THE EFFECT OF CONNECTED MATHEMATICS ON STUDENT ACHIEVEMENT IN SELECTED MIDDLE SCHOOL GRADES

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Abstract

The purpose of this study was to examine the effect of *Connected Mathematics Project* on the mathematics achievement of sixth and seventh grade students in the Olathe School District. The design of this study was an experimental, control group. The treatment variable was the type of mathematics instruction taught in the classroom. Students in the control group received mathematics instruction in a traditional, lecture-based setting. The treatment for the experimental group was mathematics instruction using CMP.

The study focused on 357 seventh grade students at 5 participating junior high schools. The researcher analyzed scores from a sample of students (n=119) who received two years of mathematics instruction using CMP, a sample of students (n=119) who received one year of mathematics instruction using CMP, and a sample of students (n=119) who received no mathematics instruction using CMP. The study also examined the effects of CMP on students qualifying for special education services and students of low SES. The dependent variable, mathematics achievement, was measured using scores obtained from the 2008 seventh grade Kansas Mathematics Assessment. Additional analyses were conducted on the fifteen mathematics indicators on the seventh grade KMA test.

The results of the data analysis showed that while the mean score of students receiving mathematics instruction using CMP were higher than the mean scores of students not receiving mathematics instruction using CMP, the differences were not statistically significant at the .05 level. The results also showed the main effect of mathematics instruction on students qualifying for special education services or students of low SES was not statistically significant. However, there were statistically significant differences indicated on mean scores of four of the fifteen seventh grade tested indicators between students with CMP instruction and those with no CMP instruction.

Dedication

This is dedicated to my mother, Dr. Bonnie Gleason, to whom I owe a lifetime of gratitude. You have been my mentor, model and inspiration. Even more, you have always been my friend. If I can be half the teacher and leader you have been, I'll be content. I hope I have made you proud.

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I also want to thank Sammy and Alex for smiles and hugs throughout the last two years. And, yes Sammy, the dining room table will finally be clean, so you may eat there again.

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CHAPTER ONE

INTRODUCTION AND RATIONALE

On October 4, 1957, the Soviet Union successfully launched Sputnik. Many argue this event changed mathematics education in the United States, marking the beginning of educational reform in this country (Hiatt 8). The modern math, or New Math, movement was the outgrowth of the Cold War and a perception throughout the country that the United States was not training enough mathematicians and scientists. New Math, while appealing to students' intellect, was aimed at developing student understanding through mathematical structure and a focus on abstractions. Meaning was imposed out of the structure of mathematics such as set theory and number bases other than ten (North Central Regional Educational Laboratory 2). There was substantial criticism of New Math and by the early 1970s, New Math was dead. The National Science Foundation discontinued funding New Math programs, and there was a call to go "back to the basics" in mathematics (Klein 9). A more "traditional" approach to mathematics education dominated many schools during the 1970's, while others returned to progressivist roots through the Open Education Movement.

In the early 1980s, there was a widespread perception that the quality of math and science education had been deteriorating. A 1980 report requested by President Carter pointed to low enrollments in advanced mathematics and science courses and the general lowering of school expectations and college entrance requirements. The commission feared a rising tide of mediocrity as evidenced by an emphasis on minimum competencies and lack of rigor in academic offerings (Ravitch 51-52). The next wave of educational reform was initiated by a document issued by The National Commission on Education called “A Nation at Risk” (Amrein and Berliner 2). This report claimed that our nation was falling behind the rest of the world in education. The report suggested states develop and implement sets of standards to improve curricula and implement assessments for the mastery of these standards in an effort to hold schools accountable. “A Nation at Risk” caused a major shift of focus upon the educational system. It was at this time The National Council of Teachers of Mathematics (NCTM) began to lead the way in attempting to reform math curriculum and instruction. The initial NCTM recommendations “emphasized problem solving and applications; reexamination of basic skills; incorporation of calculators, computers and other technology into the mathematics curriculum, and more mathematics for all students” (Manouchehri 197).

In 1989, NCTM released *Curriculum and Evaluation Standards for School Mathematics* (*Curriculum and Evaluation Standards for School Mathematics*). The document became the standard by which mathematics reform was to be measured over the next decade. The NCTM *Standards* called for a move away from the new math that was established in the 1960s to a curriculum that emphasized problem solving, cooperative activities, higher level thinking, connection of ideas, active learning and increased understanding within mathematics (C. Cook 1). Recommendations were made for use of a method of instruction called constructivism, which involves the discovery approach to learning.

The National Science Foundation (NSF) was key to the implementation of the NCTM *Standards* across the nation. Spurred by the 1989 Education Summit attended by President George H. W. Bush and all of the nation's governors, NSF set about to make systemic changes in the way math and sciences were taught in United States schools (Klein 16). NSF supported the creation and development of commercial mathematics curricula aligned to the NCTM Standards including *Connected Mathematics*. *Connected Mathematics* is a comprehensive, problem-centered curriculum designed for students in grades 6-8 based on the NCTM standards. The program seeks to make connections within mathematics, between mathematics and other subject areas, and to the real world. Problems are solved by observing patterns and relationships, thereby enhancing understanding of mathematics. "Natural extensions involve conjecturing, testing, discussing, verbalizing, and generalizing" (Edwards 1). Students often work in cooperative groups with the teacher serving in the role as the facilitator.

Background and Conceptual Framework

Shortly after NCTM released *Curriculum and Evaluation Standards for School Mathematics*, Kansas also developed and adopted mathematics standards mirroring the national standards. The adoption of a standards-based mathematics program in Olathe, Kansas, brought about numerous changes for administrators, teachers, students and parents of middle school aged children.

Olathe is a city in Johnson County, Kansas, located in the northeast part of the state. It is the county seat and the fifth most populous city in Kansas with an estimated population of 118,034 in 2007. In 2008, the United States Census Bureau ranked Olathe the 24th fastest-growing city in the nation (Wikipedia 2). Olathe is a suburb of Kansas City and is the fourth-largest city in the Kansas City metropolitan area. 2008 *CNN/Money* and *Money* magazines ranked Olathe 11th on its list of "100 Best Cities to Live in the United States." According the 2000 Census, the median income for a household in Olathe was $61,111. About 4.1% of the population was below the poverty line. The racial make-up of the city was 88.63% Caucasian, 2.74 % Asian, 3.7% African American, 0.43% Native American, 0.05% Pacific Islander, 3.44% from other races and 5.44% Hispanic. Olathe is home to the Kansas State School for the Deaf and Mid America Nazarene University. It is also home to many companies, including Honeywell, ALDI, Garmin, and Farmer's Insurance Group. The Johnson County Executive Airport, the second-busiest airport in the state, is also located in Olathe (Wikipedia 2).

The Olathe School District has an enrollment of 27,009 students. Olathe has four high schools, eight junior high schools, and 33 elementary schools. District scores of sixth and seventh grade students on the 2006 Kansas Mathematics Assessment are shown in the charts below. (Eighth grade scores are not displayed since eighth grade students were not included in this study.)

Table 1

Olathe District Schools, 2006 Kansas Mathematics Assessment Scores

Grade 6

	Exemplary	Exceeds Standard	Meets Standard	Approaches Standard	Academic Warning	Not Tested
All Students	43.2%	26.5%	18.7%	6.0%	5.1%	0.0%
Economically Disadvantaged	26.1%	25.3%	24.5%	12.8%	10.3%	0.0%
Special Education	17.2%	20.5%	22.7%	17.8%	20.5%	0.0%

(Kansas State Department of Education)

Table 2

Olathe District Schools, 2006 Kansas Mathematics Assessment Scores

Grade 7

	Exemplary	Exceeds Standard	Meets Standard	Approaches Standard	Academic Warning	Not Tested
All Students	23.3%	27.2%	26.2%	15.2%	7.3%	0.0%
Economically Disadvantaged	6.2%	14.4%	32.2%	24.6%	21.0%	0.0%
Special Education	8.1%	12.5%	26.4%	31.2%	20.6%	0.0%

(Kansas State Department of Education)

In sixth grade, 23.1% of economically disadvantaged students scored below "Meets Standard." Only 23.3% of seventh grade students scored in the Exemplary category. 45.6% of economically disadvantaged seventh grade students and 51.8% of special education students scored below "Meets Standard." After researching various programs, the district decided to implement *Connected Mathematics* as a pilot program in an effort to see if this program has a positive effect on the mathematics achievement of sixth, seventh, and eighth grade students in Olathe.

Problem Statement

Kansas schools, teachers and students are now being held accountable for their performance on mathematics assessments through newly adopted state regulations and guidelines. The Kansas Department of Education is holding schools accountable for the collective performance of all students in grades 3-8, as well as grade 10. In addition, accountability includes specific subgroups of students including: African American, American Indian, Asian, Hispanic, Caucasian, low SES, special education and limited English proficient. Accountability for the subgroups is valid for schools with thirty or more students identified in a subgroup.

Adding to pressures to make Adequate Yearly Progress (AYP) as required by the No Child Left Behind Act of 2001, scores are easily accessed by the general public. The Kansas State Department of Education website (http.//online.ksde.org/rcard/) displays a building report card for each school and district in the state. The increase in the importance of student performances on standardized testing programs makes it vital for districts to examine mathematics curriculum and pedagogy in an effort to meet the standards set forth by the state.

Purpose of the Study

The purpose of this study was to describe the effect of *Connected Mathematics Project* on the mathematics achievement of sixth and seventh grade students as compared to similar students receiving mathematics instruction in a traditional mathematics classroom, as measured by the Kansas Mathematics Assessment (KMA). The study focused on 357 students at 5 participating schools. For consistency, eighth grade was not selected as course offerings included algebra and CMP. While there are numerous studies related to the effects of CMP on student achievement, there is a lack of research in the Olathe School District identifying any relationship between the CMP curriculum in grades 6 and 7 and increased KMA performance levels.

Significance of the Study

As educators try to meet the ever-increasing demand for students to demonstrate competence in math as well as in the ability to solve problems, recent reform in mathematics education calls for changes that alter dramatically the way math is being taught in schools (*Curriculum and Evaluation Standards for Mathematics*). However, there is still controversy as to how mathematics instruction should be accomplished. The difference in perspectives is mostly caused by whether the emphasis should be on pure, formal math or applied, real-world math.

The requirements set forth by the No Child Left Behind Act of 2001 have caused schools to make every effort to increase student achievement in mathematics. Low mathematics achievement of middle-school-aged students, especially those who are economically disadvantaged or in special education, motivated this study.

Many questions have been raised about the effects of reform-based mathematics upon student achievement. As Baxter, Olson and Woodward have noted: “An underlying assumption of the reform is that the new mathematics pedagogy and curricula are effective for all students, including low achievers” (530). Research has suggested, however, that the standards adopted by NCTM provide little guidance and modifications for students who are at risk (Baxter, Olson, and Woodward 530).

Since the Olathe School District has invested in the CMP curriculum in three elementary schools and three junior high schools and is considering adoption district wide, it is necessary to determine if continued financial investment in this program is effective in reaching the goal of improved student achievement in mathematics. More specifically, it is vital ,because of a commitment to all students, to determine if this program is positively affecting the mathematics performance of students who are at risk due to low SES or special education because of low test scores of these subgroups in particular. In the context of this study, these two groups continue to evidence an achievement gap in mathematics.

Evaluation results from field test reports as well as state and district reports provided evidence that *Connected Mathematics* positively affects middle school students’ mathematics achievement. However, to date, there are no studies specific to the Olathe School District. There is a need to provide the district with data analysis specific to the student population so decision-makers may determine the merit and value of the program for students in the district identified in this study.

Delimitations

The study was delimited by the researcher in several ways. First, the decision to use a sample of junior high school students from Olathe, Kansas limited the ability to generalize findings outside of this area. Second, the sample was from a public school setting. Those schools enrolled in private school settings may bear different characteristics and, therefore, were not represented by this sample population.

Assumptions

As with any study, there were operating assumptions. This study was based on the assumption the Kansas Mathematics Assessment is a valid and valuable measure of mathematics achievement of junior high school students. The researcher also assumed that all subjects provided reasonable effort.

Research Questions

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

1. What is the effect of the use of *Connected Mathematics* on the mathematics achievement of sixth and seventh grade students as compared to students receiving instruction in a traditional mathematics classroom as measured by the Kansas Mathematics Assessment?
2. What is the effect of the use of *Connected Mathematics* on the mathematics achievement of sixth and seventh grade students of low SES as compared to sixth and seventh grade students of low SES students receiving instruction in a traditional mathematics classroom as measured by the Kansas Mathematics Assessment?
3. What is the effect of the use of *Connected Mathematics* on the mathematics achievement of sixth and seventh grade special education students as compared to sixth and seventh grade special education students receiving instruction in a traditional mathematics classroom as measured by the Kansas Mathematics Assessment?

Definitions of Key Terms

Connected Mathematics Project (CMP): A middle school mathematics curriculum that is standards-based in content as developed by Glenda Lappan, James Fey, William Fitzgerald, Susan Friel, and Elizabeth Phillips of Michigan State University and published by Dale Seymour Publications with support from the National Science Foundation.

Kansas Mathematics Assessment: Starting in the spring of 2006, the revised Kansas Mathematics Standards (2003) are assessed using a revised Kansas Mathematics Assessment designed for all grades, 3^{rd} through 8^{th} plus 10^{th} (KSDE).

Middle School: The term "middle school" is defined as a school comprised of sixth, seventh, and eighth grade students in an academic setting.

National Council of Teachers of Mathematics (NCTM): An international professional association organized for the purpose of promoting mathematics teaching and learning for all students.

No Child Left Behind Act of 2001 (NCLB): Reauthorized the Elementary and Secondary Education Act which is the main federal law affecting public education from kindergarten through high school. According to the United States Department of Education, "NCLB is built on four principles: accountability for results, more choices for parents, greater local control, and doing what works based on scientific research" (1).

Reform Mathematics: Mathematics based on the National Council of Teachers of Mathematics curriculum standards.

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

Overview of the Methodology

The design of this study was an experimental, control group. The treatment variable is the type of mathematics instruction taught in the classroom. Students in the control group received mathematics instruction in a traditional lecture-based setting. The treatment for the experimental group was mathematics instruction using CMP.

Three junior high schools were used in the experimental group. Two comparison junior high schools were used in this study. The demographics for the schools are illustrated in Table 3 and Table 4. This study narrowed the focus to students at risk for disabilities and low SES in response to district scores that evidenced needs specifically in these two subgroups.

Table 3

Demographics of Experimental Schools

School	Total Enrollment	Caucasian	African American	Hispanic	Other Ethnicities	Low SES	Students with Disabilities
A	854	87.12 %	3.28 %	1.41 %	8.20 %	2.34 %	6.2 %
B	619	67.69 %	7.75 %	20.03 %	4.52 %	31.5 %	10.5 %
C	713	87.38 %	3.79 %	3.23 %	5.61%	9.26%	7.3%

(Kansas State Department of Education Report Card 2007-2008 1)

Table 4

Demographics of Comparison Schools

School	**Total Enrollment**	**Caucasian**	**African American**	**Hispanic**	**Other Ethnicities**	**Low SES**	**Students with Disabilities**
D	810	84.57 %	4.69 %	4.69 %	6.05 %	6.3 %	9.9 %
E	572	63.46 %	9.44 %	18.88 %	8.22%	36.71%	14.9%

(Kansas State Department of Education Report Card 2007-2008 1)

The dependent variable, mathematics achievement, was measured using scores obtained from the 2008 Kansas Mathematics Assessment. Student scores on the assessment were reported as percentage scores and performance levels, which provided an adequate measure of student math achievement of seventh grade students participating in the study. Although the Kansas Mathematics Assessment was designed to measure individual student performance, overall performance of student cohorts and selected subgroups of each population were also studied. The Kansas Mathematics Assessment is aligned with the *Kansas State Mathematics Standards* which in turn are aligned with the national mathematics standards developed by the National Council of Teachers of Mathematics. In addition, *Connected Mathematics Project* aligns with the national mathematics standards; therefore, it is assumed that the Kansas Mathematics Assessment is an acceptable measure of the effectiveness of the curriculum to increase student achievement.

For the purposes of analysis, student percentage scores on the seventh grade Kansas Mathematics Assessments were compared with the statistical procedure of analysis of variance to study the effect of *Connected Mathematics* on student achievement. The ninety-five percent confidence level ($p<.05$) is used as the criterion level for determining statistical significance.

Organization of the Study

This study was organized into five chapters. Chapter One contains the introduction and background of the problem, rationale of the study, research questions, significance of the study and definition of terms. Chapter Two presents a review of related literature including history of mathematics education in the United States, *Connected Mathematics*, constructivism, the influence of SES and special education on mathematics achievement. Chapter Three outlines the research design and methodology of the study. Data gathering procedures, instrumentation, and determination of the sample selected for the study are described. In Chapter Four, an analysis of the data and a description of the findings are delineated. Chapter Five presents the summary, conclusions, and recommendations for further analysis. The study concludes with a bibliography and appendixes.

CHAPTER TWO

REVIEW OF THE LITERATURE

Introduction

In 1957, an event occurred that changed the course of mathematics and science education in the United States. The launch of Sputnik created reactions ranging from awe to near-hysteria. Senator Mike Mansfield from North Dakota echoing sentiments of many stated, “What is at stake is nothing less than our survival” (Guillemette 2). Guillemette indicated the United States’ official response to Sputnik was multi-pronged. Curriculums with an emphasis on math and science were quickly established to prepare students for the coming challenges. The National Defense Education Act was enacted to provide hundreds of millions of dollars in student loans, scholarships, fellowships, and the purchase of math and science resources for schools. Expanded support was provided to the National Science Foundation, and the Advanced Research Projects Agency was created (3). That same year, the American Mathematical Society set up the School Mathematics Study Group to develop a new curriculum for high schools (Klein 8).

Some feel the United States is once again at a critical point in history in regards to mathematics and science education. Kraver states, “Today it is China and a host of other emerging countries that are providing the global competitive challenge. K-12 National Assessment for Educational Progress (NAEP) scores have been virtually flat for years. Unfortunately we cannot order up a Sputnik moment whenever we need it” (qtd. in Sutton 1).

In response to the perceived needs in the area of mathematics, President George W. Bush established The National Mathematics Advisory Panel and instructed the Panel to use the best available scientific research to advise on improvements in the mathematics education of the nation's children (Foundations for Success: The Final Report of the National Mathematics Advisory Panel xv). The members of the advisory panel contended:

> "During most of the 20th century, the United States possessed peerless mathematical prowess—not just as measured by the depth and number of the mathematical specialists who practiced here but also by the scale and quality of its engineering, science, and financial leadership, and even by the extent of mathematical education in its broad population. But without substantial and sustained changes to its educational system, the United States will relinquish its leadership in the 21st century" (Foundations for Success: The Final Report of the National Mathematics Advisory Panel xi).

