stevenson, 1998). In spite of the fact that American students in fourth grade scored above the average on the TIMSS, American students in eighth and twelfth grades did "progressively worse" (Burrill, p.585).

Mathematics curricula has been one target of blame for the poor performance of middle school students on mathematics achievement measures. Reports from the TIMSS study (Beaton, 1997; Schmidt, 1997) indicated that middle school mathematics curricula in our country lack focus, provide little opportunity for students to be challenged, and cover a wide range of content with little depth.

The curriculum has a significant impact on what is taught and learned in middle school mathematics programs. Mathematics taught as an integrated field of study rather than a collection of separate strands or standards allows for a deeper and more lasting understanding of connected mathematical ideas (NCTM, 1989). In mathematics education within the subject public school district, curriculum is changed every five years with the to adoption of a new textbook. This change usually occurs without analysis of the existing curriculum to determine the impact the curriculum

has had on learning and student achievement. The effect curriculum has on student achievement in middle school mathematics programs is important and needs to be investigated. Therefore, this study is significant because it strives to link curriculum with student achievement.

1.6 Connected Mathematics Project

The National Science Foundation (NSF) funded five innovations of mathematical curriculum reforms at the middle school level: MathThematics, Connected Mathematics, Mathematics in Context, MathScape, and Middle-School Mathematics Through Applications. Each curriculum was designed and developed by a team of educators, teachers and mathematicians.

Connected Mathematics Project (CMP) is a standards based mathematics curriculum based on the content and principles of the National Council of Teachers of Mathematics (NCTM). Standards based mathematics curriculum emphasizes the development of conceptual understanding and reasoning whereas traditional mathematics focuses on memorization, rote learning, and the application of facts and procedures. CMP is a complete mathematics curriculum for grades six tat Michigan State University. It was funded from 1991-1997. The project directors were Glenda Lappan, William Fitzgerald, and Elizabeth Phillips of Michigan State University; James Fey of the University of Maryland; and Susan Friel of University of North Carolina. CMP is currently implemented in over 2,200 schools in all

50 states plus Washington, D.C. and Puerto Rico (NWREL, 1998). CMP was developed over a six year period, 1991-1997, and has only been available since the 1997-1998 school year Dale Seymour Publishers distributes the version of CMP materials used in this southeastern Tennessee public school district. As the name implies, the authors created a curriculum that is rich in connections with other disciplines, everyday activities, meets the needs and special interests of middle school students, and makes connections to the real world.

The developers were guided by five fundamental mathematical and instructional themes:

• The curriculum is organized around a selected number of important mathematical concepts and process goals.

• The curriculum emphasizes significant connections among various mathematical topics that are presented and connections between mathematics and problems in disciplines that are meaningful to students.

• Instruction emphasizes inquiry and discovery of mathematical ideas through investigation of structurally rich problem situations.

• Students grow in their ability to reason effectively with information represented in graphic, numeric, symbolic, and verbal forms and in their ability to move flexibly among these representations.

• Selection of mathematical goals and teaching approaches will reflect the information processing capabilities of calculators and computers and fundamental changes such tools are making ways people learn mathematics and apply their knowledge to problems solving tasks (Lappan, Fey, Fitzgerald, Friel, & Phillips 1996).

Connected Mathematics encompasses a combination of theoretical curriculum perspectives: experiential, structure of the disciplines, and cognitive. When examining the central questions of these perspectives, this curriculum attempts to answer each question through problems that are organized around these perspectives. This curriculum attempts to answer each through problems that are organized around these three headings: Applications, Connections, and Extensions. Each investigative unit concludes with Mathematical Reflections. The educational aim of CMP is for students to become critical and creative thinkers equipped with problem solving strategies. Connected Mathematics breaks from the traditional math curriculum in that it does not include drill and practice learning. Basic skills, such as addition, subtraction, multiplication, division, fractions, percentages, reading charts and graphs and measurement are assumed to be mastered. These math concepts are integrated into each investigative unit through word problems, maps, tables, and charts (CMP, 1999). This curriculum demands that students be able to read.

An expert panel by the U.S. Department of Education's Mathematics and Science named CMP as an exemplary curriculum (U.S. Dept. Education, 2000). However, opponents of this curriculum contend the shortcomings include the limited number of users of this curriculum and the test of time. But according to the article, "What is Standing in the Way of Middle School Mathematics Curriculum Reform?" *CMP* has been extensively field tested with positive results on standard measures of achievement nand measures of problem solving (Reys, Reys, Barnes, Been, & Papick 1998).

CMP is organized into eight units at each of the three grade levels. Each unit containing four to seven investigations, focusing on a set of content goals that connect with other units. The design aims for students to build their knowledge of important mathematical content throughout the entire curriculum. Students are initially introduced to ideas in grade six units and the concepts spiral into the seventh and eighth grade units. The sixth, seventh, and eighth grade units are listed in Table 1.

The CMP instructional model organizes the lesson into three phases: launch,
explore, and summarize. During the launch, the teacher introduces the investigation to the students by providing background information or new ideas, reviewing previous material, or supplying directions and /or expectations for the learning experience. In the second phase, exploration, students actually "investigate" a problem usually in pairs. A shift occurs in the locus of authority, and teachers are no longer sources of truth (Schifter

and Fosnot, 1993). Instead, the teacher's role during this time is as a acilitator of student experience through asking probing or focusing questions, monitoring, and encouraging students.

Summarizing is the final phase of each lesson. During this period, the class discusses its data and its strategies for developing the information. The teacher is responsible for guiding those strategies into problem-solving techniques and assessing the students' understanding of the major mathematical ideas. The summary of a lesson or investigation may or may not occur each class period, but will happen at the end of each investigation.

