# THE EFFECT OF THE MATH CONCEPTS AND SKILLS (MCS) COMPUTER PROGRAM ON STANDARDIZED TEST SCORES AT A MIDDLE SCHOOL IN EAST CENTRAL FLORIDA

by

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# ABSTRACT

This study measures the effectiveness of the National Computer Systems (NCS) Learn SuccessMaker Math Concepts and Skills computer program on standardized test scores at a middle school in east central Florida. The NCS Learn Company makes three claims for the SuccessMaker interactive computer program, Math Concepts and Skills (MCS): 1. Student Florida Comprehensive Assessment Test (FCAT) scores will improve from using the software 30 hours or more; 2. The increase in FCAT scores is directly related to the length of time the students' spend using the program; 3. The software package grading system is equivalent to the FCAT scoring. This study was designed to evaluate each claim.

To test the first claim, the FCAT Norm Referenced Test (NRT) Mathematics scale scores of the 6th-grade middle school students were compared to the same students' previous FCAT scores. The scores were compared before and after they used the Math Concepts and Skills program. An independent t test was used to compare the scores. There was a statistically significant difference in scale scores when the students used the MCS program for 30 hours or more. Further investigation is needed to establish the causal effect for the observed differences.

To test the second claim, the $6^{th-}$ and $8^{th}$-grade students' time on task in the laboratory was compared to their change in FCAT scores. A Pearson correlation

coefficient of 0.58 was found to exist for the complete 6$^{th}$-grade data set and a 0.71 correlation for the 8$^{th}$-grade group.

To test the third claim, the MCS computer program grade equivalent scores were compared to the mathematics FCAT Level using the dependent t test to see if the two scores were equal. The analysis revealed that the difference in the two scores was statistically significant. Therefore the claim that the two scores are equivalent was not true for this data set.

Recommendations were made for future studies to include qualitative data, a control group, and larger sample sizes. Studying the effect of the Math Concepts and Skills program on FCAT scores continues to be a project for investigation as implementation of the computer software is contingent on improving FCAT scores.

This work is dedicated with love and appreciation to my parents, Dave and Leanne; my children, Christopher and Matthew; and the loving memory of my Nana. Thank you for helping me believe in myself and achieve my dream.

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| | |
|---|---|
| CCC | Computer Curriculum Corporation |
| FCAT | Florida Comprehensive Assessment Test |
| MCS | Math Concepts and Skills |
| NCS | National Computer Systems |

# CHAPTER ONE

# INTRODUCTION

High stakes testing has an increasingly dramatic impact on Florida students and schools. Both student achievement and schools' success are measured with the Florida Comprehensive Assessment Test (FCAT). Therefore, improving the students' test scores is a valued endeavor for Florida educators (George, 2001). This project evaluates the ability of NCS Learn Math Concepts and Skills (MCS) software to improve the students' FCAT scores in middle school.

Children in Florida schools in grades three through ten are evaluated using the FCAT Norm Referenced Test (NRT). The NRT is made up of multiple choice questions that are machine scored. The student's progress in the mathematics section is reported in scale score measurements between 424 and 863 or Sunshine State Level scores ranging from 1 to 5. An increase in scale score or Sunshine State Level is indicative of improved mathematical abilities. Therefore, the lower test performers are assigned to remedial instruction while the advanced classes are reserved for the higher FCAT levels. Furthermore, students unable to pass FCAT minimum performance tasks are retained in 3rd grade or denied graduation in high school. It is evident that the importance placed on the FCAT scores affects the students' educational opportunities. When student scores increase, schools are rewarded with bonus funds and favorable publicity. The extra state or federal (Title 1) funds provide students with access to various academic programs. However, continuous failure to meet minimum standards or improve student abilities results in poor school evaluations and changes in school management.

School evaluations are derived from the students' FCAT scores. Points are awarded to the school for the percent of students that meet standards in mathematics, reading or writing. Extra points are given for the percent improving more than one grade level. Grade levels are measured by the Sunshine State Standards assigned to each school year. Students in the $6^{th}$ grade may be proficient in 3rd-grade skills while unsuccessful in 6th-grade skills. When the student advances more than one year's skill level, the school is rewarded with extra points. The intent is to have all students improve yearly. Therefore, if 56% of the school's population improves one or more grade levels, the school is assigned 56 points. The points are added together to determine the school's final grade. Grades range from A to F corresponding to varying levels of student achievement. In 2003, the grade point scale is, A - 410 or more, B - 380 to 409, C - 320 to 379, D - 280 to 319 and F - 0 to 279 (Florida Department of Education, 2003). Under the No Child Left Behind Act (NCLB)(2001), schools must demonstrate annual yearly progress (AYP) of the students' by sub-groups in order to receive a passing grade at the Federal Level.

The site of this study has received a "C" grade for the past five years due to below average mathematics FCAT scores and a grade of "C" from the federal government based upon AYP of its achievements in mathematics and reading. The school is caught in a cycle: the students test below average therefore the school is graded below average. In an attempt to improve the school's overall grade by increasing the students' mathematics scores, this middle school purchased the National Computer Services (NCS) Learn SuccessMaker Math Concepts and Skills program.

The Math Concepts and Skills is a computer-based interactive program designed to help students improve mathematical skills. The program is the only software used at this middle school to raise mathematics FCAT scores.

In this study, the FCAT scores are evaluated to determine the impact of the Math Concepts and Skills program on FCAT scores. Using both the Sunshine State Level and the scale score reported on the FCAT Norm Referenced Test (NRT) as the measure of student ability, the scores from before using the computer program are compared to the student's score after using the program in sixth grade.

According to NCS Learn, the Math Concepts and Skills program not only raises FCAT scores but also is a predictor of scores. In the Math Concepts and Skills program, the prediction is calculated with a gain score. The gain score is a measurement of the students' success in the computer program. The relationship between the computer program gain score and the FCAT score is evaluated in this study. A common thread in both the FCAT test and the Math Concepts and Skills program is the Sunshine State Standards. The test and the program are designed to meet the Sunshine State Standards' objectives.

The Sunshine State Standards are designed to outline the skills students learn at varying levels of their education. The computer generated gain score is aligned with the same Sunshine State Standards as the FCAT. In this study, the Math Concepts and Skills score is compared to the change in FCAT score to see if there is a correlation between the two measures. If the Math Concepts and Skills scores and FCAT scores follow the outline of the Sunshine State Standards, then the predictive aspect described by NCS Learn, the Math Concepts and Skills developers, is evident in the correlation coefficient.

Another predictor of increased FCAT scores, according to NCS Learn, is the time students invest in using the Math Concepts and Skills program. To investigate the relationship between the time students spend using the program and the FCAT mathematics scores; the two variables are examined using the repeated measures model.

Since increasing FCAT mathematics scores is the main objective of this middle school's Improvement Plan (2003), the focus of this study is to evaluate the extent to which the Math Concepts and Skills section of the NCS Learn's SuccessMaker affects sixth-grade FCAT scores. By studying the FCAT scores before the sixth-grade students use the Math Concepts and Skills program and after, the effect of the software on the FCAT scores is measurable with descriptive statistics. Furthermore, if the SuccessMaker program can be used to predict FCAT improvements, then the gain score and time on task measurement is correlated with the FCAT scores.

The results of this study will be used by the School Improvement Committee to determine the future of the Math Concepts and Skills software in sixth-grade mathematics.

## Purpose of the Study

The purpose of this study is to determine the effect of the NCS Learn SuccessMaker Math Concepts and Skills program on improving mathematical abilities of sixth-grade students at this east central Florida middle school. The study includes:

(a) Comparing FCAT scores before and after exposure to the MCS program for 30 hours or more

(b) Comparing the students' total MCS time on task with the FCAT changes

(c) Comparing the MCS grading system to the FCAT Level scoring system

## Research Questions

The following questions are investigated:

1. Is there a significant improvement in sixth-grade students' FCAT scores when they use NCS Learn Success Maker Math Concepts and Skills (MCS) program for 30 hours or more?
2. Is there a correlation between the changes in students' FCAT scores and increased time on task using the MCS program?
3. Are the students' MCS scores equal to the FCAT Levels as outlined by the program developers?

## Definitions

Ability Grouping - The assignment of students to groups for instruction based on academic achievement (Hallinan, 1995).

Assessment - The process of measuring achievement, aptitude, or knowledge. Types of assessment include criterion referenced, norm referenced, and performance.

CCC - Computer Curriculum Corporation is the original name of the computer program founded in 1967 by Dr. Patrick Suppes, purchased by Simon & Schuster in March 1990, and sold to NCS Learn in 1997, a division of NCS Pearson.

Course Report - A report containing cumulative performance data can be found in Chapter 3. The report provides the number of exercises attempted, time on task, number of responses correct, gain score, strands mastered and failed, as well as current grade level.

Gain score - A score measured in parts of a year by the NCS Learn software package. The score is compared with the abilities students should have at any given month of every school year. For example a gain score of 6.5 refers to a student capable of completing any mathematical task a student in sixth grade during the fifth month of the year should be able to complete successfully. Sunshine State Standards and collected data are used to set the gain measurements.