We are at a critical juncture in the area of mathematics education in our country. While the national focus of the past twenty years revolves around reform mathematics based on NCTM's *Standards and Principles*, researchers must take a look at existing curriculum and instructional practices in an effort to assure American students have the opportunity to compete in the global arena of the future. Indeed, each school district must examine current curricular practices and resources if students are to be adequately prepared for the world to come.

Chapter 2 is an overview of the related literature pertinent to this research study. A brief history of mathematics follows with a focus on the evolution of mathematics instruction in the United States and the impact of reform mathematics on student achievement. This section also provides a description of the program *Connected Mathematics* and investigates past studies of this program and their relevance to this study. Mathematics achievement of economically disadvantaged students and students with disabilities is also explored.

History of Mathematics in the Twentieth Century

The debate over the best method for teaching mathematics has been going on for over a century. Under the guidance of John Dewey, progressive education began to dominate American schools early in the 20th century. Dewey believed education was a process throughout life, not a process in preparation for life. He supported and encouraged teachers to adopt a “hands-off” approach. He asserted they should only guide students’ experiences (John Dewey's Philosophy of Education--Associated Content 1). In the 19th century, mathematics education had been quite basic, with instruction emphasizing mainly whole-number operations, fractions, decimals, percents and measurement. Rules were taught followed by an assignment involving the application to a set of problems. Rote memorization was emphasized. Dissatisfaction with the basic content of the curriculum taught in secondary schools prompted mathematics reform.

In 1890, the National Education Association appointed a Committee of Ten on Secondary Schools. The subcommittee investigating mathematics in schools found that both elementary and secondary school mathematics programs were deficient. The Committee of Ten issued a report suggesting work with arithmetic be supplemented with more rigorous content including informal work in algebra and geometry (Senk and Thompson 8). Despite the recommendations of the Committee of Ten, progressive education began to take hold, and mathematics content during the first half of the 20th century continued to focus on arithmetic.

Mathematics education of the early 20th century was greatly influenced by William Heard Kilpatrick, a protégé of John Dewey. Kilpatrick, reflecting mainstream views of progressive education, did not believe the study of mathematics contributed to mental discipline. Like Dewey, Kilpatrick, a professor of education at Teachers College, Columbia University, "urged schools to abandon their traditional passivity for projects that would have a more lasting influence on children by engaging them with wholehearted purpose. Such projects could range from producing a newspaper, to organizing a play, to solving a geometry problem" (Olson 4). Kilpatrick proposed the study of algebra and geometry for the most part be discontinued in high school. Kilpatrick regarded mathematics as detrimental rather than helpful to the type of thinking necessary for ordinary living (Klein 3). In 1925, Kilpatrick's book, *Foundations of Method*, became a standard text for teacher education courses across the country (Klein 3). Kilpatrick's style of mathematics education was prevalent from the 1920s until the 1950s when the popularity of progressive education greatly declined. Unfortunately, during this time the number of high school students taking algebra and geometry decreased significantly.

Mathematics education began to move away from the progressivist doctrine in the early 1950s, but mathematics reform did not truly come until after the launch of Sputnik in October of 1957. Americans became panicked at the thought of possible domination by the Soviets. The demand was made for more rigorous mathematics and science training in the schools. Congress responded by passing the National Defense Act in 1958 which provided government funding to attract students to mathematics, science and engineering courses. This was the beginning of the New Math movement (U.S. Department of Education).

New Math was aimed at developing student understanding through mathematical structure and a focus on abstractions, appealing to students' intellect. Meaning was imposed out of the structure of mathematics (Cook 2). New Math emphasized abstract concepts such as set theory and number bases other than 10 and stressed these concepts should be introduced early on in students' mathematics education. Test scores in mathematics increased from 1957 through 1963 but then began to decline and continued that decline through the 1960s and early 1970s. In 1974, results of the

National Assessment of 1972 were published and showed that students were not performing as desired. The *Wall Street Journal* reported that New Math had failed (Usiskin 7). New Math was dead and there was a call to go back to the basics.

In the early 1970s, a movement that emphasized computation and algebra developed in reaction to New Math. Textbooks written by advocates of the "back-to-basics" movement had "few references to mathematical principles, very little to read, and thousands of exercises to practice skills. There were virtually no problems showing how mathematics was used in daily life or other fields, and no challenging problems in these texts" (Senk and Thompson 9).

In response to the continued debate surrounding mathematics education, the National Assessment for Educational Progress (NAEP) was initiated by the United States Congress. The goal was to gather information about student achievement in mathematics and to update citizens about the nature of students' comprehension of the subject, curriculum specialists about the level and makeup of student achievement, and policymakers about aspects related to schooling and its relationship to student proficiency in mathematics (National Assessment Governing Board 1). Poor student performance on the initial assessment in 1972 created even further criticism of mathematics education in the United States. During the 1970s, standardized test scores continued to steadily decrease and bottomed out in the early 1980s (Klein 10).

In 1977, the National Council of Supervisors of Mathematics called for a revision of the definition of basic mathematical skills. A report was issued suggesting problem solving, mathematical applications, number sense, geometry, and data analysis be included in the broader definition. In 1980, this was followed by *An Agenda for Action*, a report published by the National Council of Teachers of Mathematics which called for similar changes in mathematics curricula (Senk and Thompson 9).

In 1983, the next wave of educational reform was initiated by a document issued by The National Commission on Education called "A Nation at Risk" (Amrein and Berliner 4). This report claimed that our nation was falling behind the rest of the world in education. The report suggested states develop and implement sets of standards to improve curricula and implement assessments for the mastery of these standards in an effort to hold schools accountable. This report caused a major shift of focus upon the educational system, and it was at this time that The National Council of Teachers of Mathematics began to lead the way in attempting to reform mathematics curriculum and instruction.

During the twentieth century, mathematics education in the United States experienced many evolutions leading up to the Reform Movement in the 1990s. The ebb and flow of mathematics education and reform during the twentieth century illustrates the fact that no single curriculum or method of teaching mathematics has yet proven to be the perfect solution in helping all students become truly proficient in the area of mathematics.

Reform Mathematics

In 1989, NCTM published *Curriculum and Evaluation Standards for School Mathematics*, a document with proposed guidelines for improving mathematics education in grades K-12. Establishing a framework to guide reform in school mathematics, the NCTM document represented a consensus of NCTM's members about the essential content that should be incorporated in the school mathematics curriculum. Inherent is the idea that all students need to learn more, and often different, mathematics (Suydam 5). The *Curriculum and Evaluation Standards for School Mathematics,* often just referred to as the *Standards,* represented an effort to develop mathematically literate students. The *Standards* were intended "to ensure quality, to indicate goals, and to promote change" (*Curriculum and Evaluation Standards for School Mathematics* 2). The document focused on the need to provide all students with "opportunities to share the new vision of mathematics and to learn in ways consistent with it" (*Curriculum and Evaluation Standards for School Mathematics* 6). Several assumptions were inherent in the vision of the *Standards*:

"(1) Mathematical power can and must be at the command of all students in a technological society.

(2) Mathematics is something one DOES—solve problems, communicate, reason; it is not a spectator sport.

(3) The learning of mathematics is an active process, with student knowledge derived from meaningful experiences and real problems.

(4) A curriculum for all includes a broad range of content, a variety of contexts,

and deliberate connections.

(5) Evaluation is a means of improving instruction and the whole mathematics program" (Suydam 6).

The *Curriculum and Evaluation Standards* became widely accepted and greatly influenced mathematics curriculum across the nation. The *Standards* were followed by the *NCTM Teaching Standards* in 1991 and the *NCTM Assessment Standards* in 1995. The *NCTM Teaching Standards* added information on best practices for teaching mathematics and the *NCTM Assessment Standards* focused on the best use of assessment methods. Wilson contended that "collectively these standards advocated methods that emphasized mathematical power: conceptual understanding, problem solving, reasoning, connection building, communicating, and self-confidence developing" (1).

Mathematics instruction based on recommendations in NCTM's three sets of *Standards* came to be known as reform mathematics or standards-based mathematics. After the release of NCTM's *Curriculum and Evaluation Standards*, many states began to develop and modify their own standards and curriculum framework in an effort to more closely align with the ideas behind reform mathematics. The National Science Foundation also began to initiate systematic reforms of mathematics education with the *Curriculum and Evaluation Standards* cited as the curriculum framework to be promoted. Senk and Thompson indicate that by 1991, NSF had issued calls for proposals that would produce comprehensive instructional materials for elementary, middle, and high schools coherent with the calls for change in *Curriculum and Evaluation Standards* and other key policy reports. Ultimately NSF funded more than a dozen projects to develop reform-based instructional materials in mathematics (14). During the decade of the 1990s, NSF sponsored the creation of the following mathematics programs:

Table 5

Program Title	School Level	Grade Levels
Everyday Mathematics	Elementary	K-6
TERC's Investigations in Number, Data, and Space	Elementary	K-5
Math Trailblazers (TIMS)	Elementary	K-5
Connected Mathematics	Middle School	6-8
Mathematics in Context	Middle School	5-8
MathScape: Seeing and Thinking Mathematically	Middle School	6-8
MATHThematics (STEM)	Middle School	6-8
Pathways to Algebra and Geometry	Middle School	6-7 or 7-8
Contemporary Mathematics in Context (Core-Plus Mathematics Project)	High School	9-12
Interactive Mathematics Program	High School	9-12
MATH Connections: A secondary Mathematics Core Curriculum	High School	9-11
Mathematics: Modeling Our World (ARISE)	High School	9-12
SIMMS Integrated Mathematics: A Modeling Approach Using Technology	High School	9-12

(Klein 17)

The NSF sponsored curricula were created and tested over a 4 to 6 year time period by a large team of developers that included instructors from both K-12 schools and university representatives. Each project team developed their own process of writing, research design including validity and reliability criteria, piloting and field-testing. In addition, each team secured a commercial publishing company to market and publish the material. The reform curricula placed greater emphasis on providing problem sets with more realistic content and fewer problems than more traditional mathematics texts. In addition, fewer problems requiring only rote memorization or simple arithmetic computation were presented. Calculator and computer use were required where the use of technology was rarely mentioned in traditional textbooks. The standards-based and traditional curricula also differed in the delivery of material. In the standards-based curricula, students often worked in small groups to find solutions using a variety of strategies and techniques. In contrast, the traditional curricula most often required the teacher to demonstrate an algorithm while students worked independently to memorize and reproduce the method (Senk and Thompson 15).

Although there were gains made in the 1990s, data obtained from the 1995 Third International Mathematics and Science Study (TIMSS) indicated the performance of U.S. students was still below the desired level (Findell, Kilpatrick and Swafford 4). The 1999 TIMSS Video Study brought further evidence that mathematics education in the United States had deficiencies when compared to high-achieving countries. Students in the United States practiced procedures demonstrated by the teacher while students in Japan and Germany worked on problems that required advanced solution techniques.

Teachers in Japan and Germany guided, through questioning, the process of problem solving, complex concepts and inductive reasoning exercises, which are often quite challenging (Findell, Kilpatrick and Swafford 49). The TIMMS study also found that the United States curriculum contained superficial coverage of topics that were repeated year after year while the curriculum in high-achieving countries tended to cover fewer topics in more depth. The high-achieving countries spent more time working on new content rather than reviewing concepts previously covered (Findell, Kilpatrick and Swafford 50).

In 1999, thirty-eight countries including the United States participated in TIMSS 1999 (also known as TIMSS-Repeat or TIMSS-R). The TIMSS results showed little change in eighth-grade mathematics achievement between 1995 and 1999. In 1999, the U.S. performed significantly above the TIMSS international average but about in the middle of the achievement distribution (above 17 countries, similar to 6, and below 14). Singapore, the Republic of Korea, Chinese Taipei, and Hong Kong SAR had the highest average performances (TIMSS 1999 2).

The TIMSS National Research Center indicated the TIMSS and TIMSS-R had important implications for mathematics education in the U.S. and suggested: "(a) Providing better preservice and inservice opportunities to enhance teacher knowledge of mathematics and science; (b) Improving the consistency and focus curricula; (c) Increasing opportunities for teachers to interact within and across subject areas; (d) Aligning national standards, curriculum frameworks, instructional methods, and assessment practices; (e) Eliminating tracking; and (f) Encouraging policy changes that will support improved curriculum and instruction" (Haury, Green and Herman 4).

NCTM, partially in response to data obtained from TIMSS in 1995, decided to revise its *Standards* (Findell, Kilpatrick and Swafford 35). In 1995 NCTM's Board of Directors appointed the Commission on the Future of the Standards to recommend how NCTM should proceed in updating the existing *Standards* document. Collections of curriculum material, state and provincial curriculum documents, research publications, policy documents, and international frameworks and curriculum materials were studied. Association Review Groups, a set of "white papers" commissioned by NCTM's Research Advisory Committee, and conferences sponsored by NSF and the Eisenhower National Clearinghouse furnished additional input. Based on the research and input, the Writing Group substantially revised the document and the resulting book, *Principles and Standards for School Mathematics* (*PSSM*), was released in 2000 (National Council of Teachers of Mathematics 2). The *PSSM* replaced the three prior publications of NCTM: *Curriculum and Evaluation Standards for School Mathematics* (1989), *Professional Standards for Teaching Mathematics* (1991), and *Assessment Standards for School Mathematics* (1995).

The *Principles and Standards for School Mathematics* established foundations for programs in mathematics by considering the issues of equity, curriculum, teaching, learning, assessment, and technology. The first five standards in *PSSM* presented goals in the mathematical content areas of number and operations, algebra, geometry, measurement, and data analysis and probability. The second five standards address the processes of problem solving, reasoning and proof, connections, communication, and representation. The ten standards are separated in four grade-band chapters: prekindergarten through grade 2, grades 3-5, grades 6-8, and grades 9-1 (NCTM 2).

While *Principles and Standards for School Mathematics* has been championed and supported by many mathematicians, teachers, and administrators as raising standards for students, it has also received criticism from some groups including mathematicians and parents. Since the inception of the reform-based curricula, the effectiveness of such an approach to mathematics education has been disputed. The debates have become so heated they are now referred to as the "Math Wars" (Klein 22). According to Schoen, Fey, Hirsch and Coxford, "what seemed to be an overwhelming national consensus on directions for change in mathematics education is now facing passionate resistance from some dissenting mathematicians, teachers, and other citizens. Wide dissemination of the criticisms through reports in the media, through Internet mailings, and through debates in the meetings and journals of mathematics professional societies – has shaken public confidence in the reform process" (444). Many opposing reform mathematics complained about a decreased focus on basic computation skills and confusion created by an emphasis on exploration and explanation. Some parent groups called for a tighter focus on basic mathematics skills and an end to "mile wide, inch deep" state standards that force schools to teach numerous math topics in each grade (Lewin 1). Some states including Washington and California revised state mathematics standards in response to the pressure of the anti-reform groups as well as lagging test scores (Cohen 297).

On November 18, 1999, the *Washington Post* published the "Open Letter" sent to the U.S. Education Secretary, Richard Riley, from more than 200 mathematicians and prominent individuals. The "Open Letter" called for the withdrawal of the U.S. Department of Education's recommendations of the following "exemplary" or "promising" mathematics programs: *Cognitive Tutor Algebra, College Preparatory Mathematics, Connected Mathematics Project, Core-Plus Mathematics Project, Interactive Mathematics Program, Everyday Mathematics, MathLand, Middle-School Mathematics through Applications Project, Number Power* and *The University of Chicago School Mathematics Project* (Klein 34-35). In response, John A. Thorpe, Executive Director of NCTM, responded with a letter also addressed to Secretary Riley. Thorpe stated, "We are deeply disappointed that so many eminent and well-intentioned mathematicians and scientists have chosen to attack the work of the Panel. We note, however, that the advertisement represents the opinion of a small, but vocal, minority of mathematicians and scientists, many of whom have little direct knowledge of the elementary and secondary school mathematics curriculum nor how to make it responsive to the needs of all students" (Klein 40).

While the "Math Wars" have created heated debate, some people have called for a balance between reform and traditional mathematics teaching styles. In an address at the 77th NCTM Annual Convention, John A. Van de Walle stated, "On one side are those who fervently believe children need to learn 'the basics.' On the other side are those who believe or think they believe in the message of the *Standards*…these two positions, reform and the basics, are not opposite ends of the same continuum. On one hand, the basics tend to be about content, specifically about the content that was common when today's adults were in school. On the other hand, reform is much more about how children learn and how to achieve the content goals one desires" (2). Van de Walle went on to suggest that both sides have made mistakes. Those pushing for the basics have taken some extreme positions. He contends in California, the skills recommended are not always appropriate for the grade levels suggested nor reflective of today's societal needs to be able to apply mathematics within the real world. On the other hand, the reformers are guilty of misguided emphases. By praising the values of calculators and complaining about tedious computations some of the valid content objectives have been avoided. Basic facts are essential and all children need to be able to compute (2).

As debate concerning mathematics education continued, in 2006, NCTM issued a document, entitled *Curriculum Focal Points,* that presented critical topics and a more concise set of goals and objectives at each grade level from kindergarten through grade 8. The *Curriculum Focal Points* (CFP) offer "a focused framework to guide states and school districts as they design and organize revisions of their expectations, curricular standards and assessments" (Curriculum Focal Points for Prekindergarten through Grade 8 Mathematics 1). The CFP were perceived by some members of the press to be an admission that recommendations from *Principles and Standards of School*

Mathematics had reduced or even omitted instruction in traditional arithmetic facts and procedures. *The Chicago Sun Times, The Wall Street Journal, San Francisco Chronicle* and *New York Times* all ran articles giving credence to this thought (Hechinger A1; Saunders B7; Lewin 1). Skip Fennell, President of NCTM refuted the ideas presented in such articles. In response to Hechinger's "New Report Urges Return to Basics in Teaching Math," Fennel states, "Contrary to the impression left in your article, learning the basics is certainly not new marching orders from the NCTM, which has always considered the basic computation facts and related work with operations to be important. Nor is the new focal-points approach to curriculum development a remarkable reversal for NCTM…conceptual understanding and problem solving are absolutely fundamental to learning mathematics. The council has never promoted estimation rather than precise answers. Estimation is a critical component to the overall understanding and use of numbers" (Fennell A1). NCTM ascertained that *Curriculum Focal Points* was not a reversal of its position on teaching but rather the "next step in devising resources to support the development of a coherent curriculum" (Curriculum Focal Points for Prekindergarten through Grade 8 Mathematics 1).