Table 1. Eighth Grade Units and the Mathematical Strand Covered

8th Grade Units
Thinking with Mathematical Models *Algebra (Functions)*
Looking for Pythagoras *Geometry & Measurement*
Growing, Growing, Growing *Strand Algebra (Exponential Growth)*
Frogs, Fleas, and Painted Cubes *Algebra (Quadratic Growth)*
Say It with Symbols *Algebra (Linear Equations)*
Hubcaps, Kaleidoscopes, and Mirrors *Geometry & Measurement*
Samples and Populations *Probability & Statistics*
Clever Counting *Number Strand*

There are four strands or areas of study (see Table 1) that appear throughout CMP based on the NCTM Standards. Mathematical concepts are explored through these strands (algebra, geometry and measurement, number, and probability and statistics) and are studied in each of the twenty-four units. The units do not isolate the strands; but instead the units combine the strands through their natural relationships. Hence, mathematical ideas are developed across units, strands, and grade levels. For example, in the probability and statistics strand, CMP students first study data investigation by formulating questions, gathering data, organizing and analyzing data, and making decisions based on data in "Data About Us" and revisit the probability and statistics strand in "How Likely Is It"? In the seventh grade, students continue their study in the probability and statistics strand in the "What Do You Expect (Expected Value)"? Students conclude their mathematical development in the probability and statistics strand with the next to last CMP recommended unit, "Samples and Populations" (gathering data from samples to make predictions about populations).

In CMP, students work individually, in pairs, small groups, and as a large group. Individual work is usually during the launch phase of the lesson while cooperative groups, ranging in size of two to four, are encouraged for students to explore problems. The problems require students to gather data, look for patterns, and use problem solving strategies. At the conclusion of a lesson, students share strategies and solutions and teachers summarize mathematical ideas with the whole group.

1.7 Standards Based Curriculum Achievement Data

Schoenfeld presents preliminary data indicating students being taught with a standardized based curricula do as well on skills as students who study the traditional curricula, and they do better on understanding of concepts and problem solving. Also traditional performance gaps between majority students and poor or underrepresented minorities have not been eliminated but are diminished (Schoenfeld, 2002).

Schoenfeld documents the efforts by the Pittsburgh Public Schools since the early 1990's to implement standards based education in mathematics. Scores on concepts and problem solving increased with the implementation of the new curriculum. The lack of attention in basic skills is a major criticism from opponents of standards based curricula.

Reys and Reys conducted a study comparing the mathematics achievement of eighth graders from school districts in Missouri, which revealed significant differences in achievement between students using standards based curriculum materials for at least two years and students using other curriculum materials. The differences reflected significantly higher overall achievement of students using standards based material and significantly higher scores in most content strand areas than did the students using traditional curriculum (Reys, Reys, Lapan, Wasman, & Holliday 2003).

1.8 Researcher's Experience

The researcher has experience with standards based curriculum from a teacher's and an administrator's perspectives. The researcher taught elementary aged students using the system's adopted standards based curriculum for three years before transferring to the middle school.

The researcher's role as an administrator supervising those teaching CMP was considerable. The researcher facilitated workshops for the mathematics teachers in the building on a regular basis. Several lessons were modeled for novice teachers throughout the school year. Observations and evaluations with written feedback were conducted regularly. Encouragement and overall general support for the teachers and their use of the standards based curriculum was important to the researcher.

Textbook Adoption Committee

The middle school textbook adoption committee for the school district at the time of CMP adoption consisted of seven members. The committee members were selected by invitation from the mathematics supervisor. The only criteria the supervisor expressed for textbook adoption committee members was a willingness to participate in the textbook adoption process. The mathematics supervisor requested the textbooks to be considered for adoption from the publishers based on the approved middle school

textbook list from the state of Tennessee. Members of the committee would meet regularly to discuss various aspects of the different textbook series. Little research on standards based curricula was available for the committee to consider at the time of the textbooks adoption. The committee did not have considerable evidence that the standard practice of adopting traditional textbook series in the past had had no noticeable impact on mathematics standardized test scores.

1.9 Definitions of Terms

There are several terms, phrases, and definitions that will be used throughout this study. Some of them are listed below.

1. **Connected Mathematics Project (CMP):** A middle school mathematics curriculum that is standards-based in content developed by Glenda Lappan, James T. Fey, William M. Fitzgerald, Susan N. Friel, and Elizabeth D. Phillips of Michigan State University and published by Dale Seymour Publications while supported by the National Science Foundation.

2. **Middle School:** A school that is specifically called a "middle school" and
contains no grade above eighth or any grade below fourth: alternative schools are excluded (Vaccaro, 2000).

3. **Minorities:** Individuals of Non-European descent.

4. **SES:** Socioeconomic status as defined by participation and/or qualification for the federal free and reduced lunch program.

5. **Standards Based Mathematics:** Mathematics curriculum based on the National Council of Teachers of Mathematics curriculum standards that define five mathematical standards and five process standards.

6. **TIMMS:** Third International Mathematics and Science Study, a comparative achievement test of mathematics and science administered in 1994-95 at the fourth, eighth, and twelfth grades to over 40 countries was sponsored by International Association for the Evaluation of Educational Achievement (IEA).

Organization of the Study

This study will be organized into five chapters. Chapter I contains background for the problem, rationale of the study, research questions, significance of the study, and definition of terms. Chapter II includes a review of related literature, including standards based curriculum, constructivism, connected mathematics project, minorities, socioeconomic status, and gender. Chapter III describes the methodology. Chapter IV describes the findings and Chapter V presents the conclusions and questions for further study.