Mathematics achievement - The amount of mathematical skills and knowledge that an individual knows and possesses (Secada, 1992).

NCS Learn - National Computer Services organization that develops computer learning programs. Software packages available include over 30 curriculum based interactive courses in mathematics, reading, language arts, science and life skills (Paul, 2002).

Scale Score - A measurement assigned by the Florida Comprehensive Assessment Test developers explaining the level of mathematical abilities of students in grades 3rd to

10th. The score is on a continuum from 424 to 863 referring to skills required by the Sunshine State Standards for the given grade level.

Skills – The procedures that are used in a step-by-step sequence to demonstrate knowledge (Carpenter, 1986).

Standardized Test - A form of assessment that is normed by using a sample group within a given population. Scores are calculated using means, standard deviations, and percentiles.

Standards - Expectations of what students know or are able to do in a given subject area at a given grade level.

Sunshine State Standards - Strands, standards, and benchmarks is used to assess student skills in reading, writing and mathematics in Florida.

Time on Task – The time students spend using the MCS program measured in minutes displayed on the computer printout in military time. For example, 13 hours and 10 minutes would be represented as 13:10.

## Limitations

The following limitations are applicable to the study:

1. This study is limited to sixth-grade students at Holly Hill Middle School because it is the only grade level that was implementing the SuccessMaker software package as the program developers had designed. All other grade levels modified implementation and could not be compared to the program claims.
2. This study is quasi-experimental limited to a comparing a stratified sample of a given population.

3. The sample in this study, although chosen randomly from the established classrooms, is not a true random sample. A true random sample is not available because students are not assigned to classrooms randomly and they are heterogeneously grouped in the mathematics classrooms.

## Assumptions

1. The FCAT NRT mathematics scale scores and FCAT Levels measure students' mathematical abilities.
2. An increase in FCAT NRT scale scores from one year to the next year indicates an improvement in mathematical ability.
3. The NCS Learn SuccessMaker Math Concepts and Skills program is being implemented at this middle school as designed by the program developers.
4. NCS Learn claims their materials can raise standardized test scores for 5-8 grades. A comparison is made between the claims of the NCS Learn developers to make the materials appropriate for use with Holly Hill Middle School FCAT students. Then, comparisons of FCAT scores seem plausible.
5. The gain score and time on task elements of the computer-generated printouts from the SuccessMaker Math Concepts and Skills program are accurate.

## Summary

Effective teachers rethink educational priorities (Altbach, Kelly, & Weis, 1985). This east central Florida middle school makes the SuccessMaker software a priority in the sixth-grade mathematics classroom.  This project examines the effect of the Math Concepts and Skills program on the sixth-grade learners' mathematical abilities.

If the SuccessMaker software is improving the students' mathematical abilities, then the students should continue using the Math Concepts and Skills program.  If the software is not fulfilling expectations, then adjustments need to be made to meet the needs of the children.

# CHAPTER TWO

# REVIEW OF LITERATURE

A historical review of K-12 mathematics education reveals the influence of testing and technology in the mathematics classroom. In Florida, standardized testing, namely the Florida Comprehensive Assessment Test (FCAT), dictates procedures in the mathematics classroom including the use of technology. This literature review explores the use of computer technology to improve mathematics FCAT scores.

## Mathematics Education

Traditionally, mathematical achievement was equated to the student's computational skills and abilities to rapidly calculate the correct solution rapidly (Lambert & Lenthall, 1988). People familiar with only the computational aspects of mathematics argue for the inclusion of computers in the classroom (Bransford, Brown, & Cocking, 2000). However, when students view mathematics as discrete and unrelated ideas full of rules and computations, the results are devastating (Alexander, 1992). "Many people go through life afraid of mathematics and upset by numbers. They bumble along miscounting their change, bouncing checks, and eventually trying to avoid college courses or jobs that require even simple math" (Carman & Carman, 2001, p. xi). Some individuals believe they do not possess the ability to do mathematics and will not need these skills outside of school (Kloosterman & Gorman, 1990). Others state they “don’t like math” or “can’t do math” as if it is acceptable to be mathematically illiterate (Taylor & Brooks, 1986).

Yet, people can no longer avoid mathematics. Mathematical literacy is as important as reading ability in today’s society. Without minimum mathematical skills including problem solving, algebraic and geometric skills, students cannot graduate from Florida high schools and adults cannot pass the Tests of Adult Basic Skills (TABE) often a requirement for employment. Historically, higher level mathematics was reserved for students seeking mathematical centered careers, but in today’s society the skills are considered minimum competencies.

The demand for competent mathematical skill is not limited to the child learner. Educators without minimum mathematical abilities, as measured on the College Level Academic Skills Test (CLAST), are prevented from keeping or obtaining a teaching certificate in the state of Florida regardless of the specialization area (Volusia County School Board, 2003). Mathematical ability is also necessary to gain or improve employment status for Florida police officers, fireman, and nurses as measured on the Test of Adult Basic Education (TABE) (Daytona Beach Community College, 2003).

Meaningful mathematical learning has application to real life as it can open or close career doors. Experts agree that students must understand the concepts and operations of mathematics to apply them (Meyen, Vergason, & Whelan, 1993), yet computation remains the dominant focus of instruction in many classrooms (Anyon, 1981). Zenger and Zenger (2002) found that the content taught in the fifth grade mathematics classroom today has remained virtually unchanged for 35 years, although the skills necessary to be successful in the current economy are not the same (Burz, 1996).

Societal demands on education have changed due to the increased influence of electronics and science technology (Foley, 1999). Schools are pressured to teach students to be technically literate. The pressure began with “the national embarrassment over the soviet launching of Sputnik in 1957 resulting in many U.S. school districts becoming recipients of federal funding specifically for the improvement of mathematics and science teaching and learning” (Kysilka & Luckett, 2003, p. 51).

Federal funds are distributed to each state through various legislated programs. Schools in low income areas are provided federal funds mainly through Title I to help equalize learning opportunities for all students. Title I funds from the No Child Left Behind Act of 2001, provided the money for the technological advances in schools (Brown, 2002) such as the NCS Learn software under evaluation in this study. The Math Concepts and Skills program was originally funded by Title I due to the academic and financial needs of the students in an attempt to improve learning. As a result of such funding, a Title I school used technology more than a school without the extra Title I funding (National Center for Education Statistics, 1999).

Federal funds provide training as well as classroom materials and the added technology aimed at improving mathematics education. One popular program implemented in the mathematics classroom was known as “new math and focused on the importance of deductive reasoning, set theory, and abstractions” (Herrera & Owens, 2001, p. 2). It was considered a pedagogical failure because it ignored the basic facts. In response to the “new math” inadequacies, the decade of the 1970s was recognized as the “back to basics” era (Herrera & Owens, 2001, p. 4) utilizing the dominant theory of behaviorism (English, 1997).

The “Back to Basics” movement focused on the belief that children can not learn advanced concepts of mathematics without first mastering the basics skills (Slavin, 1989, p. vi). Achieving proficiency in one skill before moving to the next is prevalent in the mastery learning model of education (Joyce & Weil, 1996).

Given that all children do not learn within the same schedule (Duker, 1972), the mastery learning model is typically employed for building basic skills because it allows students time and practice to improve abilities (Ames & Archer, 1988).

In practice, teaching methodology often includes analogical reasoning (Thorndike, 1903) and Piaget’s structuralism (Inhelder & Piaget, 1958) by having students go beyond simple repetition of basic facts. As in performance based curriculum, mathematics instruction goes beyond factual knowledge (Burz, 1996). When students recognize patterns and trends, they become better problem solvers (Kallick, 1997) and better able to apply the mathematics they have learned.

Unfortunately, in an effort to provide students with the skills needed to succeed in standardized testing, complex mathematical content is presented hastily without proper time spent for exploration and synthesis. When educators cover mathematical topics too quickly and out of context, students learn only isolated facts and are introduced to principles they cannot understand because they lack the knowledge needed to make them meaningful (Bransford et al., 2000).

A student’s mathematical learning is measured by comparing the student’s abilities to predetermined standards. The inability to meet minimum standards restricts the learner’s advancement in many ways. Insufficient achievement in mathematics can prevent a third grade student from advancing to fourth grade and a high school student from acquiring a diploma in the state of Florida (National Center for Education Statistics, 2003).

Society’s demand for mathematically literate citizens is evident in the testing requirements of the FCAT, TABE, and CLAST. Yet the methods of providing mathematical concepts remain an ongoing debate in American Education. To improve mathematical literacy, “We need to study how young children learn arithmetic and simple mathematical concepts, as well as how older children learn more rigorous mathematics.” (National Council of Teachers of Mathematics [NCTM], 2003, p. 189).

This is not a new venture in mathematics education. Many believe that “Instruction in mathematics has always been an essential part of a well-rounded education” (Newton, Schlager, & Sisung, 2001, p.172), but all educators do not agree on exactly what mathematics instruction should include (Zenger & Zenger, 2002).

The long standing debate about improving mathematics teaching and learning is the focus of the National Council of Teachers of Mathematics (NCTM) since founded in 1920 (Lappan, 2003). Before NCTM, special committees were organized, as early as 1892, to make recommendations for better mathematics education in public schools (Newton et al, 2001).