In 2007, 59 countries participated in TIMSS 2007. While measuring trends from the three earlier cycles of TIMSS, this study provided information about the educational context and current achievement of students in 2007 (Mullis and Martin 1). At the fourth grade, more countries showed improvement in 2007 than declines. Continued improvement since the first TIMSS in 1995 was shown by high-achieving Hong Kong SAR and Singapore, medium-achieving countries such as England, The United States and

Slovenia, and lower-achieving countries such as El Salvador and Tunisia (TIMSS 2007 3). The pattern was less pronounced at the eighth grade, but the United States did show improvements. In mathematics, students from Singapore, Chinese Taipei, Hong Kong SAR, Japan and Korea performed highest. There was a substantial gap in mathematics achievement between the five Asian countries and the next group of four similarly performing countries, including Hungary, the Russian Federation, England and the United States (TIMSS 2007 3).

The TIMSS studies continually show Asian countries outperforming the United States. These results cause continued debate regarding quality curriculum in mathematics education. In a study by the National Research Center-TIMSS at Michigan State University and funded by the National Science Foundation, curriculum of the six leading TIMSS math countries were assumed to be far superior to the curriculum of the typical U.S. state as indicated by the difference in scores. Due to cultural differences, however, the researchers doubted that a quality Asian curriculum could be successfully implanted in the United States (Schmidt, Houang and Cogan 2). Bishop and Hook published a longitudinal study comparing "direct instruction curricula with 'constructivist' curricula" (Chat Archive: Skip Fennell 2). The study took place over a five-year time period (1998-2002) and compared scores of California students in districts using Saxon Math (text used by some of the high-achieving Asian countries) to those of students in control districts which continued using the 1991 curriculum and textbooks. Performance of the districts using Saxon was found to be statistically superior to the control districts. Furthermore, these results were achieved by school districts with high percentages of economically disadvantaged and English learning immigrant students as well as by a more affluent suburban district. Virtually no special teacher training was required to achieve the results (Bishop and Hook 125-126).

Proponents of reform mathematics still believe standards-based curricula provide a powerful means for teaching mathematics, but contend that teachers who believe skills are learned through repeated practice are sometimes tempted to supplement a standards-based program with unrelated skills practice. Since one of the characteristics of standards-based learning is coherence, it is imperative teachers use the intended curriculum; otherwise, students are at an unintended disadvantage (Urquart et. al 45).

In April 2006, President George W. Bush created the National Mathematics Advisory Panel (NMAP), with the responsibilities of "relying upon the best available scientific evidence and recommending ways…to foster greater knowledge of and improved performance in mathematics among American students" (Foundations for Success: The Final Report of the National Mathematics Advisory Panel xiii). In its final report, the National Mathematics Advisory Panel asserts that international and domestic comparisons indicate American students have not been succeeding in mathematics at a level expected of an international leader. In fact, American students achieve at a mediocre level by comparison to world peers. On the National Assessment of Educational Progress (NAEP) there are positive trends of scores at Grades 4 and 8, which have just reached historic highs. While this signifies noteworthy progress, other results from NAEP are less positive: 32% of our students are at or above "proficient" level in

Grade 8, but only 23% are proficient at Grade 12 (Foundations for Success: The Final Report of the National Mathematics Advisory Panel xii).

In looking at curricula in mathematics, the Panel noticed two major differences between the curricula in top-performing countries and those in the United States—the number of topics presented at each grade level and expectations for learning. Curricula in the United States typically include many topics at each grade level with limited development while fewer topics are presented in greater depth in high-achieving countries. In addition, more review of previously learned material at successive grade levels occur in the U. S. while top-performing countries are likely to expect closure after exposure and development of a topic. These differences are critical and distinguish a spiral curriculum from one built on developing proficiency (Foundations for Success: The Final Report of the National Mathematics Advisory Panel 20-21). The Panel recommended "A focused, coherent progression of mathematics learning, with an emphasis on proficiency with key topics, should become the norm in elementary and middle school mathematics curricula. Any approach that continually revisits topics year after year without closure is to be avoided" (Foundations for Success: The Final Report of the National Mathematics Advisory Panel 22).

The Panel also addressed instructional practices and noted a controversial issue in the field of mathematics is whether instruction should be more teacher directed or more student centered. Typically, traditional mathematics programs have been more teacher directed and reform-based mathematics programs more student centered.

Only eight studies addressing the issue were found that met standards for quality. The studies presented a mixed and inconclusive picture of the relative effect of the two instructional approaches. As a result, the Panel recommended: “All-encompassing recommendations that instruction should be entirely “student centered” or “teacher directed” are not supported by research. If such recommendations exist, they should be rescinded. If they are being considered, they should be avoided. High-quality research does not support the exclusive use of either approach” (National Mathematics Advisory Panel 45).

Reform mathematics began with the publishing of NCTM’s *Curriculum and Evaluation Standards for School Mathematics*. This document became the standard by which reform was to be measured in the 1990s. Curriculum developed with the *Standards* as a guideline became predominant throughout the United States. While gains were made on TIMSS and NAEP, American children continued to fall behind Asian countries in mathematics achievement. Many called for a return to more traditional mathematics instruction. While a body of research support standards-based instruction, controversy still exists with some new studies indicating reform may still be needed.

Connected Mathematics Project

One reform-based program that has been a part of the controversy in mathematics education is the *Connected Mathematics Project* (CMP). CMP is a standards-based, problem-centered curriculum designed for students in grades 6, 7, and 8. It began as a

National Science Foundation grant project (1991-1996), which was developed at Michigan State University by five university faculty members. NSF again provided funding (2000-2006) and revisions were made to the original project. The revised program is sometimes referred to as CMP2. According to information on the *Connected Mathematics* Home Page, CMP "helps students and teachers develop understanding of important mathematical concepts, skills, procedures, and ways of thinking and reasoning, in number, geometry, measurement, algebra, probability and statistics" (1). Based on research, CMP was field-tested across the country with 45,000 students and 390 teachers. The overarching goal of the *Connected Mathematics Project* is: "All students should be able to reason and communicate proficiently in mathematics. They should have knowledge of and skill in the use of the vocabulary, forms of representation, materials, tools, techniques, and intellectual methods of the discipline of mathematics, including the ability to define and solve problems with reason, insight, inventiveness and proficiency" (Connected Mathematics).

CMP emphasizes connections among various mathematical concepts and between mathematics and other disciplines. Information is provided using numeric, symbolic, graphic and written forms to assist students with reasoning and flexibility in moving among the various representations. Instructional methods promote the use of inquiry and problem solving with instruction consisting of three phases: launching, exploring and summarizing the problem (K-12 Mathematics Curriculum Summaries 12). Students often work in small groups in a collaborative effort to explore mathematical problems and ideas. The teacher serves in more of the role of facilitator, guiding students to their own discovery of an idea or concept. Students are encouraged to verbalize and explain their thinking, in an effort to promote greater understanding and the retention of mathematical ideas.

The material is organized into 24 sequenced units with each unit containing three to five investigations. The investigations provide one to five major problems for students to explore. Problem sets are entitled Application, Connections and Extensions (ACE) and are designed to assist students to practice, apply, connect, and extend understandings. Investigations culminate in Mathematical Reflections intended to help students connect mathematical ideas and applications (K-12 Mathematics Curriculum Center 12). The following table provides a brief description of CMP units:

Table 6

6th Grade	7th Grade	8th Grade
Prime Time Factors and Multiples number theory, including factors, multiples, primes, composites, prime factorization	*Variables and Patterns* Introducing Algebra variables; representations of relationships, including tables, graphs, words, and symbols	*Thinking With Mathematical Models* Linear and Inverse Variation introduction to functions and modeling; finding the equation of a line; inverse functions; inequalities
Bits and Pieces I Understanding Rational Numbers move among fractions, decimals, and percents; compare and order rational numbers; equivalence	*Stretching and Shrinking* Similarity similar figures; scale factors; side length ratios; basic similarity transformations and their algebraic rules	*Looking for Pythagoras* The Pythagorean Theorem square roots; the Pythagorean Theorem; connections among coordinates, slope, distance, and area distances in the plane
Shapes and Designs Two-Dimensional Geometry regular and non-regular polygons, special properties of triangles and quadrilaterals, angle measure, angle sums, tiling, the triangle inequality	*Comparing and Scaling* Ratio, Proportion, and Percent rates and ratios; making comparisons; proportional reasoning; solving proportions	*Growing, Growing, Growing* Exponential Relationships recognize and represent exponential growth and decay in tables, graphs, words, and symbols; rules of exponents; scientific notation
Bits and Pieces II Understanding Fraction Operations understanding and skill with addition, subtraction, multiplication, and division of fractions	*Accentuate the Negative* Positive and Negative Numbers understanding and modeling positive and negative integers and rational numbers; operations; order of operations; distributive property; four-quadrant graphing	*Frogs, Fleas and Painted Cubes* Quadratic Relationships recognize and represent quadratic functions in tables, graphs, words and symbols; factor simple quadratic expressions
Covering and Surrounding Two-Dimensional Measurement area and perimeter relationships, including minima and maxima; area and perimeter of polygons and circles, including formulas	*Moving Straight Ahead* Linear Relationships recognize and represent linear relationships in tables, graphs, words, and symbols; solve linear equations; slope	*Kaleidoscopes, Hub Caps and Mirrors* Symmetry and Transformations symmetries of designs, symmetry transformations, congruence, congruence rules for triangles
Bits and Pieces III Computing with Decimals and Percents understanding and skill with addition, subtraction, multiplication, and division of decimals, solving percent problems	*Filling and Wrapping* Three-Dimensional Measurement spatial visualization, volume and surface area of various solids, volume and surface area relationship	*Say It With Symbols* Making Sense of Symbols equivalent expressions, substitute and combine expressions, solve quadratic equations, the quadratic formula
How Likely Is It? Probability reason about uncertainty, calculate experimental and theoretical probabilities, equally-likely and non-equally-likely outcomes	*What Do You Expect?* Probability and Expected Value expected value, probabilities of two-stage outcomes	*Shapes of Algebra* Linear Systems and Inequalities coordinate geometry, solve inequalities, standard form of linear equations, solve systems of linear equations and linear equalities
Data About Us Statistics formulate questions; gather, organize, represent, and analyze data; interpret results from data; measures of center and range	*Data Distributions* Describing Variability and Comparing Groups Measures of center, variability in data, comparing distributions of equal and unequal sizes	*Samples and Populations* Data and Statistics use samples to reason about populations and make predictions, compare samples and sample distributions, relationships among attributes in data sets

(Contents in Brief by Unit 1-2)

A Teacher's Guide and student book is provided for each of the units. All pages in the student book are included in the Teacher's Guide as well as additional problems, various types of assessments, samples of student work, articulation information for the instructor, black line masters and form letters to parents (Adams, Tung, Warfield, Knaub, Mufavanhu, and Yong B-2). According to Adams, et al. the "Teaching the Investigation" sections are "the heart of the CMP curriculum. They give the teacher guidance on how to teach the lesson, an explanation of the mathematics in the lesson, and specific questions to ask students to make sure the important mathematical points are brought out during class…even though CMP provides enough guidance to support a novice teacher, an experienced teacher can use his or her own creativity to supplement lessons and to meet the individual needs of students" (B-2).

Connected Mathematics has been criticized by advocates of traditional mathematics as being ineffective and incomplete. In 1996, Plano Independent School District began piloting *Connected Math* in four of its nine middle schools. Parents sued the school district seeking an alternative mathematics program that was more conventional. In May, 2000, a federal judge ruled that Plano School District could not be forced to offer an alternative to *Connected Mathematics* based on parent objections (Klein 27). Hoff describes textbook reviews conducted by the American Association for the Advancement of Science (AAAS) and Mathematically Correct, a parent group opposed to national innovations in mathematics. The AAAS and Mathematically Correct reached opposite conclusions about the quality of *Connected Mathematics.* AAAS gave

Connected Mathematics its highest grade; Mathematically Correct said it was impossible to recommend this textbook (3).

Proponents of reform mathematics have given *Connected Mathematics* high marks. In 1999, the United States Department of Education announced that CMP was one of five curricula to achieve exemplary status. Out of 61 programs reviewed, only 5 were selected to receive the highest recognition of "exemplary," and CMP was the only middle school program identified for that status. Assistant Secretary Kent McGuire indicated the exemplary programs met the highest standards set by the nation's leading mathematics experts and educators (Thomas 1). The American Association for the Advancement of Science (AAAS) rated CMP highest of twelve middle school mathematics curricula in Project 2061's evaluation of textbooks. Project 2061, founded in 1985, is a long-term AAAS initiative to advance literacy in science, mathematics and technology. Curricula examined in this study were: *Connected Mathematics, Mathematics in Context, MathScape, Middle Grades MathThematics, Mathematics Plus, Middle School Mathematics, Math Advantage, Heath Passport, Heath Mathematics Connections, Transition Mathematics, Mathematics: Applications and Connections,* and *Middle Grades Math*. "This study probed beyond a superficial analysis of alignment by topic heading and examined each text's quality of instruction aimed specifically at key standards and benchmarks, using criteria drawn from the best available research about what helps students learn" (Roseman, Kulm and Shuttleworth 2). *Connected Mathematics* was also awarded one of the first annual "Eddies" for excellence in design by the International Society of Design and Development in Education (ISDDE). ISDDE stated that “Lappan and Phillips employed a development process that was the epitome of good engineering, with substantial feedback (including, for example, video of the entire lesson sequence) from three rounds of field trials. The consultation with teachers and others was thorough, the trade-offs inevitable in any design were judged shrewdly, so that *Connected Mathematics* has had a systemic positive impact on U. S. middle school mathematics teaching and learning” (ISDDE 2008 Prize for Excellence in Educational Design 2).

Various studies have been conducted in an effort to determine the effectiveness of *Connected Mathematics* on impacting student learning. Ridgway, Zawojewski, Hoover and Lambdin compared the mathematics performance of students in CMP schools with the non-CMP schools in a large-scale study. The study included 500 students in 6th grade, 861 students in 7th grade, and 1,095 students in 8th grade. The Iowa Test of Basic Skills (ITBS) and the Balanced Assessment (BA) were administered as pretests and posttests. The CMP and the non-CMP schools were reported to be matched as closely as possible on diversity, student ability grouping and geographical location. The study had mixed findings. There was a positive statistically significant effect in grades 6, 7 and 8 on the BA. The CMP students gained differentially more than students not using CMP. On the ITBS, there was a statistically negative effect of CMP on students in grade 6. Student scores in the comparison group showed a higher gain than the CMP students. Results in the 7th and 8th grade were nonsignificant (Ridgway et al.).

In another study that involved 50 schools, Riordan and Noyce found 8th grade students scored higher than comparison students using traditional texts on the 1999 Massachusetts Comprehensive Assessment System (368). The researchers contend "this study supports the notion held by proponents of standards-based curriculum, that curriculum itself can make a significant contribution to improving student learning" (Riordan and Noyce 393). In the U.S. Department of Education's Institute of Education Science's *What Works Clearinghouse(WWC)*, a detailed report of this study is provided. The WWC report states, "Riordan and Noyce report that the schools that had the CMP curriculum…had greater gains…but do not indicate whether this difference was statistically significant. Riordan and Noyce compared performance across four mathematics topics covered by the outcome measure and found that the students in CMP schools scored significantly higher in all of these areas. Caution must be taken when considering these results because the sample comprises relatively advantaged schools and there may have been variations in the way that the CMP curriculum was implemented across the schools" (U.S. Department of Education's Institute of Education Sciences 2).

Another study that has been used to support the positive results of CMP compared the effects of reform-based CMP on student achievement. Cain conducted a study of *Connected Mathematics* in Lafayette Parish, Louisiana that included nine middle schools, of which four were fully implementing CMP with the others in various stages of implementation. Test scores from the ITBS and the Louisiana Education Assessment Program were analyzed. The CMP schools significantly outperformed the non-CMP schools on both standardized tests. The CMP total mathematics percentage score was 10% higher than the parish average at the 6th grade level and 7% higher than the parish average at the 7th grade level (Cain 224-235).

A study by Schneider focuses on three cohort groups in Texas participating in a pilot of CMP. 42 schools were in Cohort 1, 38 schools were in Cohort 2, and 36 schools were in Cohort 3. Student achievement was measured using scores from the Texas Assessment of Academic Skills. CMP students in one cohort scored higher than comparison students, but the two other CMP cohorts scored lower than comparison students. Neither of these findings was statistically significant (503).

A study by Reys, Reys, Lapan, Holliday and Wasman compared the mathematics achievement of eighth graders in the first three school districts in Missouri to adopt NSF-funded curriculum, specifically *Connected Mathematics* or *MathThematics*. The mathematics portion of the Missouri Assessment Program was used to measure student achievement. Significant differences in achievement were identified between students using NSF-funded curriculum for at least 2 years and students from comparison districts using other curricula. Students using the standards-based materials scored significantly higher in data analysis and algebra (74).

In another study, Reys, Reys, Tarr and Chavez from the University of Missouri conducted a three-year research project called the Middle School Mathematics Study. The purpose was to investigate the use of mathematics textbooks in the middle grades and their impact on student learning. More specifically it examined the impact of three

NSF funded standards-based curricula, *Connected Mathematics, MathThematics*, and *Mathematics in Context*, on a diverse group of middle school students. Schools in 6 states participated in the study, representing urban, suburban, small city and rural communities. The study monitored the mathematics achievement of middle grade students over a two-year time period. Achievement was measured using the CTB/McGraw-Hill Balanced Assessment in Mathematics (BAM) and the Terra Nova Survey (TNS). It also focused on how teachers utilized district-adopted textbooks and other curricular sources (3-4).

"Using the BAM standardized test as the dependent variable, the main effect of a Standards-Based Learning Environment (SBLE) was found to be statistically significant in Cohort 2 but not in Cohort 1. Using the Terra Nova standardized test as the dependent variable, the main effect of a SBLE with prior achievement as a covariate was not statistically significant in either cohort" (Reys, et al. 11). Students using the NSF mathematics curricula that were taught using standards-based instruction were the highest performing students (Reys et al. 4).

Jansen examined the self-reported motivational beliefs and goals supporting the participation of seventh graders in whole-class discussions in CMP classrooms. "Students with constraining beliefs were more likely to participate to meet goals of helping their classmates or behaving appropriately, whereas students with beliefs supporting participation were more likely to participate to demonstrate their competence and complete their work. Results illustrated how the experiences of middle school students in discussion-oriented mathematics classrooms involve navigating social relationships as much as participating in opportunities to learn mathematics (Jansen 409).

Another study examined the three-year effect of CMP on the mathematics achievement of middle school students in a southwestern Tennessee public school district. Mathematics achievement of eighth graders completing three years of CMP was compared to their mathematics achievement after completing one and two years of CMP. Scores were measured using the Tennessee Comprehensive Assessment Program mathematics battery. Results indicated no significant difference between the mathematics achievement of students completing one or two years of CMP. However, a significant difference did occur in the achievement of students completing three years as compared to their mathematics after one and two years (Bray iv-v).

Numerous studies have been conducted using CMP with mixed results. Many studies report an increase in student achievement of students in CMP classrooms. Other studies find no statistically significant differences in achievement of students in CMP classrooms from students in non-CMP classrooms. Some studies indicate students using other curriculum score higher. Many factors may play a part in the discrepancies of these findings. Studies using assessment measures more closely aligned with the *Standards* may indicate more positive effects than studies using measurement tools designed to test concepts presented in more traditional mathematics classrooms. Quality of curriculum used in comparison groups may also affect outcomes. In some studies, control of all variables seems to be in question. Continued research on the effects of CMP on student achievement is needed. This is also true when looking at specific populations of students. Federal and state guidelines require success for all, and continued research as to the effects of CMP on subgroups established under NCLB should also be a focus.

Mathematics Education of Students of Low SES

The No *Child Left Behind Act of 2001* (NCLB) mandates that the total school as well as all subgroups meet Adequate Yearly Progress (AYP). These groups are "students who (1) are economically disadvantaged, (2) are part of a racial or ethnic group that represents a significant proportion of a school's student population, (3) have disabilities, or (4) have limited English proficiency" (United States Government Accountability Office 8). In order to make AYP, each school must show that each subgroup met the state proficiency goals for both math and reading. This can be a challenging goal for schools, especially those in high-poverty areas. According to Balfanz and Byrnes, students who are falling behind in mathematics come predominantly from high-poverty and high-minority areas. The onset of adolescence, combined with concentrated inter-generational poverty, creates its own set of risk factors (143).

The National Assessment of Educational Progress gathers background information on students, teachers, and schools, "permitting analysis of student achievement relative to the poverty level of public schools, measured as the percentage of students eligible for free or reduced-price lunch through the National School Lunch Program" (National Center for Education Statistics 1). NAEP indicates that the mathematics performance of students in high-poverty public schools is lower than that of peers in low-poverty public schools. This negative relationship between school-level poverty and average achievement in mathematics occurs when performance of students eligible for the school lunch program are considered separately from that of other students. For example, "the achievement gap between the average scores of 4th graders in the lowest and the highest poverty schools was 20 points among those eligible for the school lunch program, and 25 points among those not eligible. The schools with the highest poverty in 2005 differed from other schools in terms of characteristics. High-poverty schools had the highest percentage of minority students and students who did not speak English at home. They also had the highest percentage of 4th grade students taught by a teacher with less than 5 years of experience in teaching" (National Center for Education Statistics 1).

Most children acquire knowledge of numbers and other aspects of mathematics even before entering kindergarten. The mathematical knowledge brought to kindergarten is related to mathematics learning for years thereafter. Unfortunately, many children from low-income backgrounds enter school with far less knowledge than peers from middle-income backgrounds, and the achievement gap in mathematical knowledge progressively widens throughout their PreK-12 years (National Mathematics Advisory Panel xviii).

Many believe that the standards-based reform movement could be a step in the right direction to address the needs of at-risk students. Lachat contends individuals involved in the standards-based movement are "committed to a vision of society where people of different backgrounds, cultures, and perceived abilities have equal access to a high quality education" (14). Standards-based reform focuses on what children should know and be able to do and set specific expectations for various levels of proficiency. Process is emphasized over product and skills in problem solving, reasoning, and communication over accumulation of isolated facts and formulas. Assessment focuses on progress instead of failure and uses rubrics to identify growth (Morris 1). According to Lachat, standards-based reform attempts to "establish clear, attainable standards at internationally competitive levels for the entire student population. This represents a new way of thinking, a paradigm shift—it means high expectations for every student in every school, not just some students in some schools" (11).

Education standards alone will not improve student achievement unless they are tied in with policies and practices that address inequities in the schools. Lubienski states, "If we are truly committed to equitable outcomes, then we must commit more resources to those students who most need them. To close achievement gaps in mathematics, we need to ensure that low-SES and minority students get the best teachers, the richest mathematics curriculums, the smallest class sizes, and the most careful guidance. Although we might strive to achieve "mathematical power for all," we will not reach this goal if we focus on all students generally instead of addressing the particular barriers that historically underserved students face in learning mathematics" (58-59).

Scores on the NAEP have risen substantially since 1990 for both low- and high-SES students. Gains may be due in part to the fact the NAEP became aligned with the NCTM standards in 1990. At the same time, mathematics instruction in many schools also became more aligned with the NCTM standards. The improvement in NAEP mathematics scores indicates instructional changes may improve students' achievement (Lubienski 56).

Mathematics Education for Students with Disabilities

Another student population that has continued to fall behind in mathematics achievement is those identified with disabilities. A central principle of the NCTM Standards has been that all students can succeed in complex mathematics. This has commonly been referred to as the *equity principle*. However, since the early 1990s, some critics have been skeptical of this tenet, particularly given the considerable emphasis the *Standards* place on conceptual understanding, problem solving, and constructivist pedagogy (Woodward and Brown 151). The NCTM *Standards* offer few, if any, guidelines as to how the *Standards* might be modified for students who have a learning disability or are at risk for academic failure. Researchers in mathematics have rarely focused on the effects of reform-based pedagogy and curricula on low achievers, offering primarily anecdotal reports (Baxter, Woodward and Olson 4).

Although the NAEP has provided a national picture of the academic achievements of American students, there has been no similar national picture of the academic achievement of youths with disabilities. The National Longitudinal Transition Study-2 (NLTS2), funded by the National Center for Special Education Research in the Institute of Education Sciences in the U.S. Department of Education is providing this information about secondary-school age students with disabilities. The NLTS2 includes a sample of more than 11,000 youths who were ages 13-16 and receiving special education services in seventh grade or above in the 2000-2001 school year (National Center for Special Education Research ix). Students were assessed on two measures of language arts, two of mathematics skills, and two measures of content knowledge. Results demonstrate that by the time students who receive special education services reach secondary school, serious academic deficits are apparent for many students. Average standard scores for youths with disabilities ranged from 79-87 where 100 is the average for the general population. Low academics were pervasive across disability types (National Center for Special Education Research 47).

According to Gersten and Clarke, several consistent findings have emerged from the body of research on students who experience problems in their acquisition of mathematics over multiple school years. "The one bedrock problem found in the literature about students with mathematics difficulties was their extremely slow retrieval of even the most rudimentary arithmetic facts" (1). Several studies reported the same findings. There is no consensus as to how to best aid students in this area. Most efforts consist of work with number families to demonstrate relationships between facts. It is hoped repeated practice or over learning will increase speed of fact retrieval. Another problem found in the studies was impulsivity or lack of inhibition. It was suggested that instructional approaches prompting students to think aloud or draw a problem might be helpful for students with disabilities in mathematics (Gersten and Clarke 1).

The National Mathematics Advisory Panel "identified surprisingly few methodologically rigorous studies (given a literature base that spanned the past 30 years) that examined instructional practices designed to improve the performance of low-achieving students and students with learning disabilities" (49). However, the few that were identified were of high quality. Based on those studies, the Panel recommends "students with learning disabilities and other students with learning problems receive, on a regular basis, some explicit systematic instruction that includes opportunities for students to ask and answer questions and think aloud about decisions they make while solving problems" (48-49). Some of the time should be dedicated to making sure these students possess foundational skills and the conceptual knowledge needed to understand mathematics at their grade level (xxiii).

Woodward and Brown conducted a study examining the effects of two kinds of curricula on middle school students at risk for receiving special education supports in mathematics. Students involved in the study had learning disabilities but did not have IEPs in mathematics. This was done purposely to help control the high variability in student performance associated with students who have learning disabilities and IEPs in mathematics. Teachers in the intervention group taught using *Transitional Mathematics, Level 1* curricular materials. These resources reflect the NCTM *Standards* and have been adapted to meet the needs of students at risk for academic failure as well as students with disabilities. The comparison group used the first level of *Connected Mathematics*. The intervention group had daily instruction for 55 minutes that was divided into three sections: math warm-up, guided practice on new concepts, and problem solving or application of concepts. The comparison group had 80 minutes of daily instruction. The "additional 25 minutes of daily instruction over the intervention group was simply an artifact of the way the middle school structured mathematics for all of its academically low-achieving students" (155). The instruction was divided into four sections. The first three (launch, explore, and summarize) were components involved in the specified structure of CMP. The final 25 minutes involved structured basic skills independent of CMP. The results indicated that the curriculum, *Transitional Mathematics*, that used researched-based principles found in the special education literature led to higher achievement and attitudinal results by the end of the year. These results occurred despite the fact there were 25 additional minutes of skills instruction per day for comparison students. Furthermore, the study suggests many instructional strategies articulated in special education math literature are applicable to students who do not have IEPs in mathematics (Woodward and Brown 151-158).

Summary

This chapter reviewed the literature relevant to the proposed study including the history of mathematics in the twentieth century, the development of curriculum reform in mathematics, the *Connected Mathematics Project* and mathematics education of low SES students and students with disabilities. The review of literature suggested many students using CMP perform as well or better academically on mathematics achievement tests than non-CMP students, however some results showed otherwise. The literature also suggested a need still exists to provide experiences in mathematics that provide equity to economically disadvantaged students and students with disabilities.

CHAPTER THREE

METHODS

Introduction

The purpose of this study was to describe the effect of *Connected Mathematics Project* (CMP) on the mathematics achievement of sixth and seventh grade students as compared to similar students receiving mathematics instruction in a classroom not using CMP. This chapter describes the methodology used to conduct this study. Specifically, the research design, population, sampling procedures, instrumentation, data collection procedures, research questions and hypotheses, data collection and analysis with respect to student achievement, and limitations are outlined in this section.

Research Design

The basic design of this study employed quantitative methodology with an experimental, control group. Therefore, an examination of the mathematical achievement of seventh grade students in Olathe was conducted. Treatment variable was the type of mathematics instruction taught in the classroom. Students in the control group received mathematics instruction in a traditional, lecture-based setting. The treatment for the experimental group was mathematics instruction using CMP. Using existing data provided by the Olathe District Assessment Office, scores from the

2008 Kansas Mathematics Assessment were compared for: seventh grade students receiving mathematics instruction using CMP in both sixth and seventh grades, seventh grade students receiving mathematics instruction using CMP in seventh grade but not in sixth grade, and seventh grade students who did not receive mathematics instruction using CMP in either sixth or seventh grades.

Population and Sample

The Olathe School District includes 33 elementary schools and 8 junior high schools. During the 2006-2007 school year, Olathe piloted CMP in seventh grade classes at three junior high schools. In addition, sixth grade students at one feeder elementary school of each of the selected junior high schools also implemented CMP. High-ability sixth grade students participating in pre-algebra classes were excluded from the pilot. During the 2007-2008 school year, eighth grade students at the three original junior high schools were also included in the pilot with the exclusion of students in Algebra 1. Sixth grade students at all the feeder elementary schools began receiving instruction using CMP as well. In addition to the original three elementary schools involved in the pilot program, 10 feeder elementary schools were added to the pilot during the 2007-2008 school year. Once again, sixth grade students receiving pre-algebra classes were excluded.

The participants for this study were drawn from the population of sixth and seventh grade students enrolled in the Olathe District Schools during the 2006-2007 and 2007-2008 school years. The student sample of the experimental group during the 2007-

2008 school year included 119 seventh grade students from three junior highs. These students were involved in the pilot during both the 2006-2007 and 2007-2008 school years and received two years of mathematics instruction using CMP. This group represents the entire population of seventh grade students in the district who received instruction using CMP during both the 2006-2007 and 2007-2008 school years. The sample also included 119 seventh grade students from the same three junior high schools who received mathematics instruction using CMP during their seventh grade year but did not receive instruction using CMP during their sixth grade year. The sample was limited to 119 in an effort to balance out the size of each group represented in this study since the original pilot group only had 119 members remaining. The schools used in the experimental group are geographically dispersed throughout the Olathe District, and together form a representative sample of the district as a whole. They were selected based on the implementation of the standards based curriculum, *Connected Mathematics Project*. Demographics of the experimental group are illustrated in Table 3 in Chapter One.

The student sample of the control group during the 2007-2008 school year included 119 seventh grade students from two junior high schools. Sample size was selected in an effort to reflect the number of students remaining in the original CMP pilot group. Students in the control did not receive mathematics instruction using CMP in either of their sixth or seventh grade school years. The schools used in the control group were geographically dispersed throughout the Olathe District, and together form a representative sample of the district as a whole. Demographics of the control group are illustrated in Table 4 in Chapter One.

Sampling Procedures

Purposive sampling was utilized to designate the 119 students in the experimental group who received mathematics instruction for two consecutive years using CMP. This was necessary since this population was limited to students who attended sixth grade in one of the three elementary schools implementing CMP during the first year of the pilot. All students who participated in CMP in sixth grade during the 2006-2007 school year were used in this study.

Students in the experimental group who had one year of mathematics instruction using CMP were selected from the three junior highs implementing CMP during the second year of the pilot. A total of 537 students at the three junior high schools were in their first year of CMP during the 2007-2008 school year. A random number generator was utilized to determine which seventh grade students were chosen for this sample.

Students in the control group were chosen from two junior high schools with no implementation of CMP during the 2006-2007 or 2007-2008 school years. Students who had been involved in pre-algebra during their sixth grade year were excluded. A random number generator was utilized to determine the sample from the 430 seventh grade students at the two schools.

Students qualifying for special education services and economically disadvantaged students were identified among the overall population of 357 students designated in this study. These subgroup populations were limited to those in the overall sample of 357 in an effort to maintain reliability and validity in the study.

Instrumentation

The dependent variable, mathematics achievement, was measured using individual scores obtained from the 2008 Kansas Mathematics Assessment. The Kansas Mathematics Assessment is a state-mandated assessment aligned to the Kansas Mathematics Standards. It is administered annually to all students in third, fourth, fifth, sixth, eighth and tenth grades with the purpose of measuring student achievement and comparing that achievement to the larger population.

Students are assessed in three test sessions. One is a non-calculator session and two sessions allow the use of a calculator. The assessment is composed of multiple choice questions with twelve to fifteen indicators assessed per grade level. Four to eight items are included per indicator.

Table 7 Grade 7 Assessment Framework 3-Sessions

Note: Number in parentheses equals number of questions

INDICATORS SELECTED FOR MULTIPLE CHOICE ASSESSMENT ITEMS				MATHEMATICS COGNITIVE CATEGORIES					
Standard	Benchmark	Knowledge Indicator	Application Indicator	Category 1 Number of Questions	Category 2 Number of Questions	Category 3 Number of Questions	Category 4 Number of Questions	Category 5 Number of Questions	Total Number of Questions
1—Number Sense	1 Number Sense (6)		1a			3		3	6
1—Number Sense	4 Computation (8)	2a			1	1			2
		2b			1	1			2
		2c			1	1			2
		2d			1	1			2
1—Number Sense	4 Computation (5)	5			5				5
Number and Computation Standard Percentage of Test: 22.6%									**19**
2--Algebra	1 Patterns (4)	1a					2		2
		1b					2		2
2--Algebra	1 Patterns (5)	4					5		5
2--Algebra	2 Variables (8)	7			5	3			8
2--Algebra	2 Variables (5)	8			5				5
2--Algebra	2 Variables (6)		1			5		1	6
Algebra Standard Percentage Test: 33.3%									**28**
3--Geometry	1 Figures (7)	3a		1					1
		3b		1					1
		3c		1					1
		3d		1					1
		3e		1					1
		3f		1					1
		3g		1					1
3--Geometry	2 Measurement (5)		1		3			2	5
3--Geometry	2 Measurement (5)	4	2	3					5
3--Geometry	2 Measurement (4)	6a		2					2
		6b		2					2
3—Geometry	3 Transformation (4)		3			2		2	4
Geometry and Measurement Standard Percentage of Test: 29.8%									**25**
4—Data	2 Statistics (7)	1a			1				
		1b			1				
		1c			1				
		1d			1				
		1e			1				
		1f			1				
		1g			1				
4—Data	2 Statistics (5)		3a				2		
			3b			3			
Data Standard Percentage of Test: 14.3%									**12**
Total Number of Multiple Choice Questions									**84**

Percentage of Test with Calculator Use Allowed: 90.5% (76)

Knowledge Indicator Percentage of Test: 69.0% (58)

Application Indicator Percentage of Test: 31.0% (26)

(Kansas State Department of Education Assessment Framework)

Validity

In May 2002, looking to NCTM's *Standards* as a guide, the Kansas State Board of Education directed academic standards committees composed of stakeholders from throughout Kansas were to be convened for the curriculum areas defined by state law. The mathematics committee was charged to:

1) Review the current standards document
2) Review modified and extended standards for inclusion in the document
3) Review the format to ensure usability
4) Determine the level of specificity of skills assessed
5) Recommend essential indicators to be assessed
6) Review previous assessment results and review past KSDE studies as they related to student achievement (*Kansas Curriculum Standards for Mathematics* 6-7).

After six working drafts and the input of over 1600 stakeholders, the Kansas Mathematics Standards were revised and approved at the July 2003 meeting of the Kansas State Board of Education. Kansas Mathematics Assessments, based on these standards, were revised and aligned with the new standards. The revised assessment was first administered to students during the spring of 2006 (Mathematics Assessments 1). These revisions based on the input of mathematics experts throughout the state helped to establish the content validity of this instrument.

A study conducted by the National Center for Research on Evaluation in 2007, further established the validity of this instrument. The study, *A Comparison of Changes Over*

Time in White-Black and White-Hispanic Achievement Gaps on State Assessments Versus State NAEP, was based on the premise that when a state test and the National Assessment of Educational Progress (NAEP) are both measuring the same construct, the achievement gaps between subgroups on both tests should be the same. In an analysis of scores on the Kansas Mathematics Assessments as compared to the NAEP, Erickson, et. al, found "the median trend plots showed that the gap is closing in the same way, with both White and Black groups increasing their median score but with Black medians increasing faster than the White median" (19). This study provides further indication that the Kansas Mathematics Assessment is a valid instrument for measuring mathematics achievement of students since it closely measures the same constructs as the NAEP.