Researchers looking for solutions for improving mathematics education scrutinized school curriculum, teaching methods, and standards carefully (Altbach et al., 1985). The National Council of Teachers of Mathematics (NCTM, 1989, 1991a, 1991b, 2000) continues to publish curriculum standards today.

In 1989, NCTM produced Curriculum and Evaluation Standards for School Mathematics. NCTM determined that school mathematics content should:

1. Facilitate the opening of secondary mathematics to include discrete mathematics, statistics, and mathematical modeling, with increased attention overall to applications.
2. Serve across the grades with stress on connections of mathematics to the real world.
3. Have more integration of mathematics topics.
4. Include emphasis on higher-order thinking and on "making sense" of mathematics through problem solving, communication, connections, and reasoning.
5. Exhibit a change at the elementary level from almost total concentration on arithmetic to inclusion of such topics as geometry, patterns, and statistics (Herrera & Owens, 2001 p.7).

Using standards to guide instruction, American students' are evaluated and compared worldwide in mathematical performance. In the Third International Mathematics and Science Study of United States, students from 1995 to 1999 when compared to other countries, did better in fourth grade than in eighth grade (Figure 1).

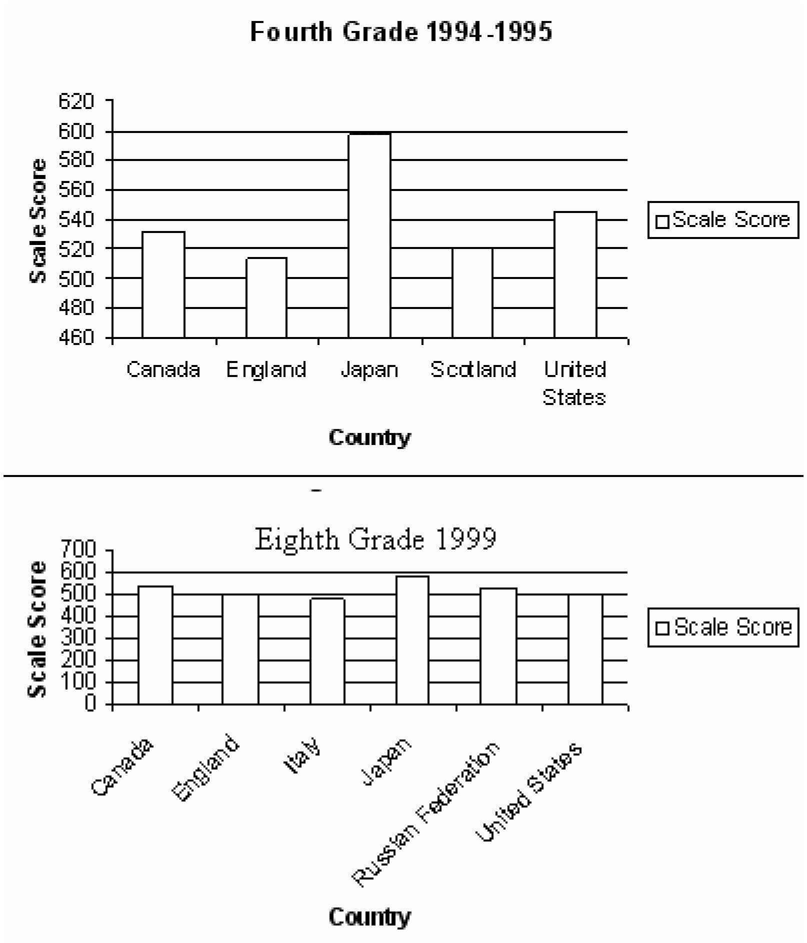



Figure 1: Mathematics Scale Score Comparisons by Country

The graphs show that age is not the determining factor in ability. Children in all the countries are in comparable age brackets. The U.S. students performed second in scale scores in fourth grade in 1995, but fell to the fourth place in eighth grade in 1999. In 1999, the United States eighth grade students had a mean score of 502 in mathematics on the Repeat of the Third International Mathematics and Science Study (TIMSS-R). The 502 score was equal to scores of children in Italy and England, while below those of Japanese, Canadian, and Russian children (United States Department of Education, 1998, p. 50).

In another study by the National Assessment of Educational Progress (National Center for Education Statistics, 1999), the percent of students in grades four through twelve scoring at or above basic levels increased during 1990-1996. In 1995, 4th graders in the United States performed better than 12 countries but below their peers in 7 countries (p. 32). The eighth grade student findings were reversed with 20 countries performing better than the United States and only 7 countries below the United States (pp. 32-33). The worst results were found in 12th grade students where the United States were better than only 2 countries but below 14 countries.

Comparing male and female performance internationally, the United States has the least difference in male and female abilities but overall scores below the other countries (Table 1).

Table 1

Global Comparison of Male and Females

| Country | Overall | Male | Female |
|---|---|---|---|
| USA | 461 | 466 | 456 |
| Russian Fed. | 471 | 488 | 460 |
| Italy | 476 | 490 | 464 |
| Canada | 519 | 537 | 504 |
| France | 523 | 544 | 506 |

The difference in gender abilities in mathematics has been attributed to participation in mathematics activities (Pallas & Alexander, 1983). Subsequently, as the sex role stereotypes in society decrease, so does the gender gap in mathematical abilities (National Research Council, 1989).

Table 2 reveals a clear difference in ethnic test scores. Educational achievement has been found to be correlated with minority status and poverty (Bennett & LeCompte, 1990). The mathematics test score difference in ethnic groups is stronger than gender differences. The differences in gender achievement are closing while the differences in ethnic achievement appear constant. Without additional information regarding the test scores, speculation about the differences is impossible.

Table 2

Comparing Males, Females, White, and Black Mathematics Scores

| Gender | | | Race | | Year |
|---|---|---|---|---|---|
| Male | Female | All | White | Black | |
| 303.8 | 297.1 | 300.4 | 305.9 | 268.4 | 1979 |
| 306.3 | 302.9 | 304.6 | 309.5 | 288.5 | 1990 |
| 308.9 | 304.5 | 306.7 | 311.9 | 285.8 | 1992 |
| 308.5 | 304.1 | 306.2 | 312.3 | 285.8 | 1994 |
| 309.5 | 304.9 | 307.2 | 313.4 | 289.4 | 1996 |
| 309.8 | 306.8 | 308.2 | 314.8 | 283.3 | 1999 |

Table 3 compares the amount of time fourth and eighth grade students spend on studying mathematics. The percent of students who spend 3 hours or more of study in the classroom is higher in $4^{th}$ grade than in $8^{th}$ grade. The amount of time spent on homework each night, in both the $4^{th}$ and $8^{th}$ grades about the same, 30 minutes or more every evening. Overall the aversion to mathematics appears to progress as students advance through their education. In elementary school, the students' attitudes about mathematics are generally positive. As students progress through the middle school, the mathematical content to which they are exposed is less appealing (Taylor &

Brooks, 1986). This indicates that confidence in mathematical ability decreases as children progress from elementary to high school (NCTM, 1991a).

Table 3

Time Spent on Mathematics Study

| Area | 4th grade<br>3 or more | 1996–2000<br>30 min. | 8th grade<br>3 or more | 1998–2000<br>30 min. |
|---|---|---|---|---|
| All USA | 89 | 58 | 71 | 50 |
| North East | 91 | 56 | 79 | 46 |
| South East | 84 | 58 | 67 | 52 |
| Central | 87 | 58 | 67 | 49 |
| West | 92 | 62 | 70 | 51 |

In the middle and high school, students are often placed in ability groups in mathematics classrooms (Useem, 1991). Theoretically, homogeneous grouping allows teachers to present specific content at appropriate ability levels. What is known is that the content must be well defined and structured for successful transfer to learners regardless of class demographics (Alexander, 1992). "Educators hope that students will transfer learning from one problem to another within a course, from one year in school to another, between school and home, and from school to workplace" (Eisenberg & Berkowitz, 2000, p. 12).

Students should be required to share, question, and challenge mathematical ideas (NCTM, 1989) to further the understanding and application of concepts. Previously, the activities that utilize in-depth discussion and reflection were considered time consuming and hard to measure on standardized tests. Currently, the FCAT developers claim to measure higher level thinking (Ellington, 2003).

## Impact of Standardized Testing in Mathematics

Assessment and accountability play an increasingly important role in American schools (Linn, 1998). The pressures for higher test scores push teachers to present large volumes of information quickly (Middlebrooks, 2003); yet American children are still behind other students in mathematics (Stevenson, Chen, & Lee, 1993; National Center for Education Statistics, 1999). In an attempt to change this trend, improving students' test scores is the focus of valuable classroom time (Kulm, 1994; Middlebrooks, 2003). Although the original goal of assessment was to measure the extent to which schools were meeting students' needs (Mann, 1965), today educational priorities and the reasons tests are implemented are debatable factors. In Florida, the students' performance on one test can determine if the students are retained in a grade level or are prevented from graduating from high school.