Teachers in the pilot program were expected to implement CMP per the authors' recommendations, however, it is impossible to control interactions and instruction in every classroom which can create a concern with issues regarding validity. Fidelity to the curriculum was increased, however, due to professional development that occurred to ensure participating teachers were proficient and consistent in the implementation of CMP. During the spring of 2006, teachers involved in the first year of the Olathe pilot program were sent to Michigan State University where they received four days of training related to CMP. In addition, the core group of pilot teachers and the Olathe District Mathematics Coordinator met weekly throughout the summer of 2006 to plan for classroom instruction and implementation. This team created a notebook that clearly outlined a long-range plan for the implementation of CMP. Fidelity was also increased with the expectation that teachers attend one-hour sessions monthly to discuss the questions and concerns with the implementation of CMP. These meetings, facilitated by the Olathe District Math Coordinator, provided consistency in the vision and expectations for implementation.

The second wave of the CMP pilot program occurred during the 2007-2008 school year. The Olathe District Mathematics Coordinator and the team of teachers involved in the first year of the program provided the professional development for the teachers implementing CMP for the first time in 2007-2008. Professional development continued throughout the year through monthly meetings and professional development days. District teachers not involved in CMP were not involved in these professional development sessions. Teachers not implementing CMP continued to use prior curriculum that did not have a focus on constructivist classroom practices and was described by the Olathe District Mathematics Coordinator as “traditional.”

Data Collection Procedures

To obtain permission to conduct the study in the Olathe School District, a research proposal was submitted to Olathe District Schools outlining the purpose, design and dissemination of the study (Appendix A). A letter granting permission to conduct the research using existing student data was acquired (Appendix B). The following data were obtained from the experimental group and comparison group:

1. Individual scores for the 2008 Kansas Mathematics Assessment for seventh grade students in the Olathe District Schools.
2. Special education and socioeconomic status of seventh grade students participating in the 2008 Kansas Mathematics Assessment.
3. Sixth grade students participating in classrooms piloting *Connected Mathematics* during the 2006-2007 school year.
4. Sixth grade students enrolled in Pre-Algebra during the 2006-2007 school year.

The data were provided to the researcher by the Assessment Department of the Olathe District Schools in such a manner students would not be identified. The data were entered into the Statistical Package for the Social Sciences (SPSS) statistical program with careful checking for accuracy. Students were identified by student identification number. Population samples were selected using a random number generator.

Research Questions and Hypotheses

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

1. What is the effect of the use of *Connected Mathematics* on the mathematics achievement of sixth and seventh grade students as compared to students receiving instruction in a traditional mathematics classroom as measured by the Kansas Mathematics Assessment?
2. What is the effect of the use of *Connected Mathematics* on the mathematics achievement of sixth and seventh grade students of low SES as compared to sixth and seventh grade students of low SES students receiving instruction in a traditional mathematics classroom as measured by the Kansas Mathematics Assessment?
3. What is the effect of the use of *Connected Mathematics* on the mathematics achievement of sixth and seventh grade special education students as compared to sixth and seventh grade special education students receiving instruction in a traditional mathematics classroom as measured by the Kansas Mathematics Assessment?

Field test reports during the developmental phase of *Connected Mathematics* show positive, statistically significant growth for students who use CMP as compared to students who did not use CMP (http://connectedmath.msu.edu/ retrieved 3/01/07). District data reports from Blue Valley School District and Kansas City Kansas School District (KSDE 2006) also show significant growth in mathematics achievement after implementation of CMP. Even though these evaluations provide evidence that use of CMP positively affect students' mathematics achievement, NCLB requires school personnel to evaluate value, merit or worth of the program for students in their school and district. Therefore, the following research hypotheses were tested:

1. The mathematics achievement of sixth and seventh grade students in Olathe, Kansas who use *Connected Mathematics* is statistically significantly different than the mathematics achievement of sixth and seventh grade students in Olathe, Kansas who do not use *Connected Mathematics* at the .05 level of significance.
2. The mathematics achievement of low SES sixth and seventh grade students in Olathe, Kansas who use *Connected Mathematics* is statistically significantly different than the mathematics achievement of low SES sixth and seventh grade students in Olathe, Kansas who do not use *Connected Mathematics* at the .05 level of significance.
3. The mathematics achievement of sixth and seventh grade special education students in Olathe, Kansas who use *Connected Mathematics* is statistically significantly different than the mathematics achievement of sixth and seventh grade special education students in Olathe, Kansas who do not use *Connected Mathematics* at the .05 level of significance.

Data Collection and Statistical Analysis

The data collected using the procedures described in the previous section were analyzed using analysis of variance (ANOVA). The ninety-five percent confidence level ($p < .05$) was used as the criterion level for determining statistical significance.

Limitations

This study was limited to data collected from assessment scores during the 2007-2008 school year. This study was also limited to sixth and seventh grade students in a public school setting. The study based mathematics achievement on one set of scores, those of the Kansas Mathematics Assessment during the two years of the study. Student records provided demographic information and test scores for this study. No new assessments were administered for this study. The study did not address characteristics of individual teachers such as years of experience, being highly qualified in mathematics, classroom management, instructional style, etc.

Summary

The purpose of this study was to determine the effect of the use of CMP on the mathematics achievement of sixth and seventh grade students in Olathe District Schools. This chapter reviews the methodology that was used to conduct this study and includes the following subsections: research design, population and sample, sampling procedures, instrumentation, validity, data collection procedures, research questions and hypotheses, data collection and statistical analysis, and limitations.

Chapter Four will summarize the results obtained from this study. The results from this study are presented in narrative and tabular form.

CHAPTER FOUR

RESULTS

The purpose of this study was to determine the effect of *Connected Mathematics Project* on the mathematics achievement, as measured by the Kansas Mathematics Assessment, of sixth and seventh grade students as compared to similar students receiving mathematics instruction in a traditional mathematics classroom. The researcher used data from five junior high schools in the study. Schools were chosen based on participation in the pilot study of CMP in the Olathe District Schools. The treatment group consisted of 119 students who received mathematics instruction using CMP during both sixth and seventh grade years, and 119 students who received mathematics instruction using CMP during the seventh grade year but not during the sixth grade year. The comparison group consisted of 119 students who did not receive mathematics instruction using CMP during either sixth or seventh grade years.

This chapter presents the quantitative analyses of the numerical data that were supplied by the Olathe District Schools with regard to achievement. For the purpose of these analyses, the following were used as independent variables: curriculum participation, SES established by participation in the free or reduced lunch program, and qualification for special education services. The Kansas Mathematics Assessment was the dependent variable.

Hypothesis Testing

Data for this study were compiled from seventh grade scores on the 2008 Kansas Mathematics Assessment. The results are presented in the order of the research questions listed in Chapters 1 and 3 covering each of the hypotheses tested.

Research Question 1

What is the effect of the use of Connected Mathematics on the mathematics achievement of sixth and seventh grade students as compared to students receiving instruction in a traditional mathematics classroom as measured by the Kansas Mathematics Assessment?

The following research hypothesis regarding the effects of mathematics instruction on student achievement was proposed:

1. The mathematics achievement of sixth and seventh grade students in Olathe, Kansas who use *Connected Mathematics* is statistically different than the mathematics achievement of sixth and seventh grade students in Olathe, Kansas who do not use *Connected Mathematics* at the .05 level of significance.

Using a One-Way Analysis of Variance (ANOVA), the researcher analyzed a sample of students (n=119) who received two years of mathematics instruction using CMP, a sample of students (n=119) who received one year of mathematics instruction using CMP, and a sample of students (n=119) who received no mathematics instruction using CMP. The mean score for students with two years of CMP instruction was 75.882 with a standard deviation of 15.006. The mean score for students with one year of CMP instruction was 76.328 with a standard deviation of 13.540. The mean score for students with no CMP instruction was 73.151 with a standard deviation of 14.864 (see table 8). The obtained value between groups was $F_{(2, 354)} = 1.598$. The critical value was 3.02. The comparison of the two indicates there is not enough evidence to reject the null hypothesis and conclude there is a statistically significant difference between at least two of the means.

Table 8

Descriptives

	N	Mean Score on KMA	Std. Deviation	95% Confidence Interval for Mean	
				Lower Bound	Upper Bound
CMP 2	119	75.882	15.006	73.158	78.607
CMP 1	119	76.328	13.540	73.870	78.786
No CMP	119	73.151	15.878	70.269	76.034
Total	357	75.120	14.864	73.573	76.668

Table 9

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	545.922	2	351.986	1.598	.204
Within Groups	78022.605	354	220.203		
Total	78568.527	356			

Research Question 2

What is the effect of the use of Connected Mathematics on the mathematics achievement of sixth and seventh grade students of low SES as compared to low SES students receiving instruction in a traditional mathematics classroom as measured by the Kansas Mathematics Assessment?

The following research hypothesis regarding the effects of mathematics instruction on student achievement was proposed:

2. The mathematics achievement of low SES sixth and seventh grade students in Olathe, Kansas who use *Connected Mathematics* is statistically different than the mathematics achievement of low SES sixth and seventh grade students in Olathe, Kansas who do not use *Connected Mathematics* at the .05 level of significance.

Using a Univariate Two-Factor Analysis of Variance, the researcher analyzed a sample of students (n=119) who received two years of mathematics instruction using CMP, a sample of students (n=119) who received one year of mathematics instruction using CMP, and a sample of students (n=119) who received no mathematics instruction using CMP. From the entire sample (n=357), students were divided into those who qualified for free or reduced lunch (n=45) and those who did not qualify for free or reduced lunch (n=312). The mean score for students receiving two years of instruction using CMP who did not qualify for free or reduced lunch was 77.738 with a standard deviation of 13.245. The mean score for students receiving two years of instruction using CMP who did qualify for free or reduced lunch was 63.938 with a standard deviation of 20.068. The mean score for students receiving one year of instruction using CMP who did not qualify for free or reduced lunch was 77.439 with a standard deviation of 12.318. The mean score for students receiving one year of instruction using CMP who did qualify for free or reduced lunch was 66.417 with a standard deviation of 19.626. The mean score for students receiving no mathematics instruction using CMP who did not qualify for free or reduced lunch was 75.431 with a standard deviation of 14.785. The mean score for students receiving no mathematics instruction using CMP who did qualify for free or reduced lunch was 59.471 with a standard deviation of 15.725 (see table 10). The obtained value for the main effect of socio-economic status as indicated by qualification for free or reduced lunch was $F_{(1, 351)} = 35.568$. The critical value was 3.87. The results indicate there is a statistically significant difference between the mean of students who qualify for free or reduced lunch and those who do not. The obtained value for the main effect of treatment (CMP) was $F_{(2, 357)} = 1.437$. The critical value was 3.02. The comparison of the two indicates there is not enough evidence to conclude there is a statistically significant difference between any two of the three means. The obtained value for the interaction between CMP and free or reduced lunch, the one of interest in regards to the research question and hypothesis of this study, was $F_{(2, 357)} = .378$. The critical value was 3.02. The comparison of the two indicates there is not enough evidence to reject the null hypothesis and conclude there is a statistically significant difference between any two of the six means.

Table 10

Descriptive Statistics

Treatment	Lunch	Mean	Std. Deviation	N
CMP 2	Free/Reduced	63.938	20.068	16
	Not Free/Reduced	77.738	13.245	103
	Total	75.882	15.006	119
CMP 1	Free/Reduced	66.417	19.626	12
	Not Free/Reduced	77.439	12.318	107
	Total	76.328	13.540	119
No CMP	Free/Reduced	59.471	15.725	17
	Not Free/Reduced	75.431	14.785	102
	Total	73.151	15.878	119
Total	Free/Reduced	62.911	18.216	45
	Not Free/Reduced	76.881	13.464	312
	Total	75.120	14.864	357

Table 11

Tests of Between-Subjects Effects

Source	Type III Sum Of Squares	df	Mean Square	F	Sig.
Treatment	575.717	2	287.858	1.437	.239
Lunch	7122.929	1	7122.929	35.568	.000
Treatment*Lunch	151.208	2	75.604	.378	.686
Error	70291.387	351	200.260		
Total	2093236.000	357			
Corrected Total	78655.821	356			

Research Question 3

What is the effect of the use of Connected Mathematics on the mathematics achievement of sixth and seventh grade special education students as compared to special education students receiving instruction in a traditional mathematics classroom as measured by the Kansas Mathematics Assessment?

The following research hypotheses regarding the effects of mathematics instruction on student achievement was proposed:

3. The mathematics achievement of sixth and seventh grade special education students in Olathe, Kansas who use *Connected Mathematics* is statistically different than the mathematics achievement of sixth and seventh grade special education students in Olathe, Kansas who do not use *Connected Mathematics* at the .05 level of significance.

Using a Univariate Two-Factor Analysis of Variance, the researcher analyzed a sample of students (n=119) who received two years of mathematics instruction using CMP, a sample of students (n=119) who received one year of mathematics instruction using CMP, and a sample of students (n=119) who received no mathematics instruction using CMP. From the entire sample (n=357), students were divided into those who qualified for special education services (n=22) and those who did not qualify for special education services (n=335). The mean score for students receiving two years of instruction using CMP who did not qualify for special education services was 76.739 with a standard deviation of 13.588. The mean score for students receiving two years of instruction using CMP who did qualify for special education services was 51.250 with a standard deviation of 31.690. The mean score for students receiving one year of instruction using CMP who did not qualify for special education services was 77.309 with a standard deviation of 12.554. The mean score for students receiving one year of instruction using CMP who did qualify for special education services was 64.333 with a standard deviation of 19.532. The mean score for students receiving no mathematics instruction using CMP who did not qualify for special education services was 74.855 with a standard deviation of 14.847. The mean score for students receiving no mathematics instruction using CMP who did qualify for special education services was 52.333 with a standard deviation of 13.702 (see table 12). The obtained value of the main effect of qualification of special education services was $F_{(1, 351)} = 37.463$. The critical value was 3.87. The results indicate there is a statistically significant difference between the means of students who qualify for special education services and those who do not. The obtained value of the main effect of treatment (CMP) was $F_{(2, 357)} = 2.510$. The critical value was 3.02. The comparison of the two indicates there is not enough evidence to conclude there is a statistically significant difference between the means. The obtained value for the interaction between CMP and qualification for special education, the one of interest in regards to the research question and hypothesis of this study, was $F_{(2, 357)} = 1.425$. The critical value was 3.02. The comparison of the two indicates there is not enough evidence to reject the null hypothesis and conclude there is a statistically significant difference between any two of the six means.

Table 12

Descriptive Statistics

Treatment	SPED	Mean	Std. Deviation	N
CMP 2	SPED	51.250	31.690	4
	No SPED	76.739	13.588	115
	Total	75.882	15.006	119
CMP 1	SPED	64.333	19.532	9
	No SPED	77.309	12.554	110
	Total	76.328	13.540	119
No CMP	SPED	52.333	13.702	9
	No SPED	74.855	14.847	110
	Total	73.151	15.878	119
Total	SPED	57.046	19.9750	22
	No SPED	76.308	13.692	335
	Total	75.120	14.864	357

Table 13

Tests of Between-Subjects Effects

Source	Type III Sum Of Squares	df	Mean Square	F	Sig.
Treatment	998.625	2	499.312	2.510	.083
SPED	7452.027	1	7452.027	37.463	.000
Treatment*SPED	566.960	2	283.480	1.425	.242
Error	69820.088	351	198.918		
Total	2093236.000	357			
Corrected Total	78655.821	356			

Additional Analyses

In addition to those used to directly address the research questions, hypothesis tests were conducted to evaluate the individual indicators of achievement on the Kansas Mathematics Assessment to determine the effect of *Connected Mathematics* on student achievement of each mathematics indicator. District data is analyzed by indicators to determine specific areas of strength and weakness. Analyzing the effect of CMP on individual indicators provides the district additional information about CMP in relation to district strengths and weaknesses. A more in-depth look at the effects of *Connected Mathematics* on student achievement will better allow district evaluators to make judgments regarding this program and the benefits to students in the Olathe District Schools. Table 14 provides information regarding assessed indicators.

Table 14
Data Access Indicators at the Seventh Grade Level

Data Access Indicator	Kansas and Olathe Indicators	Description
1	M.7.1.1.A1a 7M.NC.NS.6	The student generates and/or solves real-world problems using equivalent representations of rational numbers and simple algebraic expressions.
2	M.7.1.1.K2a 7M.NC.C.2	The student performs and explains these computational procedures: a. adds and subtracts decimals from ten millions place through hundred thousandths place. b. multiplies and divides a four-digit number using numbers from thousands place through thousandths place. c. multiplies and divides using numbers from thousands place through thousandths place by 10; 100; 1,000; .1; .01; .001; or single-digit multiples of each. d. adds, subtracts, multiplies, and divides fractions and expresses answers in simplest form.
3	M.7.1.1.4.K5 7M.NC.C.5	The student finds percentages of rational numbers.
4	M.7.2.1.K1b 7M.A.P.1	The student identifies, states, and continues a pattern presented in various formats including numeric (list or table), algebraic (symbolic notation), visual (picture, table or graph), verbal (oral description), kinesthetic (action), and written using these attributes: a. counting numbers including perfect squares, cubes, and factors and multiples. b. positive rational numbers including arithmetic and geometric sequences (arithmetic: sequence of numbers in which the difference of two consecutive numbers is the same, geometric: a sequence of numbers in which each succeeding term is obtained by multiplying the preceding term by the same number).
5	M.7.2.1.K4 7M.A.P.4	The student states the rule to find the n^{th} term of a pattern with one operational change (addition or subtraction) between consecutive terms.
6	M.7.2.2.A1 7M.A.V.9	The student generates and/or solves real-world problems using equivalent representations of rational numbers and simple algebraic expressions.
7	M.7.2.2.K7 7M.A.V.7	The student knows the mathematical relationship between ratios, proportions, and percents and how to solve for a missing term in a proportion with positive rational number solutions and monomials.
8	M.7.2.2.K8 7M.A.V.8	The student evaluates simple algebraic expressions using positive rational numbers.
9	M.7.3.1.K3a 7M.G.GFP.3	The student identifies angle and side properties of triangles and quadrilaterals: a. sum of the interior angles of any triangle is 180^o. b. sum of the interior angles of a quadrilateral is 360^o. c. parallelograms have opposite sides that are parallel and congruent. d. rectangles have angles of 90^o, opposite sides are congruent. e. rhombi have all sides the same length, opposite angles are congruent. f. squares have angles of 90^o, all sides are congruent. g. trapezoids have one pair of opposite sides parallel and the other pair of opposite sides are not parallel.
10	M.7.3.2.A1c 7M.G.ME.10	The student solves real-world problems by finding perimeter and area of two-dimensional composite figures of squares, rectangles, and triangles.
11	M.7.3.2.K4 7M.G.ME.4	The student knows and uses perimeter and area formulas for circles, squares, rectangles, triangles, and parallelograms.
12	M.7.3.2.K6a 7M.GmME.6	The student uses given measurement formulas to find: a. surface area of cubes b. volume of rectangular prisms
13	M.7.3.3.A3 7M.G.TG.5	The student determines the actual dimensions and/or measurements of a two-dimensional figure represented in a scale drawing.
14	M.7.4.2.K1a	The student organizes, displays, and reads quantitative (numerical) and qualitative (non-numerical) data in a clear, organized, and accurate manner including a title, labels, categories, and rational number intervals using these data displays: a. frequency tables. b. bar, line, and circle graphs. c. Venn diagrams, or other pictorial displays. d. charts and tables. e. stem-and-leaf plots (single). f. scatter plots. g. box-and-whisker plots.
15	M.7.4.2.A3a 7M.D.S.7	The student recognize and explains: a. misleading representations of data. b. the effects of scale or interval changes on graphs of data sets.