"The origin of standardized testing goes back to Sir Francis Galton, a cousin of Charles Darwin and creator of the infamous bell curve" (Armstrong & Casement, 2001, pp. 70-71). The tests are constructed to divide the students into two groups, half above the norm (Kohl, 1982) and half below the norm. Therefore students are compared to the norm as determined by the original normed group (Sowell, 1993). Standardized tests are not renormed very often (Gellman, 1995).

Standardized assessment is used to measure levels of student achievement (Eisenberg & Berkowitz, 2000). Teachers use standardized testing results to make judgments about student’s learning (Kallick, 1997); individualize instruction and the identification of special student needs (Eisenberg & Berkowitz, 2000). The test score is also used to place students in remedial or advanced mathematics classrooms.

Test scores can also be used to identify possible mathematical handicaps. When students with normal or above average intelligence display a significant discrepancy (two or more years) between age and mathematics ability the cause could be attributed to dyscalculia, a recognized learning disability involving the inability to complete mathematical procedures (Kenyon, 2000).

In practice, the standardized tests are used to explain learning accomplishments and deficiencies as well as set goals for future learning (Meyen et al., 1993). Therefore an individual’s educational opportunity in mathematics is highly related to there standardized test score.

The “No Child Left Behind” (NCLB) Act mandates that students with disabilities are expected to improve abilities (McLester, 2003). NCLB Act of 2001 requires states to bring all students to proficiency in the respective state tests by the 2013-2014 school years. The schools’ ability to raise all students scores are evaluated in the Adequate Yearly Progress (AYP) report. States are particularly concerned with meeting the AYP guidelines to avoid being identified as failing schools in need of improvement (Olson, 2003). Schools are faced with the monumental task of improving all students’ performance on the standardized tests used to evaluate AYP.

A theory for improvement is that if teachers raise expectations, students will improve success on the standardized tests (Gratz, 2003). Since the standardized tests are designed to measure achievement of students’ varying levels, some questions are answerable by only the highest achieving students.  To ensure minimum proficiency, teachers present all students with specific mathematical standards covered on the standardized test.  The standardized test used in Florida is the Florida Comprehensive Assessment Test (FCAT) which is aligned with the Sunshine State Standards.

The FCAT and the Sunshine State Standards are used in Florida to assess the students' learning.  The FCAT is composed of varying response styles including multiple choice, short response and long response.  The norm referenced section has only multiple choice style answers.  The questions correspond to the Sunshine State Standards.

In May 1996, the state of Florida adopted the Sunshine State Standards.  The standards are divided into four grade-level groups; PreK-2, 3-5, 6-8, and 9-12.  The students' ability to meet the standards is evaluated and reported yearly.

The first Florida Comprehensive Assessment Test (FCAT) results were first reported in 1998.  Yearly assessment of all students grade 3$^{rd}$ to 10$^{th}$ was included in the revised 1999 student assessment law.  The Norm-referenced test (NRT) section of the FCAT includes only questions that can be machined scored.  The machine scored questions are multiple choice and gridded response.

In 2003, the test for the 3$^{rd}$ to 10$^{th}$ graders is the Stanford Achievement Test 9 (SAT 9).  Beginning in March 2005, the SAT 10 will be used through March 2006 (Ellington, 2003).

Using the standards and alignments, the FCAT mathematics test for the middle school student is divided into five groups; number sense, concepts, and operations:

measurement; geometry and spatial sense; algebraic thinking; and data analysis (Ellington, 2003).

Volusia County students in grades two through eight took the Comprehensive Test of Basic Skills 4th Edition (CTBS) until 1999. Since the discontinuation of the CTBS testing, Volusia County has used the Florida Comprehensive Assessment Test (FCAT). FCAT is the latest version of Florida’s statewide assessment program.

The FCAT measures the content defined by the Sunshine State Standards also called the Florida curriculum frameworks. Initially designed to measure skills in only four grade levels (3rd, 5th, 8th, and 10th), the FCAT now includes grades 3rd through 10th. The year 2001 was the first year reports were given for all seven grades evaluated. For the class of 2003, the FCAT was the test required for high school graduation.

The Norm Referenced Test (NRT) section of the FCAT is reported in scale measurements that range from 424-863 across all grades. According to the Department of Education in Florida, the primary purpose of the FCAT is to assess students’ achievement on higher order cognitive skills. Although this is evident in many of the questions in the FCAT mathematics test, computational and conceptual skills are also a major focus of the test. Critics indicate that standardized tests frequently measure only quick and superficial thinking and cannot be accurate predictors of higher order thinking or academic success (Sowell, 1993). However, others have found strong positive relationships between how students are taught, particularly the use of task related interaction, and gain on standardized tests (Cohen, 1984).

The first 3 years of the FCAT reporting scores include both scale scores and achievement levels. The achievement level scores range from level 1 (lowest) to level 5 (highest) and were adopted by the State Board of Education (2001).

## Computer Use in the Mathematics Classroom

Billed as "a greater educational invention than books and writing" (Walker, 1984, p. 30), technology possesses the intrinsic ability to improve skills measured by standardized tests (Curry & Sabatino, 1994) and are expected to improve education (Schofield, 1995). Some researchers have found computers are able to meet this expectation and raise student scores (Becker, 1994; Christmann & Badgett, 1999; Hativa, 1994; Kulik & Kulik, 1987), but not all educators believe technology can solve the problems in education today.

The first computers used in mathematics were simple manipulation machines like the abacus. Blaise Pascal (1623–1662) designed a simple calculator for addition and subtraction. Then in the 1670s, Gottfried Leibniz (1646–1716) improved on Pascal's invention by making a machine capable of multiplication and division. Charles Babbage (1791–1871) made a machine capable of calculating entire mathematical tables (Sharples, Hogg, Hutchinson, Torrance, & Young, 1989). Computers today are capable of far more, yet often limited to constructing tables and basic computation. The computers are used to measure the same abilities tested on the standardized tests. When the goal is to raise test scores, the technology is molded to that objective.

This improvement in test scores has been attributed to more than just fact acquisition. Some claim an increase in academic interest and motivation is the true reason computers are successful for improving test scores. There is an abundance of literature that tells us if students are motivated to learn, they learn (Sprinthall & Sprinthall, 1987).

Below average educational achievement is correlated with minority status and poverty (Bennett & LeCompte, 1990) and include the multiple factors affecting mathematical ability such as math anxiety, value of learning, self-efficacy (Berndt & Miller, 1990; Kloosterman, 1988), and environment. Although these factors are not part of this study, the achievement of minority students who have access to computers is.

When using any technology in the classroom atmosphere, the physical location of the computers is as important as the specific software and hardware chosen (Schofield, 1995). The choice of software and technology should be guided by academic goals, sound research, and teacher input (Duker, 1972).

Although academic outcomes are the purpose for the use of computer packages in mathematics classroom (Schofield, 1995), these are often difficult to measure objectively. The promises of technology in the classroom go beyond mire tutorial experiences and are described by some researchers as having utopian visions for improving success in mathematics (Papert, 1980; Walker, 1984).

"Technology can affect virtually every aspect of assessment, from test design and administration to the scoring and reporting of results" (Olson, 2003, p.1). Cost is one influencing factor for using technology in testing. The same paper and pencil test would cost 8 to 10 dollars to administer only cost 5 to 6 dollars using the computer (Olson, 2003). In 2003, Congress provided $384 million dollars to help states pay the cost of standardized test administration and development (Florida Department of

Education, 2003). With the limits on school funding, the goal is to reduce the cost of standardized tests while maintaining the accuracy of the assessment.

Using computers for standardized testing is problematic; for example, it is difficult to provide the same atmosphere at the same time to all students. Georgia was forced to suspend their online testing after discovering that 270 actual test questions were available on the internet for teachers, students and parents to view (Olson, 2003). Therefore, computers are used more for preparing students for testing rather than in administration of testing.

The United States has increased expenditures for each student in public and private schools from 6,680 in 1994 to 7,764 in 1998. The United States' spending on students' educational needs is greater than France, Germany, Italy, Japan, and the United Kingdom (Sherman, 2000).

Olson (2003) predicts that the United States will increase expenditures in technology based programs to prepare students for state exams. Although scores increase when students use computer preparation, some claim they also increase academic interest and motivation (Kozma, 1991; Sivin-Kachala, 1998) which is the reason computers improve standardized test scores. Relan (1997) attributed the increased motivation to the immediate feedback and individualized instruction. Fox (1998) argued that the increased motivation is attributed to the new medium and the positive effects of technology will wear off as the students get used to the computerized instrument.

The use of computers in U.S. schools continues to increase in an attempt to improve learning. The number of students who use computers at home rose from 14%

in 1984 to 45% in 1997. Children's use of technology at school rose from 30 % in 1984 to 76% in 1997 (National Center for Education Statistics, 1999). The popular idea is that the computer is capable of reaching a child's individual level and accommodating learning efficiently (Curry, 1994).

The increase of technology in the classroom necessitates ensuring usage is correct and effective. Teachers report differing uses of technology in the mathematics classroom. Fourth grade learners play more games, while eighth grade students report using more drill and practice programs. Few students use computers for demonstration of new topics, simulation, or application of skills (National Center for Education Statistics, 1999).

Oh (1999) recommended that before schools purchase computer software, they ask the following questions:

1. Does the software program focus on the skills you want your class to master?
2. Does the program contain a range of levels to accommodate all of your students?
3. Can children easily change skill levels and select any activity so that they can work independently?
4. Does the program keep track of a student's progress from one session to the next?
5. Is the program engaging?

Changes in instruction are required when using computer programs (Meyen et al., 1993; Fuchs, 1989). The teacher's role in the computer equipped classroom changes from lecturer and dispenser of knowledge to individualized coach for the students (Kerr, 1991; Linn, 1992; Office of Technology Assessment, 1996; Schofield, 1995). “Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances student learning. It needs to be used wisely, by well-informed teachers, to support understanding” (NCTM, 2003, p. 2). Nonetheless; “There is not a technological panacea; there are only technological solutions to some educational problems (Sloan, 1991, p 14).

The educational problem addressed by NCS Learn computer program is improving test scores. Students using the Math Concepts and Skills program are promised higher mathematics test results. Using the behaviorist theory, material is presented and the students are required to respond to the given stimuli. Upon the correct response, the students are rewarded with points and a yellow ribbon displayed on their computer screen. The constructivist approach to education is also implemented in the Math Concepts and Skills (MCS) software by guiding students to create their own understanding of concepts by manipulating objects on the computer screen.

The Behaviorist and Constructivist theories in mathematics education have been repeatedly investigated (Gales & Yan, 2001; Martin, 1973). Many researchers agree that basic facts are important for problem solving (Brown, 1989; Burstein, 1986; Gentner, 1989; Holyoak & Thagard, 1989; Novick, 1988). Although the cognitive theorist believes that a collection of mathematical ideas must be built in the student’s mind to be relevant, the constructivist believes that new mathematical ideas come from previously learned ideas (English, 1997). It was the constructivist’s view that drove the “Back to Basics” movement.

In an effort to improve basic skills, NCS Learn employs the mastery learning philosophy in that students must attain mastery of prerequisite skills before advancing to more difficult content. The learner must complete questions within a 75% accuracy to move to the next level. Students that do not meet the minimum requirement are presented background information, algorithm steps, and subsequent examples to promote mastery upon reevaluation.

The premise of the Math Concepts and Skills program is that practice with the Sunshine State Standards improves standardized test scores. Since knowledge is most likely to be applied in the context for which it was learned (English, 1997), the questioning styles of test preparatory computer programs are closely aligned to the test. In the case of this study, the Math Concepts and Skills questions closely mirror the Florida Comprehensive Assessment Test (FCAT).

The Math Concepts and Skills program was field tested on 1000 students before a full scale implementation and has been continuously evaluated in practice (Brush, 1998; Underwood, Cavendish, Dowling, Fogelman, & Lawson, 1994). The evaluations are quasi-experimental and measure outcomes with standardized test scores which mirror the design of this study.

## Conclusion

The historical review of K–12 mathematics education reveals that students can no longer avoid higher-level mathematics however there is an increased focus on testing. Educators strive to improve test-taking skills and increase mathematical skill level to prepare students to be successful on FCAT for Annual Yearly Progress reports and school evaluations. The FCAT dictates technology procedures in the mathematics classroom so that technology is used to improve selected skills tests are designed to measure. The multitude of Sunshine State Standards required in a given year limits the instruction time available for hands on activities and in depth exploration.  Exploration is not tested on the FCAT and skills practiced in the classroom mirror test questions. Computer use for improving mathematics FCAT scores lends to individual pace and the ability to reach students success level. Therefore, individualized computer instruction is suitable for improving student progress on the FCAT mathematics test.

# CHAPTER THREE

# METHODOLOGY

To evaluate the effect of the Math Concepts and Skills (MCS) program on FCAT scores at an East Central Florida middle school, the $6^{th}$ grade (2003–2004) and $8^{th}$ grade (1998–1999) students FCAT scores were examined. Understanding the unique make up of the sample group, the procedures followed in this study, and the measurements which evaluate the MCS computer program are essential to this project.

## Sample

The sample group for this study includes 114 students from the middle school, 64 $6^{th}$-grade students from the 2003–2004 school year, and 50 $8^{th}$-grade students from 1998.

This middle school is part of the greater metropolitan area of East Central Florida. It is a comparatively small town covering only four square miles. Students are drawn from within city limits and the surrounding communities. The middle school is one of 71 schools which includes; three alternative education centers, three charter, forty-six elementary, eight high schools, along with the eleven middle schools.

The student population does not mirror the county or city populations as evident when examining the economic level of the school population. The median household income for city residents is substantially lower than that for county. In the 1990 census, the county median income ranged from $20,000 to $34,000 with 25% of the total population earning less than $25,000 (National Center for Education Statistics, 2003). Yet, the median household income for middle school was between $15,000 and $16,000 (National Center for Education Statistics, 2003). The middle school is disproportionately lower in economic status than the surrounding areas in the county.

The free lunch eligibility mirrors the residential make up with 65% of the school population qualify for free or reduced lunch. Table 4 shows the free lunch participants for the middle school over the past five years and indicates that the pattern of eligibility has been consistent over time.

Table 4

Reduced Lunch Data

| School year | Free or reduced % |
|---|---|
| 2001–2002 | 65.0 |
| 2000–2001 | 65.7 |
| 1999–2000 | 63.0 |
| 1998–1999 | 63.9 |
| 1997–1998 | 63.9 |

Source: National Center for Education Statistics, 2003

The financial need of the school population is relevant in that it qualifies the school for the Title I services and concomitant funding for the Math Concepts and Skills program.

Beyond financial differences, the students are ethnically different than the county and city reported in the 2002 Census (National Center for Education Statistics, 2003).

At the middle school in the 2001-2002 school year, the racial percentage was nearly balanced with 53% white and 47% minority (43% black and 4% other). The statistic is surprising since out of the 12,119 people living in city currently only 13% are minority (9% black and 4% other) and 87% white. Comparatively, the county population is 86% white and 14% minority (9.3% black and 4.6% other). The city and county have about the same racial mix, yet the middle school does not reflect the average majority/minority ratio.

Student discipline is not affected by race but is recognized as a pressing problem at this middle school. Student behavior has been an issue of concern for the School Improvement Plan committee members since 1997. Table 5 shows the percent of suspensions from 1997-2002. Suspensions, both in-school and out of school, have steadily increased.

Table 5

School Suspension Rate from 1997 to 2002

| Year | In-school suspension % | Out-of-school suspension % |
|---|---|---|
| 2001–2002 | 43.6 | 24.9 |
| 2000–2001 | 36.8 | 23.9 |
| 1999–2000 | 38.9 | 15.5 |
| 1998–1999 | 43.9 | 19.9 |
| 1998–1997 | 29.4 | 19.3 |

Source: National Center for Education Statistics, 2003

The school climate is influenced by a large exceptional educational population, which exceeds 20%. With so many special needs students, the middle school is an inclusion school, providing the least restrictive environment for all students. The inclusion model has been adapted to best fit the needs of the school and students. As a result, a pull-out program for students with special needs in mathematics and reading separates the slower learners. The students are selected for the program reviewing their standardized test scores. Students in the lowest quartile are placed in the pull-out program and provided intense study of either mathematics or reading.

The school schedule begins at 8:15 AM but classes begin at 8:55. The students are provided tutoring before and after school. During the tutoring program, the learner can access the NCS Learning Computer Laboratory and use the MCS program.

The MCS program is designed to improve FCAT scores. The need to raise FCAT test scores is a recurring theme at this middle school. Test results of students compared to the County and State scores reveal this middle school lags behind an average of 11 points below the county and 8 points below the state. The below average test achievement is a factor of the school rating allocated by the county. The middle school has historically been a “C” school on a scale of A to F.

The focus of this study is the influence of Math Concepts and Skills on the Florida Comprehensive Assessment Test (FCAT) scores at this East Central Florida middle school. Family influence, race, and economic status will not be evaluated in this study but are important factors to consider for future investigations.

## Instrumentation/Measures

The instruments used in this study include the Math Concepts and Skills (MCS) program printouts and Florida Comprehensive Assessment Test (FCAT) scores.

The MCS program is a computer based mathematics software package designed by NCS Learn SuccessMaker. The goal of the program is to develop mathematical understanding, critical thinking, problem-solving skills, making inferences and finding patterns. Instructional objectives are organized in strands (Appendix C) with each strand focusing on either computation or application. The MCS program is a closed system with all diagnostic and evaluative functions automatically calculated. A sample student activity is in Appendix B.

To measure the students' success, the skills are assigned grade equivalent coding. For example, a skill noted MU 3.55 would be a multiplication problem any 3$^{rd}$ grade student in the 5$^{th}$ month of 3$^{rd}$ grade should be able to complete correctly. The grade level score is calculated using the Sunshine State Standards and supplemental data accumulated from schools across the country.

Grade level score is displayed in the students' program evaluation reports along with the students' time on task and MCS gain score. In the printout, the students' time on task is given under the TOT Time column while the MCS gain score is the difference between the current level and initial placement level (IPM). A sample MCS printout can be found in Table 6.