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Data Access Indicator 1

Using a One-Way Analysis of Variance, the researcher analyzed a sample of students (n=119) who received two years of mathematics instruction using CMP, a sample of students (n=119) who received one year of mathematics instruction using CMP, and a sample of students (n=119) who received no mathematics instruction using CMP. Scores for Data Access Indicator 1 of the Kansas Mathematics Assessment were utilized. The mean score for students with two years of CMP instruction was 77.019 with a standard deviation of 22.961. The mean score for students with one year of CMP instruction was 75.698 with a standard deviation of 21.761. The mean score for students with no CMP instruction was 72.053 with a standard deviation of 25.385 (see table 15). The obtained value between groups was $F_{(2, 354)} = 1.4345$. The critical value was 3.02. The comparison of the two indicates there is not enough evidence to conclude there is a statistically significant difference between at least two of the means.

Table 15

Descriptives for Data Access Indicator 1

	N	Mean Score on KMA	Std. Deviation	95% Confidence Interval for Mean	
				Lower Bound	Upper Bound
CMP 2	119	77.019	22.961	72.851	81.188
CMP 1	119	75.698	21.761	71.747	79.648
No CMP	119	72.053	25.385	67.445	76.661
Total	357	74.923	23.446	72.483	77.364

Table 16

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1574.394	2	787.197	1.435	.239
Within Groups	194130.59	354	548.392		
Total	195704.99	356			

Data Access Indicator 2

Using a One-Way Analysis of Variance, the researcher analyzed a sample of students (n=119) who received two years of mathematics instruction using CMP, a sample of students (n=119) who received one year of mathematics instruction using CMP, and a sample of students (n=119) who received no mathematics instruction using CMP. Scores for Data Access Indicator 2 of the Kansas Mathematics Assessment were utilized. The mean score for students with two years of CMP instruction was 73.845 with a standard deviation of 22.899. The mean score for students with one year of CMP instruction was 72.899 with a standard deviation of 22.034. The mean score for students with no CMP instruction was 71.954 with a standard deviation of 22.133 (see table 17). The obtained value between groups was $F_{(2, 354)} = .213$. The critical value was 3.02. The comparison of the two indicates there is not enough evidence to conclude there is a statistically significant difference between at least two of the means.

Table 17

Descriptives for Data Access Indicator 2

	N	Mean Score on KMA	Std. Deviation	95% Confidence Interval for Mean	
				Lower Bound	Upper Bound
CMP 2	119	73.845	22.899	69.688	78.001
CMP 1	119	72.899	22.034	68.899	76.899
No CMP	119	71.954	22.133	67.936	75.972
Total	357	72.899	22.309	70.577	75.221

Table 18

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	212.710	2	106.355	.213	.808
Within Groups	176961.66	354	499.892		
Total	177174.37	356			

Data Access Indictor 3

Using a One-Way Analysis of Variance, the researcher analyzed a sample of students (n=119) who received two years of mathematics instruction using CMP, a sample of students (n=119) who received one year of mathematics instruction using CMP, and a sample of students (n=119) who received no mathematics instruction using CMP. Scores for Data Access Indicator 3 of the Kansas Mathematics Assessment were utilized. The mean score for students with two years of CMP instruction was 71.764 with a standard deviation of 27.972. The mean score for students with one year of CMP instruction was 75.462 with a standard deviation of 26.095. The mean score for students with no CMP instruction was 69.076 with a standard deviation of 28.344 (see table 19). The obtained value between groups was $F_{(2\ 354)} = 1.619$. The critical value was 3.02. The comparison of the two indicates there is not enough evidence to conclude there is a statistically significant difference between at least two of the means.

Table 19

Descriptives for Data Access Indicator 3

	N	Mean Score on KMA	Std. Deviation	95% Confidence Interval for Mean	
				Lower Bound	Upper Bound
CMP 2	119	71.765	27.972	66.687	76.843
CMP 1	119	75.462	26.095	70.725	80.199
No CMP	119	69.076	28.344	63.930	74.221
Total	357	72.100	27.536	69.235	74.967

Table 20

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2447.059	2	1223.529	1.619	.199
Within Groups	267477.31	354	755.586		
Total	269924.37	356			

Data Access Indicator 4

Using a One-Way Analysis of Variance, the researcher analyzed a sample of students (n=119) who received two years of mathematics instruction using CMP, a sample of students (n=119) who received one year of mathematics instruction using CMP, and a sample of students (n=119) who received no mathematics instruction using CMP. Scores for Data Access Indicator 4 of the Kansas Mathematics Assessment were utilized. The mean score for students with two years of CMP instruction was 67.857 with a standard deviation of 26.269. The mean score for students with one year of CMP instruction was 68.698 with a standard deviation of 24.620. The mean score for students with no CMP instruction was 68.361 with a standard deviation of 27.938 (see table 21). The obtained value between groups was $F_{(2, 354)} = .031$. The critical value was 3.02. The comparison of the two indicates there is not enough evidence to conclude there is a statistically significant difference between at least two of the means.

Table 21

Descriptives for Data Access Indicator 4

	N	Mean Score on KMA	Std. Deviation	95% Confidence Interval for Mean	
				Lower Bound	Upper Bound
CMP 2	119	67.857	26.269	63.089	72.626
CMP 1	119	68.698	24.620	64.228	73.167
No CMP	119	68.361	27.938	63.290	73.433
Total	357	68.305	26.239	65.574	71.036

Table 22

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	42.577	2	21.289	.031	.970
Within Groups	245057.14	354	692.252		
Total	245099.72	356			

Using a One-Way Analysis of Variance, the researcher analyzed a sample of students (n=119) who received two years of mathematics instruction using CMP, a sample of students (n=119) who received one year of mathematics instruction using CMP, and a sample of students (n=119) who received no mathematics instruction using CMP. Scores for Data Access Indicator 1 of the Kansas Mathematics Assessment were utilized. The mean score for students with two years of CMP instruction was 81.177 with a standard deviation of 25.551. The mean score for students with one year of CMP instruction was 81.009 with a standard deviation of 26.277. The mean score for students with no CMP instruction was 80.000 with a standard deviation of 26.934 (see table 23). The obtained value between groups was $F_{(2, 354)} = .070$. The critical value was 3.02. The comparison of the two indicates there is not enough evidence to conclude there is a statistically significant difference between at least two of the means.

Table 23

Descriptives for Data Access Indicator 5

	N	Mean Score on KMA	Std. Deviation	95% Confidence Interval for Mean	
				Lower Bound	Upper Bound
CMP 2	119	81.177	25.551	76.538	85.815
CMP 1	119	81.008	26.277	76.238	85.779
No CMP	119	80.000	26.934	75.111	84.889
Total	357	80.728	26.191	78.002	83.454

Table 24

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	96.359	2	48.179	.070	.933
Within Groups	244114.29	354	689.588		
Total	244210.64	356			

Data Access Indicator 6

Using a One-Way Analysis of Variance, the researcher analyzed a sample of students (n=119) who received two years of mathematics instruction using CMP, a sample of students (n=119) who received one year of mathematics instruction using CMP, and a sample of students (n=119) who received no mathematics instruction using CMP. Scores for Data Access Indicator 6 of the Kansas Mathematics Assessment were utilized. The mean score for students with two years of CMP instruction was 72.001 with a standard deviation of 26.823. The mean score for students with one year of CMP instruction was 74.785 with a standard deviation of 23.453. The mean score for students with no CMP instruction was 71.282 with a standard deviation of 25.201 (see table 25). The obtained value between groups was $F_{(2, 354)} = .642$. The critical value was 3.02. The comparison of the two indicates there is not enough evidence to conclude there is a statistically significant difference between at least two of the means.

Table 25

Descriptives for Data Access Indicator 6

	N	Mean Score on KMA	Std. Deviation	95% Confidence Interval for Mean	
				Lower Bound	Upper Bound
CMP 2	119	72.001	26.823	67.132	76.870
CMP 1	119	74.785	23.458	70.528	79.042
No CMP	119	71.282	25.201	66.708	75.857
Total	357	72.689	25.178	70.069	75.309

Table 26

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	814.544	2	407.272	.642	.527
Within Groups	224737.34	354	634.851		
Total	225551.88	356			

Data Access Indicator 7

Using a One-Way Analysis of Variance, the researcher analyzed a sample of students (n=119) who received two years of mathematics instruction using CMP, a sample of students (n=119) who received one year of mathematics instruction using CMP, and a sample of students (n=119) who received no mathematics instruction using CMP. Scores for Data Access Indicator 7 of the Kansas Mathematics Assessment were utilized. The mean score for students with two years of CMP instruction was 81.660 with a standard deviation of 18.929. The mean score for students with one year of CMP instruction was 81.2866 with a standard deviation of 18.047. The mean score for students with no CMP instruction was 78.151 with a standard deviation of 21.418 (see table 27). The obtained value between groups was $F_{(2, 354)} = 1.190$. The critical value was 3.02. The comparison of the two indicates there is not enough evidence to conclude there is a statistically significant difference between at least two of the means.

Table 27

Descriptives for Data Access Indicator 7

	N	Mean Score on KMA	Std. Deviation	95% Confidence Interval for Mean	
				Lower Bound	Upper Bound
CMP 2	119	81.660	18.9287	78.224	85.096
CMP 1	119	81.387	18.047	78.110	84.663
No CMP	119	78.151	21.418	74.263	82.039
Total	357	80.399	19.527	78.367	82.432

Table 28

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	906.408	2	453.204	1.190	.306
Within Groups	13482.96	354	380.912		
Total	135749.37	356			

Data Access Indictor 8

Using a One-Way Analysis of Variance, the researcher analyzed a sample of students (n=119) who received two years of mathematics instruction using CMP, a sample of students (n=119) who received one year of mathematics instruction using CMP, and a sample of students (n=119) who received no mathematics instruction using CMP. Scores for Data Access Indicator 8 of the Kansas Mathematics Assessment were utilized. The mean score for students with two years of CMP instruction was 92.353 with a standard deviation of 18.763. The mean score for students with one year of CMP instruction was 90.252 with a standard deviation of 18.387. The mean score for students with no CMP instruction was 87.101 with a standard deviation of 22.816 (see table 29). The obtained value between groups was $F_{(2, 354)}$ =2.061. The critical value was 3.02. The comparison of the two indicates there is not enough evidence to conclude there is a statistically significant difference between at least two of the means.

Table 29

Descriptives for Data Access Indicator 8

	N	Mean Score on KMA	Std. Deviation	95% Confidence Interval for Mean	
				Lower Bound	Upper Bound
CMP 2	119	92.353	18.763	88.947	95.759
CMP 1	119	90.252	18.387	86.914	93.590
No CMP	119	87.101	22.816	82.959	91.243
Total	357	89.902	20.148	87.805	91.999

Table 30

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1663.165	2	831.583	2.061	.129
Within Groups	142858.40	354	403.555		
Total	144521.57	356			

Data Access Indicator 9

Using a One-Way Analysis of Variance, the researcher analyzed a sample of students (n=119) who received two years of mathematics instruction using CMP, a sample of students (n=119) who received one year of mathematics instruction using CMP, and a sample of students (n=119) who received no mathematics instruction using CMP. Scores for Data Access Indicator 9 of the Kansas Mathematics Assessment were utilized. The mean score for students with two years of CMP instruction was 67.336 with a standard deviation of 21.205. The mean score for students with one year of CMP instruction was 67.692 with a standard deviation of 18.351. The mean score for students with no CMP instruction was 65.171 with a standard deviation of 22.436 (see table 31). The obtained value between groups was $F_{(2, 354)} = .515$. The critical value was 3.02. The comparison of the two indicates there is not enough evidence to conclude there is a statistically significant difference between at least two of the means.

Table 31

Descriptives for Data Access Indicator 9

	N	Mean Score on KMA	Std. Deviation	95% Confidence Interval for Mean	
				Lower Bound	Upper Bound
CMP 2	119	67.336	21.205	63.487	71.186
CMP 1	119	67.692	18.351	64.360	71.023
No CMP	119	65.171	22.436	61.099	69.244
Total	357	66.733	20.707	64.578	68.888

Table 32

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	442.821	2	221.410	.515	.598
Within Groups	512195.39	354	429.930		
Total	152638.21	356			

Data Access Indicator 10

Using a One-Way Analysis of Variance, the researcher analyzed a sample of students (n=119) who received two years of mathematics instruction using CMP, a sample of students (n=119) who received one year of mathematics instruction using CMP, and a sample of students (n=119) who received no mathematics instruction using CMP. Scores for Data Access Indicator 10 of the Kansas Mathematics Assessment were utilized. The mean score for students with two years of CMP instruction was 71.429 with a standard deviation of 26.880 The mean score for students with one year of CMP instruction was 74.286 with a standard deviation of 27.295. The mean score for students with no CMP instruction was 64.033 with a standard deviation of 30.762 (see table 33). The obtained value between groups was $F_{(2, 354)} = 4.140$. The critical value was 3.02. The comparison of the two indicates there is enough evidence to conclude there is a statistically significant difference between the means. Since a statistically significant difference in means occurred, a Tukey Post Hoc was performed in order to provide further analysis of pairwise differences between the groups contributing to the overall significant difference. There was no pairwise difference between the group that had two years of CMP instruction and the group that had no mathematics instruction using CMP. There was a significant difference between the group that had one year of CMP instruction and the group that had no mathematics instruction using CMP (see table 35).

Table 33

Descriptives for Data Access Indicator 10

	N	Mean Score on KMA	Std. Deviation	95% Confidence Interval for Mean	
				Lower Bound	Upper Bound
CMP 2	119	71.429	26.880	66.550	76.308
CMP 1	119	74.286	27.295	69.331	79.241
No CMP	119	64.033	30.762	58.450	69.618
Total	357	69.916	28.615	66.938	72.894

Table 34

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6662.185	2	3331.092	4.140	.017
Within Groups	284835.29	354	804.619		
Total	291497.48	356			

Table 35

Tukey Post Hoc Tests

(I)CMP	(J)CMP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
CMP2	CMP1	-2.857	3.677	.717	-11.512	5.798
	No CMP	7.395	3.677	.111	-1.260	16.050
CMP1	CMP2	2.857	3.677	.717	-5.798	11.512
	No CMP	10.252*	3.677	.015	1.5798	18.907
No CMP	CMP2	-7.395	3.677	.111	-16.050	1.260
	CMP1	-10.252*	3.677	.015	-18.907	-1.597

* The mean difference is significant at the .05 level.

Data Access Indicator 11

Using a One-Way Analysis of Variance, the researcher analyzed a sample of students (n=119) who received two years of mathematics instruction using CMP, a sample of students (n=119) who received one year of mathematics instruction using CMP, and a sample of students (n=119) who received no mathematics instruction using CMP. Scores for Data Access Indicator 11 of the Kansas Mathematics Assessment were utilized. The mean score for students with two years of CMP instruction was 76.303 with a standard deviation of 24.697. The mean score for students with one year of CMP instruction was 77.983 with a standard deviation of 23.920. The mean score for students with no CMP instruction was 72.269 with a standard deviation of 28.177 (see table 36). The obtained value between groups was $F_{(2, 354)} = 1.558$. The critical value was 3.02. The comparison of the two indicates there is not enough evidence to conclude there is a statistically significant difference between at least two of the means.

Table 36

Descriptives for Data Access Indicator 11

	N	Mean Score on KMA	Std. Deviation	95% Confidence Interval for Mean	
				Lower Bound	Upper Bound
CMP 2	119	76.303	24.697	71.819	80.786
CMP 1	119	77.983	23.920	73.641	82.325
No CMP	119	72.269	28.177	67.154	77.384
Total	357	75.518	25.705	72.843	78.194

Table 37

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2052.661	2	1026.331	1.558	.212
Within Groups	233176.47	354	658.691		
Total	235229.13	356			

Data Access Indicator 12

Using a One-Way Analysis of Variance, the researcher analyzed a sample of students (n=119) who received two years of mathematics instruction using CMP, a sample of students (n=119) who received one year of mathematics instruction using CMP, and a sample of students (n=119) who received no mathematics instruction using CMP. Scores for Data Access Indicator 12 of the Kansas Mathematics Assessment were utilized. The mean score for students with two years of CMP instruction was 88.025 with a standard deviation of 19.487. The mean score for students with one year of CMP instruction was 85.588 with a standard deviation of 21.394. The mean score for students with no CMP instruction was 80.966 with a standard deviation of 26.137 (see table 38). The obtained value between groups was $F_{(2, 354)} = 3.018$. The critical value was 3.02. The comparison of the two indicates there is enough evidence to conclude there is a statistically significant difference between the means. Since a statistically significant difference in means occurred, a Tukey Post Hoc was performed in order to provide further analysis of pairwise differences between the groups contributing to the overall significant difference. There was no pairwise difference between the group that had one year of CMP instruction and the group that had no mathematics instruction using CMP. There was a significant difference between the group that had two years of CMP instruction and the group that had no mathematics instruction using CMP (see table 40).