Table 6

Level, Session, and Performance

| Date 00/00/00 | | Level, Session, and Performance | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | 667 HHMS MANNING 7 | | | | |
| Student | Crs. | Total time | Total correct | Enr level | IPM level | Curr level | Total Sess | Gain |
| 1234 | MCS | 0:33 | 42 | 7.07 | 7.05 | 7.05 | 3 | 0.00 |
| | LS | 0:10 | 89 | 3.00 | ---- | 3.23 | 1 | 0.23 |
| | RW | 1:48 | 78 | 4.50 | 4.50 | 6.28 | 7 | 1.78 |

Program developers equate time on task and MCS grade level scores to specific FCAT scores. Therefore these reports were instrumental in measuring the effect of the MCS program on FCAT scores.

MCS grade level scores and the program claim of equated FCAT Levels are in Table 7 while the complete time on task flow chart is in Table 12 (Appendix D).

Table 7

FCAT to MCS Grade Level Conversion

| | FCAT | Program level | FCAT | Grade level |
|---|---|---|---|---|
| FCAT M2 | Level 1 | 0.01–4.89 | Level 2 | 4.9 |
| FCAT M3 | Level 2 | 4.90–6.09 | Level 3 | 6.1 |
| FCAT M4 | Level 3 | 6.10–7.19 | Level 4 | 7.2 |

The FCAT Sunshine State Level and FCAT NRT scale scores were examined to study the relationship of FCAT and MCS scores. The NRT was designed to measure the students' abilities against national norms (Felsch, 2003). The NRT assesses number sense, concepts and operations, measurements, geometry, spatial sense, algebra thinking, data analysis and probability. The NRT mathematics scale scores range from 424-863 where as the FCAT Levels range from 1 to 5. The students' FCAT scale score was compared to each students' previous scale score, the MCS gain score, and the time on task measurement for a complete evaluation of program effectiveness. The FCAT Level score was compared to the MCS level outlined in Table 5.

## Procedures

Students' FCAT scores from the 2003-2004 and 1998-1999 school years were entered into SPSS statistics software program. In order to answer the research questions, the statistical procedures included an independent t test, Pearson correlation, and dependent t test with paired means.

The fundamental questions of the study were: Do students who use the Math Concepts and Skills program for 30 hours or more achieve higher FCAT scores? The MCS literature claims that 75% of the students will increase one year in math skills if they use the program for 30 hours (Reference Manual for Math Concepts and Skills, 1998). To explore this claim, the students' MCS time on task score was divided into two groups, one group of 30 hours or more and one group of 29 hours or less. An independent t test was run on the students' 2003-2004 FCAT scores to see if the scores were statistically different after the students use the MCS program for 30 hours or more.

Secondly, does increasing the time on task using the MCS program significantly improve standardized test scores? To evaluate if any extra time on task in the MCS laboratory would improve FCAT scores, student FCAT gain scores were correlated with time on task in the MCS laboratory to see if the two measurements were related. In order to ascertain if the relationship was consistent beyond the 6th grade class, the first group to use the MCS program from1998 was examined. This group consisted of 8th grade students only.

And finally, is the MCS grade equal to the FCAT level score? To verify if the MCS grade score is the same as the change in FCAT Level, the 2004 FCAT Level was compared to the program claims found in Table 5 using a dependent t test. If the two scores were related, as stated by the NCS Learn Company, then the two scores would not have a statistically significant difference.

To improve the analysis of the MCS program, the county Title 1 program distributed and collected a Likert-type survey (Appendix A) to all teachers. The results of this survey were examined concerning the evaluation of the MCS program's use in the mathematics classroom. The program was used this middle school from 1998 to 2004 and evaluating the effect of the MCS program on FCAT scores was the focus of this study.

# CHAPTER FOUR

# FINDINGS

The purpose of this study was to evaluate three of the claims from the Math Concepts and Skills (MCS) computer program produced by the NCS Learn Company.

The first claim was that students using the MCS laboratory for 30 hours or more would experience higher FCAT scores than students using the program for less than 30 hours. The 2003-2004 $6^{th}$-grade students were examined to find this relationship. They were the only group that experienced 30 hours or more in the MCS laboratory.

The 64 $6^{th}$-grade students' FCAT scores from 2003–2004 were compared to their $4^{th}$ grade FCAT scores. The students did not use the program in $4^{th}$ grade. This comparison yielded a difference score. This difference was calculated by subtracting the students' $4^{th}$-grade score from their $6^{th}$-grade score. The FCAT scores were then divided into two groups, students that used the program for 30 hours or more and students that used the program for less than 30 hours.

Using the FCAT scores and the MCS total time on task score, the Levene's Test for equal variances showed the variances were statistically equal so the independent t test was acceptable for evaluation. The independent t test revealed that there was a statistically significant increase in the group scores that had 30 hours or more in the MCS laboratory ($t\ (62) = 2.93$, $p \leq .05$). Descriptive statistical data can be found in Table 8.

Table 8

Statistical Data

| Total MCS time | N | Mean | Std. Deviation |
|---|---|---|---|
| 30 hours or more | 11 | 61.55 | 23.45 |
| Less than 30 hours | 53 | 36.64 | 26.06 |

The scores were tested for initial difference. The 11 students in the 30 hours or more group had an original 4th-grade FCAT score that was lower than the 53 students in the less than 30 hours group to a statistical significance ($t(10) = 3.26, p \leq .05$). When the 6th-grade scores were studied, there was no difference in the two groups' scores ($t(10) = 1.06, p \geq .05$).

This evaluation showed that the improvement in FCAT scores were significantly higher for students that spent 30 hours or more using the MCS program as claimed. The initial difference in 4th-grade FCAT scores was not evident in the 6th-grade scores after using the MCS program for two years.

The second claim that any extra time in the MCS laboratory would improve FCAT score was tested using a Pearson correlation. Increased time in the laboratory was predicted by the program designers to result in higher FCAT scores (Table 12 in Appendix D). The FCAT scores were compared to the time spent in the laboratory using two sets of student data from the academic years 2003–2004 and 1998–1999.

The laboratory time on task was reported in hours and minutes. This value was available in the Math Concepts and Skills printout (Table 9).

Table 9

Today's Session Report

| TODAY'S SESSION (COMPLETE): DATE 00/00/00 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 667 HHMS MANNING 7 | | | | | | | | |
| Student | | Session time | Corr/Att exercises | Percent correct | Course AVG | Time out | Audio repeat |
| 1234 Name | MCS | 6:26 | 33/42 | 79 | 5.75 | 1 | 0 |
| 2345 Name | MCS | 0:14* | 20/35 | 57 | 7.44 | 0 | 0 |
| 3456 Name | MCS | 0:25 | 47/84 | 56 | 4.46 | 0 | 0 |

To test the claim that more time would result in higher FCAT scores, the time students' used the computer program was correlated to their FCAT score (Table 10).

Table 10

Correlation Statistics

| Group | Correlation | N |
|---|---|---|
| FCAT 2003–2004 | 0.46 | 64 |
| FCAT 1998–1999 | 0.71 | 50 |

The 2003-2004 correlation coefficient was 0.46. The correlation of 0.71 was found in the 1998-1999 group, which was the first group of students to use the MCS program at Holly Hill Middle School. They were also the first group to take the FCAT test.

Since both correlations were positive, the data shows that the time on task (TOT) and FCAT score have an increasing relationship. As time on task increases, FCAT score also increases. Since strength of the correlation was different, further study would be needed to determine why the correlations changed from on year to the next.

Regardless of the strength, the findings imply that the program time does relate to FCAT scores, but a casual relationship should not be assumed. There could be other factors interfering with the correlation factor. It is the position of this researcher that a stronger correlation may exist if extraneous factors were controlled, but more study would be necessary to investigate the lack of relationship in this data set.

Finally to test the third claim that the MCS grading system was equal to the FCAT Level, the scores provided by the MCS program were compared to the 2003-2004 $6^{th}$ grade students' FCAT Levels. To make this comparison, the MCS scores had to be converted using the outline provided by the program developers in Table 7.

Using the table, the students MCS grade level score was translated into a Level score prediction. For example, a score of 5.65 would equate to a Level 2. Once converted, the two scores were assumed to be equivalent and should have had no statistically significant difference. In reality, the two scores were found to be statistically different using the dependent t test ($t(63) = 3.27$, $p \leq .05$). The difference shows that the MCS program score is not equal to the FCAT Level observed for the students. The findings are summarized in Table 11.

Table 11

Statistical Data

| Paired samples | Mean | Std. D. | t | df | Sig (2-tailed) | N | Correlation | Sig. |
|---|---|---|---|---|---|---|---|---|
| MCS - FCAT | 0.36 | 0.88 | 3.27 | 63 | 0.002 | 64 | 0.49 | 0.00 |

The difference in the MCS predicted level and the true FCAT observed level was statistically significant. The two scores are correlated 0.49. This correlation shows a positive relationship between the scores, but the dependent t test revealed that the two scores are not the same. Therefore, the third claim from the computer program that the MCS grade level scores can be used to predict FCAT scores was not true for this data set.

In an effort to gain additional insight into the MCS program, the county surveyed the teachers and reported the effectiveness of the program. The survey and results are important to this study to adequately evaluate the MCS program. The complete survey can be found in Appendix A. While reviewing the results of the survey, it is important to note that the both columns 4 and 5 are considered positive answers. In relationship to the program effectiveness, 56% of the respondents approved very strongly and 25% approved strongly. Therefore it can be concluded that 81% of the teachers felt the program was more effective than not effective.

Measuring the effectiveness of the program reports showed that most teachers (79%) felt that the reports were helpful. The reports helped the teachers understand the students' progress and matched the classroom curriculum (77%). The overall rating was favorable by the teachers that responded to the survey (88%). The lowest rating was given to adequate training for the teachers using the program. This could be one source of improvement for future use of MCS program. The Figure 2 bar graph summarizes the survey results.

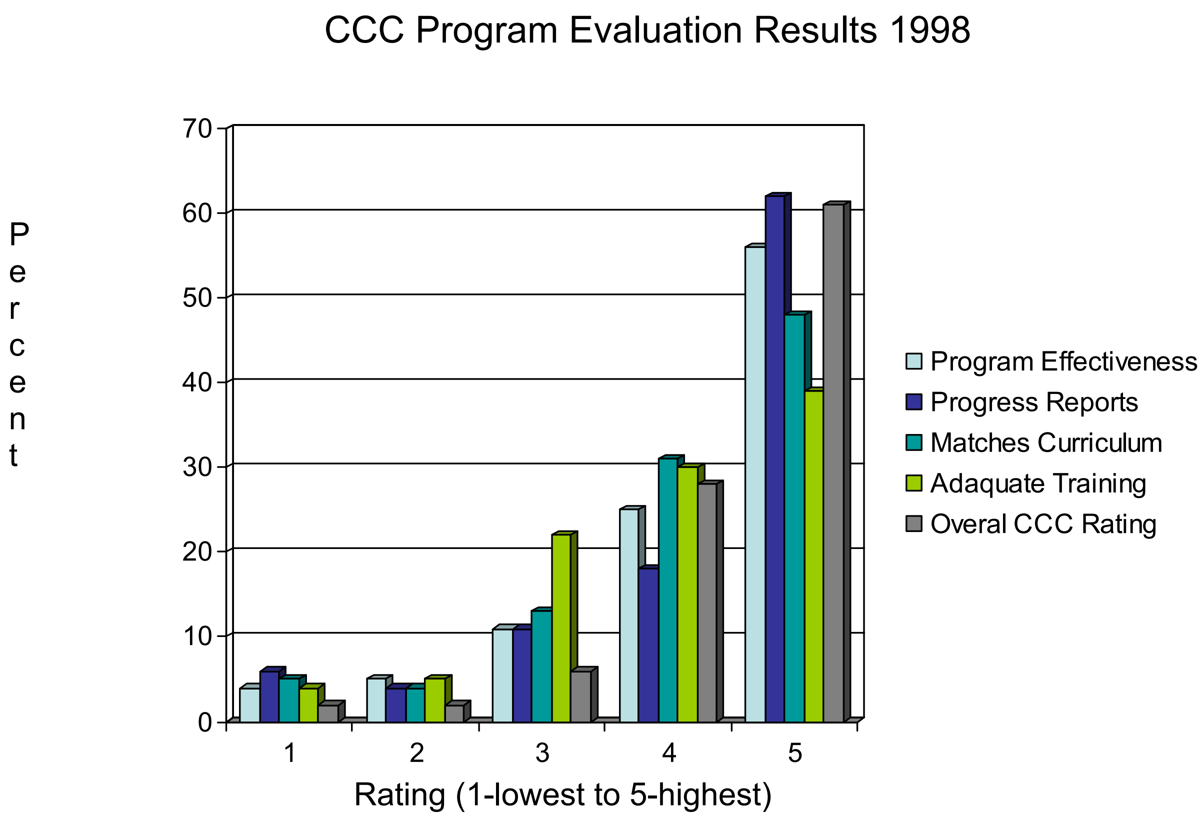



Figure 2: Survey Results

Since the independent t test showed that the scores for students using the program 30 hours or more are different to a statistically significant degree, the claim that the program raises students' FCAT scores after using the program for 30 hours or more was found to be true for the students.

The second claim that increasing the time on task in the MCS laboratory improves FCAT scores was also substantiated using the correlations of the FCAT scores to time on task (TOT) measurement. Further study is recommended to investigate the relationship between the scores.

The third claim that MCS scores are equivalent to FCAT Levels was not substantiated. The MCS score did not accurately predict the FCAT Level performance observed with the 2003-2004 $6^{th}$ grade students at this East Central Florida middle school. The scores were found to be significantly different and therefore cannot be claimed equivalent.

In conclusion, this project found that the MCS program does improve the students' FCAT scores. The overall findings were positive even though the third claim was not proven. More study is needed to determine if the MCS program should be continued, revised or removed from the middle school.

# CHAPTER FIVE

# CONCLUSION

## Discussion

"We seldom know all the causes of an effect." (May, 1984, p 22). The purpose of this study was to study the effect of the Math Concept and Skills (MCS) program on mathematics FCAT scores at an east central Florida Middle School. Despite the abundance of data collected, it is obvious that more study is needed to confidently determine the effect of the MCS program at this middle school.

The mathematics curriculum has employed a variety of packaged programs with the promise of improving mathematical abilities. The first school wide investment was manipulative kits, many of which remain unopened on closet selves. The next solution was graphing calculators. After investing in expensive graphing calculator sets, the batteries die of old age rather than excessive use.

The investment in the NCS Learn SuccessMaker was the newest solution. The Math Concept and Skills (MCS) section of the software was the focus for this study. As in the earlier curriculum investments, teacher commitment is imperative to the MCS program success.

In part, the program can be measured successful, however this study does not support all the claims of the designers. Some definite improvements were found from using the program for 30 hours or more, but further research is needed to define the mitigating factors.  Further study is needed to determine what FCAT score equates to one year's growth since Level 1 encompasses skills through grade 4 while Level 2 includes grades 4 through 6.  Another important factor to consider is that the FCAT Levels have changed since the design of the MCS program.  The new levels may not be a contributing factor to these findings.

Qualitative information would be valuable to measure the influence of different factors in the classroom such as the student interaction with the teacher and the group's opinion of the program as well as the teachers' commitment to using the program. Suggestions for improvements would be a worthwhile point to investigate in a future project.

All the data samples in this project were unique.  This middle school is not a typical population and a true random sample was not available.  This study compares the same group before and after to control for original differences but the students are different from other school populations because of geographical placement.  The students are compared to themselves so that the differences in original mathematical abilities are not contributing factors but extraneous factors may have affected the results.

Research reveals that not all students approach the computer program with the same enthusiasm (Fox, 1998; Kozma, 1991; Relan, 1997; Sivin-Kachala, 1998). While using the MCS program, the students are observed using the help buttons continuously without even looking at the questions and others engage in uninterrupted day dreaming. If the student sat quietly and the computer screen appeared to change, most teachers left the child alone.

Some students were motivated knowing they may attend the banquet activity, which was a reward for a score of 75% correct in each session. On the other hand, if the students did not perform successfully they would receive a Math Concepts and Skills homework printout of individual practice sheet. The instructor typically would pick twenty problems for increased practice.

Lack of acceptable performance (75% correct) resulted in poor classroom grades. Some teachers gave a class grade and averaged it in to the other grades they collected in nine-week grading periods. Other teachers used Math Concepts and Skills as a test grade, while still others used the scores accumulated in the laboratory periods as an independent factor equally important with tests, class work, and homework. The ability to grade independently may have influenced the different focus on the importance of the Math Concepts and Skills program.

The value each student and teacher attributed to the computer program could be a factor in there test results. During this study, it was observed that some teachers lacked the motivation and training to implement the program as designed. This lack of consistent implementation may have affected the results.

The variability in the number of students using the program for 30 hours or more was due to the fact that some teachers refused to attend the scheduled MCS sessions. Students with 30 hours or more had teachers that encourage students to use the MCS program more often for extra credit. Further research is needed controlling for the factors of teacher, grading, and student motivation. .

After careful examination of the NCS Learn program, it is determined that more investigation of the MCS program is necessary. Some students may benefit from more teacher interaction and less time on isolated tasks. In this study, the social factor of learning in the middle school was ignored.

Besides the social factor, teacher attitude may have contributed to some data samples. For some classes, teachers' attitudes include resentment of the time consuming extra work or an opportunity to grading papers.

Few teachers actually circulated the laboratory and observed the students working habits. The system operator discouraged teacher–student interaction as it would hinder the program's accurate evaluation of the student's learning. In other words, if the student asked the teacher for help on a problem, the computer program may assume the child has the knowledge needed to go to the next level. This assertion, repeated by the system operators, does not make sense to this researcher since the program literature clearly describes the process of moving from one strand to the next is more than one question.