Table 38

Descriptives for Data Access Indicator 12

	N	Mean Score on KMA	Std. Deviation	95% Confidence Interval for Mean	
				Lower Bound	Upper Bound
CMP 2	119	88.025	19.487	84.488	91.563
CMP 1	119	85.588	21.394	81.705	89.472
No CMP	119	80.966	26.137	76.222	85.711
Total	357	84.860	22.641	82.503	87.217

Table 39

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3059.384	2	1529.692	3.018	.050
Within Groups	179433.61	354	506.875		
Total	182493.00	356			

Table 40

Tukey Post Hoc Tests

(I)CMP	(J)CMP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
CMP2	CMP1	2.437	2.919	.682	-4.433	9.307
	No CMP	7.059*	2.919	.042	.189	13.928
CMP1	CMP2	-2.437	2.919	.682	-9.307	4.433
	No CMP	4.622	2.919	.254	-2.248	11.491
No CMP	CMP2	-7.059*	2.919	.042	-13.928	-.189
	CMP1	-4.622	2.919	.254	-11.491	2.248

* The mean difference is significant at the .05 level.

Data Access Indicator 13

Using a One-Way Analysis of Variance, the researcher analyzed a sample of students (n=119) who received two years of mathematics instruction using CMP, a sample of students (n=119) who received one year of mathematics instruction using CMP, and a sample of students (n=119) who received no mathematics instruction using CMP. Scores for Data Access Indicator 13 of the Kansas Mathematics Assessment were utilized. The mean score for students with two years of CMP instruction was 85.378 with a standard deviation of 20.617. The mean score for students with one year of CMP instruction was 87.479 with a standard deviation of 18.853. The mean score for students with no CMP instruction was 80.546 with a standard deviation of 24.562 (see table 41). The obtained value between groups was $F_{(2, 354)} = 3.260$. The critical value was 3.02. The comparison of the two indicates there is enough evidence to conclude there is a statistically significant difference between the means. Since a statistically significant difference in means occurred, a Tukey Post Hoc was performed in order to provide further analysis of pairwise differences between the groups contributing to the overall significant difference. There was no pairwise difference between the group that had two years of CMP instruction and the group that had no mathematics instruction using CMP. There was a significant difference between the group that had one year of CMP instruction and the group that had no mathematics instruction using CMP (see table 43).

Table 41

Descriptives for Data Access Indicator 13

	N	Mean Score on KMA	Std. Deviation	95% Confidence Interval for Mean	
				Lower Bound	Upper Bound
CMP 2	119	85.378	20.617	81.636	89.121
CMP 1	119	87.479	18.854	84.057	90.902
No CMP	119	80.546	24.562	76.087	85.005
Total	357	84.468	21.613	82.218	86.717

Table 42

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3007.703	2	1503.852	3.260	.040
Within Groups	163291.18	354	461.275		
Total	166298.88	356			

Table 43

Tukey Post Hoc Tests

(I)CMP	(J)CMP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
CMP2	CMP1	-2.101	2.784	.731	-8.654	4.452
	No CMP	4.832	2.784	.193	-1.721	11.385
CMP1	CMP2	2.101	2.784	.731	-4.452	8.654
	No CMP	6.933*	2.784	.035	.380	13.486
No CMP	CMP2	-4.832	2.784	.193	-11.385	1.7213
	CMP1	-6.933*	2.784	.035	-13.486	-.380

* The mean difference is significant at the .05 level.

Data Access Indicator 14

Using a One-Way Analysis of Variance, the researcher analyzed a sample of students (n=119) who received two years of mathematics instruction using CMP, a sample of students (n=119) who received one year of mathematics instruction using CMP, and a sample of students (n=119) who received no mathematics instruction using CMP. Scores for Data Access Indicator 14 of the Kansas Mathematics Assessment were utilized. The mean score for students with two years of CMP instruction was 66.387 with a standard deviation of 26.029. The mean score for students with one year of CMP instruction was 68.740 with a standard deviation of 24.925. The mean score for students with no CMP instruction was 56.639 with a standard deviation of 27.728 (see table 44). The obtained value between groups was $F_{(2, 354)} = 7.110$. The critical value was 3.02. The comparison of the two indicates there is enough evidence to conclude there is a statistically significant difference between the means. Since a statistically significant difference in means occurred, a Tukey Post Hoc was performed in order to provide further analysis of pairwise differences between the groups contributing to the overall significant difference. There was a significant difference between the group that had two years of CMP instruction and the group that had no mathematics instruction using CMP. There was also a significant difference between the group with one year of CMP instruction and the group that had no mathematics instruction using CMP (see table 46).

Table 44

Descriptives for Data Access Indicator 14

	N	Mean Score on KMA	Std. Deviation	95% Confidence Interval for Mean	
				Lower Bound	Upper Bound
CMP 2	119	66.387	26.029	61.662	71.112
CMP 1	119	68.740	24.925	64.215	73.264
No CMP	119	56.639	27.718	51.607	61.670
Total	357	63.922	26.296	61.142	66.700

Table 45

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	9797.199	2	4898.599	7.110	.001
Within Groups	243912.61	354	689.019		
Total	253709.80	356			

Table 46

Tukey Post Hoc Tests

(I)CMP	(J)CMP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
CMP2	CMP1	-2.354	3.403	.769	-10.362	5.656
	No CMP	9.748*	3.403	.012	1.739	17.757
CMP1	CMP2	2.354	3.403	.769	-5.656	10.362
	No CMP	12.101*	3.403	.001	4.092	20.101
No CMP	CMP2	-9.748*	3.403	.012	-17.757	-1.739
	CMP1	-12.101*	3.403	.001	-20.110	-4.091

* The mean difference is significant at the .05 level.

Data Access Indicator 15

Using a One-Way Analysis of Variance, the researcher analyzed a sample of students (n=119) who received two years of mathematics instruction using CMP, a sample of students (n=119) who received one year of mathematics instruction using CMP, and a sample of students (n=119) who received no mathematics instruction using CMP. Scores for Data Access Indicator 15 of the Kansas Mathematics Assessment were utilized. The mean score for students with two years of CMP instruction was 70.691 with a standard deviation of 18.581. The mean score for students with one year of CMP instruction was 71.297 with a standard deviation of 21.321. The mean score for students with no CMP instruction was 72.898 with a standard deviation of 20.534 (see table 47). The obtained value between groups was $F_{(2, 354)} = .380$. The critical value was 3.02. The comparison of the two indicates there is not enough evidence to conclude there is a statistically significant difference between at least two of the means.

Table 47

Descriptives for Data Access Indicator 15

	N	Mean Score on KMA	Std. Deviation	95% Confidence Interval for Mean	
				Lower Bound	Upper Bound
CMP 2	119	70.691	18.581	67.318	74.064
CMP 1	119	71.297	21.321	67.426	75.167
No CMP	119	72.898	20.534	69.171	76.626
Total	357	71.629	20.143	69.532	73.725

Table 48

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	309.630	2	154.815	.380	.684
Within Groups	144134.98	354	407.161		
Total	144444.61	356			

Summary

The results of data collected are presented in Chapter 4 with accompanying analyses. An ANOVA was performed to determine if significant differences existed between achievement of students receiving mathematics instruction using CMP and achievement of students receiving mathematics instruction without using CMP. While the means of CMP students were higher than those of non-CMP students, the difference was not statistically significant.

A Univariate Two-Factor ANOVA was performed to determine interaction of treatment and qualification for free or reduced lunch. None of the interaction terms related to this study were significant, nor did the findings show significance for the main effect of curriculum. There was a significant difference between scores of students who qualified for free or reduced lunch and those who did not.

A Univariate Two-Factor ANOVA was performed to determine interaction of treatment and qualification for special education services. None of the interaction terms related to this study were significant, nor did the findings show significance for the main effect of curriculum. There was a significant difference between scores of students who qualified for special education services and those who did not.

Using a one-way ANOVA, student scores on the fifteen data access indicators for the seventh grade Kansas Mathematics Assessment were also analyzed. The means of Indicators 1, 2, 3, 4, 5, 6, 7, 8, 9, 11 and 15 showed no statistically significant differences. The means of Indicators 10 and 13 indicated there was a statistically significant difference between students with one year of CMP instruction and students with no CMP instruction. The means of Indicator 12 indicated there was a statistically significant difference between students with two years of CMP instruction and students with no CMP instruction. Means of Indicator 14 indicated there was a statistically significant difference between students with two years of CMP instruction and students with no CMP instruction as well as a statistically significant difference between students with one year of CMP instruction and students with no CMP instruction.

Chapter 5 presents a study summary that includes the overview of the problem, purpose statement and research questions, review of the methodology, and major findings. Findings related to the review of literature are also presented, as well as implications for action and recommendations for future research.

CHAPTER FIVE

INTERPRETATION AND RECOMMENDATIONS

Introduction

This study examined the effects of *Connected Mathematics* on student achievement as measured by the Kansas Mathematics Assessment. A comparison was made between students who received mathematics instruction during both sixth and seventh grade years, those who received mathematics instruction using CMP during the seventh grade year but not the sixth grade year, and those who received mathematics instruction without using CMP during either sixth or seventh grade years. Scores of sub-group populations were also analyzed to explore trends with respect to low SES and special education student populations. Chapter 4 presented the results of the study. This chapter presents a study summary that gives the overview of the problem, purpose statement and research questions, review of the methodology, and major findings. In addition, findings related to the literature are explored as well as implications for action, recommendations for future research and concluding remarks.

Study Summary

Overview of the Problem

Kansas schools, teachers and students are now being held accountable for their performance on mathematics assessments through state regulations and guidelines.

The Kansas State Department of Education is holding schools accountable for the collective performance of all students in grades 3-8, as well as grade 10. In addition, accountability includes specific subgroups of students including: African American, American Indian, Asian, Hispanic, Caucasian, low SES, special education and limited English proficient. Accountability for the subgroups is valid for schools with thirty or more students identified in a subgroup.

Adding to the pressures, scores are easily accessed by the general public on the Kansas State Department of Education website showing a building report card for each school and district. The increase in the importance of student performances on these types of standardized testing programs makes it vital for districts to examine mathematics curriculum and pedagogy in an effort to meet the standards set forth by the state.

Purpose of the Study and Research Questions

The purpose of this study was to describe the effect of *Connected Mathematics Project* on the mathematics achievement of sixth and seventh grade students as compared to similar students receiving mathematics instruction in a traditional mathematics classroom, as measured by the Kansas Mathematics Assessment. The study focused on 357 students at 5 participating junior high schools. While there are numerous studies related to the effects of CMP on student achievement, there is a lack of research in the Olathe School District identifying any relationship between the CMP curriculum in grades 6 and 7 and increased KMA performance levels.

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

1. What is the effect of the use of *Connected Mathematics* on the mathematics achievement of sixth and seventh grade students as compared to students receiving instruction in a traditional mathematics classroom as measured by the Kansas Mathematics Assessment?
2. What is the effect of the use of *Connected Mathematics* on the mathematics achievement of sixth and seventh grade students of low SES as compared to sixth and seventh grade students of low SES receiving instruction in a traditional mathematics classroom as measured by the Kansas Mathematics Assessment?
3. What is the effect of the use of *Connected Mathematics* on the mathematics achievement of sixth and seventh grade special education students as compared to sixth and seventh grade special education students receiving instruction in a traditional mathematics classroom as measured by the Kansas Mathematics Assessment?

The Review of Methodology

The design of this study was an experimental, control group. The treatment variable was the type of mathematics instruction taught in the classroom. Students in the control group received mathematics instruction in a traditional-lecture based setting. The treatment for the experimental group was mathematics instruction using CMP. Using existing data provided by the Olathe District Assessment Office, scores from the

Kansas Mathematics Assessment were compared for: seventh grade students receiving mathematics instruction using CMP in both sixth and seventh grades, seventh grade students receiving mathematics instruction using CMP in seventh grade but not in sixth grade, and seventh grade students who did not receive mathematics instruction using CMP in either sixth or seventh grades.

Three junior high schools were used in the experimental group. Two comparison junior high schools were used in this study. The dependent variable, mathematics achievement, was measured using scores obtained from the 2008 Kansas Mathematics Assessment. Student scores were reported as percentage scores and performance levels which provided an adequate measure of student math achievement of seventh grades students participating in the study. Although the Kansas Mathematics Assessment was designed to measure individual student performance, overall performance of student cohorts and selected subgroups of each population were also studied. The Kansas Mathematics Assessment is aligned with the Kansas State Mathematics Standards which in turn are aligned with the national mathematics standards developed by NCTM. In addition, CMP aligns with the national mathematics standards, therefore it is assumed that the Kansas Mathematics Assessment is an acceptable measure of the effectiveness of the curriculum to increase student achievement.

For the purposes of analysis, student percentage scores on the seventh grade Kansas Mathematics Assessment were compared with the statistical procedure of analysis of variance to study the effect of *Connected Mathematics* on student achievement. The ninety-five percent confidence level ($p<.05$) was used as the criterion level for determining statistical significance.

Major Findings

Data for this study were compiled from seventh grade scores on the 2008 Kansas Mathematics Assessment. The results are presented in the order of the research questions covering each of the hypotheses tested. The findings are presented below.

The first variable tested was mathematics instruction using CMP. A one-way ANOVA was performed to evaluate the differences in scores. While the mean scores of students receiving mathematics instruction using CMP were higher than mean scores of students not receiving mathematics instruction using CMP, the differences were not statistically significant at the .05 level. Comparison of the two indicated a failure to reject the null hypothesis.

A Univariate ANOVA was conducted to analyze the differences and interactions between the treatment groups and the variable of socio-economic status. Once again, CMP student scores had a higher mean regardless of economic status. The mean score of students with two years of CMP instruction who did not qualify for free or reduced lunch was 77.7%. The mean score of students with two years of CMP instruction who did qualify for free or reduced lunch was 64%. The mean score of students with one year of CMP instruction who did not qualify for free or reduced lunch was 77.4%. The mean score of students with one year of CMP instruction who did qualify for free and reduced lunch was 66.4%. The mean score of students with no CMP instruction who did not qualify for free or reduced lunch was 75.4%. The mean score of students with no CMP instruction who did qualify for free or reduced lunch was 59.5%. Even though the mean scores of CMP were higher than non-CMP students, the findings showed the main effect of mathematics instruction was not statistically significant. The results also showed there was not enough evidence to conclude a statistically significant difference between the means for the interaction between CMP and free or reduced lunch. Therefore, the null hypothesis was retained.

A Univariate ANOVA was conducted to analyze the differences and interactions between the treatment groups and the variable of special education. Once again, CMP student scores had a higher mean regardless of qualification for special education services. The mean score of students with two years of CMP instruction who did not qualify for special education services was 76.7%. The mean score of students with two years of CMP instruction who did qualify for special education services was 51.3%. The mean score of students with one year of CMP instruction who did not qualify for special education services was 77.3%. The mean score of students with one year of CMP instruction who did qualify for special education services was 64.3%. The mean score of students with no CMP instruction who did not qualify for special education services was 76.3%. The mean score of students with no CMP instruction who did qualify for special education services was 52.3%. Even though the mean scores of CMP were higher than non-CMP students, the findings showed the main effect of mathematics instruction was not statistically significant. It should be noted, however, that results showed it was at the .08 level of significance. For the purposes of this study, it needed to be at the .05 level of significance to reject the null hypothesis. The results also showed there was not enough evidence to conclude a statistically significant difference between the means for the interaction between CMP and special education. Therefore, the null hypothesis was retained.

Using a one-way ANOVA, additional analyses were performed on the fifteen data access indicators at the seventh grade level of the Kansas Mathematics Assessment. The means of scores on Indicators 1, 2, 3, 4, 5, 6, 7, 8, 9, 11, and 15 showed no statistically significant differences. However, it should be noted that CMP student scores had higher means on Indicators 1, 2, 3, 4, 5, 6, 7, 8, 9, and 11. Non-CMP student scores had a higher mean on Indicator 15. CMP student scores also had higher means on Indicators 10, 12, 13, and 14. The means on Indicators 10 and 13 indicated there was a statistically significant difference between students with one year of CMP instruction and students with no CMP instruction. The means of Indicator 12 indicated there was a statistically significant difference between students with two years of CMP instruction and students with no CMP instruction. Means of Indicator 14 indicated there was a statistically significant difference between students with two years of CMP instruction and students with no CMP instruction as well as a statistically significant difference between students with one year of CMP instruction and students with no CMP instruction.

Findings Related to the Literature

A formal literature review revealed numerous studies have been conducted using *Connected Mathematics* with mixed results.   Results from many studies indicate an increase in student achievement of students in classrooms using CMP. Other studies find no statistically significant differences in achievement of students in CMP classrooms from students in non-CMP classrooms. This particular study had mixed results as well. While there were no statistically significant differences found in overall scores, there were significant differences in various indicators. In a study by Reys, et. al, students using standards-based materials scored significantly higher in data analysis (74). That is true of this study as well. Both groups of CMP students scored significantly higher on that indicator than non-CMP students.

In a study by Bray, mathematics achievement of eighth graders completing three years of CMP was compared to their mathematics achievement after completing one and two years of CMP. Results indicated no significant difference between the mathematics achievement of students completing two years of CMP, but a significant difference did occur in students completing three years of CMP. Perhaps this study would yield different results if the study were extended another year.

Research indicates that students who are falling behind in mathematics come predominantly form high-poverty and high-minority areas (Balfanz and Byrnes 143). However, many believe that the standards-based reform movement could be a step in the right direction to address the needs of at risk students (Lachat 14). Results from this study showed no significant effect on the interaction of mathematics instruction using CMP and students of low SES. However, students qualifying for free or reduced lunch who received instruction using CMP had higher mean scores than students qualifying for free or reduced lunch who did not receive instruction using CMP.

The literature review indicated there were "few methodologically rigorous studies that examined instructional practices designed to improve the performance of low-achieving students and students with learning disabilities" (National Mathematics Advisory Panel 49). The literature suggested a need still exists to provide experiences in mathematics that provide equity to students with disabilities. Findings from this study showed no significant effect on the interaction of mathematics instruction using CMP and students with disabilities.

Conclusions

Implications for Action

According to Grissmer, Flanagan, Kawata and Williamson, gradual changes on student test scores due to reforms should be expected since scores also reflect instruction in all previous grades (55). With this in mind, the results of this study could be interpreted positively toward CMP. While analyses of scores indicated no statistically significant differences in overall means of students receiving instruction using CMP and students not receiving instruction using CMP, mean scores of CMP students were higher on every hypothesis test. In addition, mean scores on fourteen of the fifteen indicators were also higher for CMP students than non-CMP students. In four of the fifteen indicators, there were statistically significant differences favoring students receiving instruction using CMP. While generalizations cannot be made from this two-year study, continued monitoring of mathematics progress of CMP students through high school would provide greater data as to the long-term effects of this reform curriculum.