Once again, the lack of interaction may be influencing the data results. Some the students are motivated to know the teacher is interested in their learning. Other students respond to the extrinsic motivation of teacher monitoring to be focused and on task. The sixth grade student is a social learner in need of acceptance and attention (Joyce & Weil, 1996), but the MCS program as implemented at Holly Hill Middle School ignored that aspect of the learning environment.

Also ignored in the learning environments was a connection to other classroom activities. The program was implemented in isolation. Students often asked, "What are these?" when viewing base ten blocks on the computer screen. If the classroom teachers provided hands on lessons to complement the MCS program, the improvement in FCAT scores may be greater.

In conclusion, the MCS program did improve FCAT scores when used for 30 hours or more at this east central Florida Middle School. In order to improve the implementation of the MCS program, further investigation is needed.

## Recommendations for Further Research

1. Does the class time spent in the laboratory improve test scores more than direct teacher instruction?
2. Comparing the financial commitment of the program to other classroom material investments such as workbooks or manipulatives, which investment yields higher FCAT test scores?
3. Does the teachers' commitment to the program influence the students' Math Concepts and Skills score significantly?
4. Would the students' benefit more from the Math Concepts and Skills program if the laboratory session was not removed from their regular mathematics instructional period?

# APPENDIX A

# TITLE I EVALUATION

Evaluation of Title I - CCC Program
Spring 1998

Please check: ____________________school-based administrator
____________________classroom teacher
____________________system operator
____________________other

Please rank items on a scale of one to five, with one (1) indicating strong disagreement or no support and five (5) indicating strong agreement or support. Leave blank any items that do not apply.

1. The 1997-1998 CCC program has been effective for students.

1 2 3 4 5

2. I have received adequate information about the students' progress from the system operator.

1 2 3 4 5

3. The software/hardware provided by CCC is congruent with the regular school curriculum.

1 2 3 4 5

4. I have received adequate training.

1 2 3 4 5

5. I rate the Title I CCC program is:

1 2 3 4 5

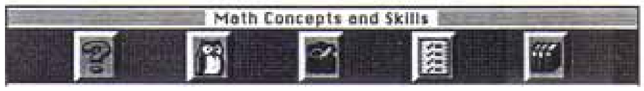
Please write any comments you have regarding the 1997–98 CCC program, or list any changes or suggestions you have for 1998–1999. Use the back of this form if you need more space.

APPENDIX B

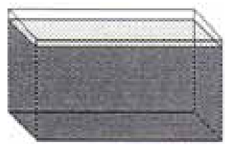
SAMPLE STUDENT PAGE

Sample Student Page

1. Measure rainfall in a container; add this measurement to the chart.




Lisa's class has been measuring rainfall for three weeks. Use the toolbox ruler to measure this week's rainfall. Fill in the chart.



This week's rainfall

| Week | Rain (co) |
|---|---|
| 1 | 1.5 |
| 2 | 2.0 |
| 3 | .5 |
| 4 | - |
| Total | |

Rainfall


The student's menu bar provides information and tools to complete the questions. The students click on the question mark to ask the computer to solve the problem. The program will solve the problem for the student.

The owl shows the student the proper steps to solve the problem. The owl moves one step at a time. The student is directed to plug in the information the owl provides. Then another similar problem is displayed for the student to answer following the same pattern.

The third icon is a tool box. In the tool box, the student accesses a ruler, calculator, protractor, and any tools needed to solve the problem presented. In some questions, the calculator is not available if the problem is computational. The tools are available as needed only.

The fourth icon is a report card. The report card is accessed to show the student's score. The score is for the present session only and simply displays the correct and incorrect responses.

The last icon is a reference area. The student can look up words, get definitions and conversion charts.

# APPENDIX C

# MATH CONCEPTS AND SKILLS STRANDS

| Strand | Code |
|---|---|
| Computational strands | |
| Additions | AD |
| Decimals | DC |
| Division | DV |
| Equations | EQ |
| Fractions | FR |
| Multiplication | MU |
| Speed games | SG |
| Subtraction | SU |
| Application strands | |
| Applications | AP |
| Geometry | GE |
| Measurement | ME |
| Number concepts | NC |
| Probability and statistics | PR |
| Problem-solving | PS |
| Science applications | SA |
| Word problems | WP |

# APPENDIX D

# ESTIMATED TIME NEEDED FOR GAIN IN MCS

Table 12

Estimated Time Needed for Gain in MCS

| | Percent of Students | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gain | 5 | 10 | 15 | 20 | 25 | 55 | 60 | 65 | 70 | 75 | 80 | 85 | 90 | 95 |
| 0.1 | 0:48 | 0:51 | 0:53 | 0:55 | 0:57 | 1:04 | 1:05 | 1:06 | 1:08 | 1:09 | 1:11 | 1:12 | 1:15 | 1:18 |
| 0.2 | 1:48 | 1:59 | 2:07 | 2:13 | 2:18 | 2:43 | 2:47 | 2:51 | 2:56 | 3:00 | 3:05 | 3:12 | 3:19 | 3:31 |
| 0.3 | 2:49 | 3:13 | 3:28 | 3:41 | 3:51 | 4:42 | 4:50 | 4:59 | 5:08 | 5:17 | 5:28 | 5:40 | 5:56 | 6:19 |
| 0.4 | 3:49 | 4:28 | 4:54 | 5:14 | 5:32 | 6:56 | 7:10 | 7:24 | 7:38 | 7:54 | 8:12 | 8:33 | 8:58 | 9:37 |
| 0.5 | 4:46 | 5:43 | 6:21 | 6:52 | 7:18 | 9:23 | 9:43 | 10:04 | 10:26 | 10:49 | 11:15 | 11:46 | 12:24 | 13:21 |
| 0.6 | 5:39 | 6:58 | 7:50 | 8:32 | 9:08 | 12:01 | 12:29 | 12:57 | 13:27 | 13:59 | 14:35 | 15:18 | 16:10 | 17:29 |
| 0.7 | 6:28 | 8:11 | 9:20 | 10:15 | 11:02 | 14:49 | 15:25 | 16:02 | 16:42 | 17:24 | 18:11 | 19:06 | 20:16 | 21:59 |
| 0.8 | 7:12 | 9:22 | 10:49 | 11:59 | 12:59 | 17:45 | 18:31 | 19:18 | 20:08 | 21:02 | 22:02 | 23:11 | 24:39 | 26:49 |
| 0.9 | 7:51 | 10:31 | 12:18 | 13:44 | 14:58 | 20:50 | 21:46 | 22:44 | 23:46 | 24:52 | 26:05 | 27:31 | 29:19 | 31:59 |
| 1.0 | 8:24 | 11:37 | 13:47 | 15:30 | 16:59 | 24:03 | 25:10 | 26:20 | 27:34 | 28:53 | 30:22 | 32:05 | 34:15 | 37:28 |
| 1.1 | 8:52 | 12:40 | 15:14 | 17:16 | 19:01 | 27:22 | 28:42 | 30:05 | 31:32 | 33:06 | 34:51 | 36:53 | 39:27 | 43:14 |
| 1.2 | 9:15 | 13:41 | 16:40 | 19:02 | 21:04 | 30:49 | 32:22 | 33:58 | 35:40 | 37:30 | 39:32 | 41:54 | 44:53 | 49:18 |
| 1.3 | 9:32 | 14:38 | 18:04 | 20:48 | 23:08 | 34:21 | 36:09 | 38:00 | 39:57 | 42:03 | 44:24 | 47:07 | 50:34 | 55:39 |
| 1.4 | 9:44 | 15:32 | 19:27 | 22:33 | 25:14 | 38:00 | 40:03 | 42:09 | 44:22 | 46:46 | 49:26 | 52:33 | 56:28 | 62:16 |
| 1.5 | 9:49 | 16:23 | 20:48 | 24:19 | 27:19 | 41:45 | 44:03 | 46:26 | 48:56 | 51:39 | 54:40 | 58:10 | 62:36 | 69:09 |
| 1.6 | 9:49 | 17:10 | 22:07 | 26:03 | 29:26 | 45:35 | 48:10 | 50:50 | 53:39 | 56:41 | 60:03 | 63:59 | 68:56 | 76:17 |
| 1.7 | 9:44 | 17:53 | 23:24 | 27:47 | 31:32 | 49:31 | 52:23 | 55:21 | 58:29 | 61:51 | 65:37 | 69:59 | 75:30 | 83:40 |
| 1.8 | 9:32 | 18:34 | 24:39 | 29:30 | 33:39 | 53:32 | 56:43 | 59:59 | 63:27 | 67:11 | 71:20 | 76:10 | 82:16 | 91:18 |
| 1.9 | 9:14 | 19:10 | 25:52 | 31:12 | 35:46 | 57:38 | 61:08 | 64:44 | 68:32 | 72:38 | 77:12 | 82:32 | 89:14 | 99:10 |
| 2.0 | 8:51 | 19:43 | 27:03 | 32:53 | 37:53 | 61:49 | 65:38 | 69:35 | 73:45 | 78:14 | 83:14 | 89:04 | 96:24 | 107:16 |

Gain = average gain
Sample size = 5,712 Students

Source: Keys to Success Workbook Computer Curriculum Corporation 1999

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