Special attention should be paid to the four data access indicators showing a statistically significant difference between CMP scores and non-CMP scores. Procedures should be analyzed to determine instructional differences in the approach to teaching these mathematical concepts.

In order to provide greater consistency in a district, mathematics curriculum in the elementary school should align with *Connected Mathematics.* Grissmer et. al state, "Students need to experience reforms from the first grade before their full effects on scores at later grades are seen" (55). Having a shared vision of mathematics education and instruction from elementary through high school will provide students with a stronger content base. True effects of reform mathematics can only be seen when consistency in practice are in place.

Findings from this study will be shared with teachers, administrators and district leaders. A copy of the full study will be given to the Teaching and Learning Department of the Olathe District Schools. The results of this study may be shared with parents concerned with changes regarding reform mathematics. While the study shows no statistically significant differences favoring *Connected Mathematics* overall, it also demonstrates no advantages to students receiving more traditional mathematics instruction.

This study was conducted to determine the effects of *Connected Mathematics* on students in Olathe District Schools. These findings should be used only in support of studies involving similar populations and demographics. Evaluation of student achievement should be an ongoing process and should not be generalized by one study alone.

Recommendations for Future Research

This study enabled the researcher explore the impact and significance of *Connected Mathematics* on student achievement of middle-school aged students. While all data were found to be reliable and valid, further research is recommended. The following recommendations are provided for the researcher interested in following up on the findings of this study:

1. Replicate this study using similar methodology but an assessment measurement tool other than the Kansas Mathematics Assessment. A different assessment might present different findings.
2. Replicate this study with a larger sample population size. The sample size in this study was limited due to the fact there were only 119 students who completed

two years of mathematics instruction using CMP. In addition, the population sample sizes for the subgroups were also small due to the fact the overall sample size was limited. Evaluation using a larger sample size would either support or contradict the findings of this study as well as similar studies.

3. Replicate this study analyzing effects of CMP on student achievement in regards to ethnicity and gender.
4. Conduct a longitudinal study involving more than two years of data. Analyzing data after more than two years of *Connected Mathematics Project* might present different findings. An extended investigation would allow the researcher to examine if the effects persist.
5. Qualitative research should be conducted to evaluate teachers', parents', and students' perceptions of *Connected Mathematics* and its impact on student achievement. Review of the literature indicates differing opinions across the nation. A study focusing on perceived impact of *Connected Mathematics Project* would provide insight to its effectiveness as measured by the opinions of those actively engaged in the implementation of and participation in the curriculum.

Concluding Remarks

In conclusion, it is the belief of this researcher that student achievement should be the main focus when evaluating mathematics curriculum and instructional practices. As educators, we cannot afford to remain in practices just because they are comfortable. Students of today need different skills in order to compete in the global arena of the future. Each school organization must examine current curricular practices and resources if students are to be adequately prepared for the world to come.

Works Cited

Adams, Loyce, et al. "MIddle School Mathematics Comparisons for Singapore Mathematics, Connected Mathematics Program, and Mathematics in Context: A Summary." A Summary of the Nov.2, 2000 Report Submitted to the National Science Foundation. 2001.

Amrein, Audrey L. and David C. Berliner. "High-Stakes Testing, Uncertainity, and Student Learning." Education Policy Analysis Archives (2002): 1-62.

Balfanz, Robert and Vaughan Byrnes. "Closing the Mathematics Achievement Gap in High-Poverty Middle Schools: Enablers and Constraints." Journal of Education for Students Placed at Risk (2006): 143-159.

Baxter, Juliet A., John Woodward and Deborah Olson. Effects of Reform-Based Mathematics Instruction On Low Achievers in Five Third-Grade Classrooms. Grant funded by the U.S. Department of Education, Special Education Programs. Washington, DC: U.S. Department of Education, Office of Special Education Programs, 2000.

Bray, Megan Shannette. Achievement of Eighth Grade Students in Mathematics After Completing Three Years of the Connected Mathematics Project. EdD Dissertation. Knoxville: University of Tennessee, 2005.

Cain, Judith S. "An Evaluation of the Connected Mathematics Project." Journal of Educational Research (2002): 224-239.

"Chat Archive: Skip Fennell." 7 March 2007. National Council of Teachers of Mathematics. 22 February 2009 <http://www.nctm.org/about/contents.aspx?id=8110>.

Cohen, David K. "Instructional Policy and Classroom Performance: The Mathematics Reform in California." Teachers College Record (2000): 297.

Connected Mathematics. "Connected Mathematics-Home." 2008. Connected Mathematics. 23 February 2009 <http://connectedmath.msu.edu>.

"Contents in Brief by Unit." 2006. Connected Mathematics. 23 February 2009 <http://connectedmath.msu.eud/mathcontent/contents.html>.

Cook, Cathy J. "Critical Issue: Implementing Curriculum, Instruction, and Assessment Standards in Mathematics." 1995. North Central Regional Educational Laboratory. 18 February 2009 <http://www.ncrel.org/sdrs/areas/issues/content/cntareas/math/ma600.htm>.

Cook, Cathy. "The Significance of the NCTM Standards to the Pathways Critical Issues in Mathematics." 1995. North Central Regional Educational Laboratory. 2 February 2009 <http://www.ncrel.org/sdrs/areas/issues/content/cntareas/math/ma0.htm>.

Curriculum and Evaluation Standards for School Mathematics. Reston, VA: National Council of Teachers of Mathematics, 1989.

"Curriculum Focal Points for Prekindergarten through Grade 8 Mathematics." 2009. National Council of Teachers of Mathematics. 22 February 2009 <http://www.nctm.org/standards/focalpoints.aspx?id=5716>.

Erickson, Varick, Andrew Ho, Deborah Holtzman, Andrew Jaciw, Brian Luckow, Xuejun Shen, Xin Wei, and Edward Haertel. Closing the Gap? A Comparison of Changes Over Time in White-Black and White-Hispanic Achievement Gaps on State Assessments Versus State NAEP, CSE Report 721. CSE Report . Los Angeles, California: National Center for Research on Evaluation, Standards, and Student Testing, 2007.

Edwards, Thomas G. Current Reform Efforts in Mathematics Education. ERIC/CSMEE Digest. 1994 <http://www.ericdigests.org/1995-1/current.htm>.

Fennell, Francis (Skip). "Reading, Writing, and Troubled Arithmetic." Wall Street Journal 27 September 2006: A1.

Findell, Bradford, Jeremy Kilpatrick and Jane Swafford. "Adding It Up: Helping Children Learn Mathematics." 2001.

Foundations for Success: The Final Report of the National Mathematics Advisory Panel. Washington D.C.: U.S. Department of Education, 2008.

G. Lappan, J. Fey, W. M. Fitzgerald, S. Friel, and E. Phillips. Getting to Know Connected Mathematics. White Plains, New York: Dale Seymour, 1996.

Gersten, Russell and Benjamin S. Clarke. "Characteristics of Students Brief." 2007. National Council of Teachers of Mathematics. 28 February 2009 <http://www.nctm.org/news/content.aspx?id=11478>.

Guillemette, Roger. "Sputnik and the Crisis That Followed." U.S. Centennial of Flight Commission. 17 February 2009 <http://www.centennialofflight.gov/essay/SPACEFLIGHT/Sputnik/SP16.htm>.

Harold L. Schoen, James T. Fey, Christian R. Hirsch, and Arthur F. Coxford. "Issues and Options in the Math Wars." Phi Delta Kappan (2000): 444.

Haury, David L., Beth D. Green and Marlena Herman. "TIMSS: What Have We Learned about Math and Science Teaching? ERIC Digest." November 2000. ERIC Clearinghouse for Science, Mathematics, and Environmental Education. 20 February 2009 <http://www.ericdigests.org/2003-1/timss.htm>.

Hechinger, John. "New Report Urges Return to Basics In Teaching Math." The Wall Street Journal 12 September 2006: A1.

Hiatt, Diana Buell. Post-Sputnik Educational Reform Era: To Dream the Impossible Dream. Los Angeles: California Educational Research Association, 1986.

Hoff, David J. "Reviews of Math Texts Parallel Pedagogy Rifts." Education Week (1999): 3.

Hook, William, Wayne Bishop and John Hook. "A Quality Math Curriculum in Support of Effective Teaching for Elementary Schools." Educational Studies in Mathematics (2007): 125-148.

"How Do the Curriculum Focal Points Relate to Principles and Standards for School Mathematics?" 2009. National Council of Teachers of Mathematics. 22 February 2009 <http://www.nctm.org/standards/content.aspx?id=268>.

"ISDDE 2008 Prize for Excellence in Educational Design." 2008. ISDDE. 28 February 2009 <http://www.isdde.org/isdde/prize08.htm>.

Jansen, Amanda. "Seventh Graders' Motivations for Participating in Two-Discussion Oriented Mathematics Classrooms." The Elementary School Journal (2006): 409-428.

"John Dewey's Philosophy of Education--Associated Content." 4 September 2008. Associated Content/Education. 1 March 2009 <http://www.associatedcontent.com/article/1008512/john_deweys_philosophy_of_education.html?cat=4>.

K-12 Mathematics Curriculum Center. Curriculum Summaries. Newton, Massachusetts: Education Development Center, Inc., 2005.

Kansas Curriculum Standards for Mathematics. Topeka, Kansas: Kansas State Department of Education, 2003.

"Kansas State Department of Education Assessment Framework." 28 November 2005. Kansas State Department of Education. 28 February 2009 <http://www.ksde.org/Default.aspx?tabid=156>.

Kansas State Department of Education. "Report Card 2006-2007." 2007. Kansas State Department of Education. 2 March 2009 <http://online.ksde.org/rcard/dist_assess.aspx?assess_type=2&org_no=D0233&grade=99&subgroup=1>.

"Kansas State Department of Education Report Card 2007-2008." 2008. Kansas State Department of Education. 3 March 2009 <http://online.ksde.org/rcard/dist_assess.aspx?assess_type=2&org_no=D0233&grade=99subgroup=1>.

Klein, David. "A Brief History of American K-12 Mathematics Education." Mathematical Cognition (2003): 1-46.

Klein, David. "A Quarter Century of U.S. "Math Wars" and Political Partisanship." Journal of the British Society for the History of Mathematics (2007): 22-33.

Kuhn, Matt, Vicki Urquhart, Carmon Anderson, Linda Brannan, and Kathleen Dempsey. EdThoughts: What We Know About Mathematics Teaching and Learning. Denver: McREL, 2008.

Lachat, Mary Ann. Standards, Equity and Cultural Diversity. Providence, Rhode Island: Northeast and Islands Regional Educational Laboratory at Brown University, 1999.

Lewin, Tamar. "As Math Scores Lag, a New Push for the Basics." The New York Times 14 November 2006: 1.

Lewin, Tamar. "Report Urges Changes in the Teaching of Math in U.S. Schools." New York Times 13 September 2006: 1.

Lubienski, Sarah Theule. "What We Can Do About Achievement Disparities." Educational Leadership (2007): 54-59.

Manouchehri, Azita. "School Mathmatics Reform: Implications for Mathematics Teacher Preparation." Journal of Teacher Education (1997): 197.

Martin, Michael O. and Ina V.S. Mullis. Overview of TIMSS 2007. Boston: TIMSS and PIRLS International Study Center, 2009.

"Mathematics Assessments." 19 June 2008. Kansas State Department of Education. 3 March 2009 <http://www.ksde.org/Default.aspx?tabid=156>.

Morris, Robert C. "Implications of Equity and Diversity Within the Standards Movement." 2000. Professing Education. 1 March 2009 <http://profed.brocku.ca/docs/vol5/num2/anum2.htm>.

National Assessment Governing Board. Mathematics Framework for the 2009 National Assessment of Educational Progress. Washington D.C.: United States Department of Education, 2008.

National Center for Education Statistics. "Indicator 15 (2006) Poverty and Student Mathematics Achievement." 2006. National Center for Education Statistics. 1 March 2009 <http://nces.ed.gov/programs/coe/2006/section2/indicator15.asp>.

National Center for Special Education Research. The Academic Achievement and Functional Performance of Youth With Disabilities. Report from the National Longitudinal Transition Study-2. Washington, DC: Institute of Education Sciences, 2006.

National Council of Teachers of Mathematics. "Standards 2000 Project." 2004. Principles and Standards. 1 March 2009 <http://standards.nctm.org/document/prepost/project.htm>.

North Central Regional Educational Laboratory. "Critical Issue: Implementing Curriculum, Instruction, and Assessment Standards in Mathematics." 2000. North Central Regional Educational Laboratory. 2 March 2009 <http://www.ncrel.org/sdrs/areas/issues/content/cntareas/math/ma600.htm>.

Olson, Lynn. "Tugging at Tradition." Education Week 21 April 2000: 1-16.

"Principles & Standards for School Mathematics." 2004. National Council of Teachers of Mathematics. 20 February 2009 <http://standards.nctm.org/document/prepost/project.htm>.

Ravitch, Diane. National Standards in American Education: A Citizen's Guide. Brookings Institutional Press, 1995.

Reys, Robert, Barbara Reys, Richard Lapan, Gregory Holliday, and Deanna Wasman. "Assessing the Impact of Standards-based Middle Grades Mathematics Curriculum Materials on Student Achievement." Journal for Research in Mathematics Education (2003): 74.

Reys, Robert, Barbara Reys, James Tarr, and Oscar Chavez. Assessing the Impact of Standards-based Middle School Mathematics Curricula on Student Achievement and the Classroom Learning Environment. National Center for Education Research. Washington DC: U.S. Department of Education, 2006.

Riordan, Julie E. and Pendred E. Noyce. "The Impact of Two Standards-Based Mathematics Curricula on Student Achievement in Massachusetts." Journal for Research in Mathematics Education (2001): 368-398.

Roseman, Jo Ellen, Gerald Kulm and Susan Shuttleworth. "Putting Textbooks to the Test." 2001. AAAS. 28 February 2009 <http://www.project2061.org/publications/articles/enc.htm>.

Saunders, Debra J. "Fuzzy Memory on Fuzzy Math." San Francisco Chronicle 14 September 2006: B7.

Schneider, C. L. "Connected Mathematics and the Texas Assessment of Academic Skills." Dissertation Abstracts International (2000): 503.

SPSS 14.0 for Windows Student Version, Pearson Prentice Hall, 2000.

Sutton, Bonnie Bracey. Thornburg Center. 13 August 2007.

Suydam, Marilyn N. "Curriculum and Evaluation Standards for Mathematics Education." Mathematics Education Digest (1990): 5.

Teachers and Teaching--The Three R's: Reading, 'Riting, and...Mathematics? January 2009. 16 February 2009 <http://social.jrank.org/pages 962/Teachers-Teaching-Three-R-S-Reading-riting-Mathematics.html>.

Thomas, David. "Expert Panel Selects Exemplary, Promising Mathematics Programs." 6 October 1999. Archived Information. 28 February 2009 <http://www.ed.gov/PressReleases/10-1999/mathpanel.html>.

Thompson, Denisse R. and Sharon L. Senk. Standards-Based School Mathematics Curricula: What Are They? What Do Students Learn? Mahwah, New Jersey: Lawrence Erlbaum Associates, 2003.

"TIMMS 1999 Benchmarking Report Executive Summary." 2001. Mathematics Benchmarking Report. 20 February 2009 <http://timss.bc.edu/timss1999b/mathbench_report/t99bmath _exec.html>.

TIMSS 2007. Boston: TIMSS & PIRLS, 2008.

U.S. Department of Education. "The Federal Role in Education." 2009. Ed.gov. 1 March 2009 <http://www.ed.gov/about/overview/fed/rolehtml>.

U.S. Department of Education's Institute of Education Sciences. Reviewed Study: Riordan, J., Noyce, P. (2001). The impact of two standards-based mathematics curricula on student achievement in Massachusetts. Journal for Reserach in Mathematics Education, 32(4), 368-398. What Works Clearinghouse. Washington, DC: U. S. Department of Education, 2005.

United States Government Accountability Office. No Child Left Behind Act: Education Actions Needed to Improve Local Implementation and State Evaluation of Supplemental Educational Services. Report to Congressional Requesters. Washington, DC: GAO, 2006.

Usiskin, Dr. Zalman. "The Stages of Change." 1999 LSC PI Meeting. Chicago: University of Chicago, 1999. 7.

Vicki Urquhart, Carmon Anderson, Linda Brannan, Kathleen Dempsey, and Matt Kuhn. EdThoughts: What We Know About Mathematics Teaching and Learning. Denver: Mid-continent Research for Education and Learning, 2008.

W. Schmidt, R. Houang, and L. Cogan. "A Coherent Curriculum: The Case of Mathematics." American Educator (2002): 1-17.

Walle, John A. Van de. "Reform Mathematics vs. The Basics: Understanding the Conflict and Dealing with It." 77th Annual Meeting of NCTM. San Francisco: National Council of Teachers of Mathematics, 1999.

Wikipedia. "Olathe, Kansas." 2009. Wikipedia. 20 February 2009 <http://en.wikipedia.org/wiki/Olathe_Kansas>.

Wilson, James W. "Technology in Mathematics Teaching and Learning." 4 March 2007. National Perspectives in Mathematics Education. 18 February 2009 <http://jwilson.coe.uga.edu/Texts.Folder/Tech/Technology.Paper.html>.

Woodward, John and Cyrus Brown. "Meeting the Curricular Needs of Academically Low-Achieving Students in Middle Grade Mathematics." The Journal of Special Education (2006): 151-159.

Appendix

March 2, 2009

Ruth Waggoner
12525 Walmer
Overland Park, KS 66213

Your research project***, What is the Effect of Connected Mathematics on Student Achievement***, has been approved with the following criteria:

- The project goals are aligned with the district and building school improvement goals.
- Nancy Hughes, Math/Science Grant Facilitator, will serve as district contact for the project. Nancy's email is nhughesirc@olatheschools.com.
- Project monitoring reports are to be submitted following the completion of your project. Please submit the project to me at the address listed below.

Olathe staff members look forward to working with you throughout the project. If you should have any questions or require any assistance, please contact me at the R.R. Osborne Instructional Resource Center (913-780-7006).

Sincerely,

Barbara Russell

Research Project Facilitator

R.R. OSBORNE
Instructional Resource Center

14090 Black Bob Road, Olathe, Kansas 66062

Bus. (913) 780-7006 Fax (913) 780-8151