Abstract


Fifth-grade students failed to achieve grade-level standards in mathematics. This applied dissertation was designed to increase fifth-grade students’ mathematical achievement on five measures including the Florida Comprehensive Assessment Test (FCAT) scale score, FCAT level score, FCAT NRT score, Silver Burdett Ginn textbook test, and the Standardized Test for Assessment in Reading (STAR) and mathematics test.

A comprehensive mathematics program was created to meet the needs of the fifth-grade students. Teachers implemented a three-tiered mathematics-tutoring program including peer tutoring, one-on-one after-school tutoring, and cross-age tutoring. Three supplementary components to the program included weekly team meetings, mathematics instructional content and practices, and classroom visitations. Research-based, effective mathematics instructional techniques and practices were identified, modeled, and implemented in the classrooms. Students collaborated on a wide range of academic competencies during classwide peer tutoring. The pause-prompt-praise system refined and expanded problem-solving skills for fifth and third grade students during cross-age tutoring sessions. In addition, an after-school-tutoring program utilized strategic tutoring with students who scored in the lowest quartile on the FCAT.

An analysis of the data revealed that four of the five outcomes predicted were met and five of the five measures used showed significant gains. Based on the five measures, an increase in scores from the pretests to the posttests was observed. This increase is considered statistically significant at the <.01 level and shows that it is not likely that this increase has come about by chance. Therefore, it is reasonable to believe that the outcomes of this applied dissertation could be applicable to other fifth-grade classes with similar student populations in the county.
# Table of Contents

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chapter 1: Introduction</strong></td>
<td>1</td>
</tr>
<tr>
<td>Description of Community</td>
<td>1</td>
</tr>
<tr>
<td>Researcher's Work Setting</td>
<td>2</td>
</tr>
<tr>
<td>Researcher's Role and Responsibilities</td>
<td>4</td>
</tr>
<tr>
<td><strong>Chapter 2: Study of the Problem</strong></td>
<td>6</td>
</tr>
<tr>
<td>Problem Statement</td>
<td>6</td>
</tr>
<tr>
<td>Problem Description</td>
<td>6</td>
</tr>
<tr>
<td>Problem Documentation</td>
<td>6</td>
</tr>
<tr>
<td>Causative Analysis</td>
<td>7</td>
</tr>
<tr>
<td>Relationship of the Problem to the Literature</td>
<td>10</td>
</tr>
<tr>
<td><strong>Chapter 3: Anticipated Outcomes and Evaluation Instruments</strong></td>
<td>25</td>
</tr>
<tr>
<td>Goals</td>
<td>25</td>
</tr>
<tr>
<td>Expected Outcomes</td>
<td>25</td>
</tr>
<tr>
<td>Measurement of Outcomes</td>
<td>25</td>
</tr>
<tr>
<td>Mechanism for Recording Unexpected Events</td>
<td>27</td>
</tr>
<tr>
<td><strong>Chapter 4: Solution Strategies</strong></td>
<td>28</td>
</tr>
<tr>
<td>Discussion and Evaluation of Solutions</td>
<td>28</td>
</tr>
<tr>
<td>Description of Selected Solutions From Literature</td>
<td>43</td>
</tr>
<tr>
<td>Selected Solution Strategies</td>
<td>51</td>
</tr>
<tr>
<td>Report of Action Taken</td>
<td>53</td>
</tr>
<tr>
<td><strong>Chapter 5: Results</strong></td>
<td>71</td>
</tr>
<tr>
<td>Results</td>
<td>71</td>
</tr>
<tr>
<td>Discussion</td>
<td>77</td>
</tr>
<tr>
<td>Recommendations</td>
<td>80</td>
</tr>
<tr>
<td>Dissemination</td>
<td>82</td>
</tr>
<tr>
<td><strong>References</strong></td>
<td>84</td>
</tr>
<tr>
<td><strong>Appendixes</strong></td>
<td></td>
</tr>
<tr>
<td>A Mathematics-Tutoring Program Student Survey</td>
<td>89</td>
</tr>
<tr>
<td>B Mathematics-Tutoring Program Teacher Survey</td>
<td>91</td>
</tr>
<tr>
<td><strong>Tables</strong></td>
<td></td>
</tr>
<tr>
<td>1 Number of Students Not Achieving at Grade-Level Standards</td>
<td>6</td>
</tr>
<tr>
<td>2 Outcomes Gains by Percent of June 2003 Assessment Measures</td>
<td>72</td>
</tr>
<tr>
<td>3 2002-2003 Pretest and Posttest Mean Scores on Five Measures</td>
<td>75</td>
</tr>
<tr>
<td><strong>Figure</strong></td>
<td></td>
</tr>
<tr>
<td>Comparison of Pretest and Posttest FCAT Scale Scores</td>
<td>76</td>
</tr>
</tbody>
</table>
Chapter 1: Introduction

Description of Community

The community in which this applied research project took place was located in a suburban neighborhood in the southeastern part of the United States. The school was located in a low-socioeconomic area with 64% of the students eligible for the federal free-or-reduced-priced-lunch program. The majority of the students came from single-parent households. Extended-family members such as grandparents and/or aunts and uncles were the guardians for many students. Family housing in the community consisted of single-family homes, apartments, mobile homes, and quadruplexes. The neighborhood population surrounding the school was transient causing the school to have a mobility rate of 33%. A homeless housing center was located a mile from the school and a public library was located 3 miles away.

There were a variety of businesses that supported the school’s efforts as Partners in Education. A regional trauma center, a national bookstore chain, and four fast-food restaurants provided incentives for students. Other businesses such as, a movie theater, a strip mall, convenience stores, and family restaurants were also located within a 2-mile radius of the school. Local daycares and the school offered child-care services. Transportation for students after school was provided by many of the local daycares. The school-based program offered services before and after school. The rates for child-care services at the school site were on a sliding scale based on family income.

In an effort to provide the school and community with aesthetic improvements, a beautification project was undertaken by a civic organization. Local residents planted trees and plants around the perimeter of the school during the summer. Throughout the school year, volunteers maintained the grounds and replace foliage as needed.
Researcher's Work Setting

The researcher's work setting was an elementary school with a grade organization of pre-kindergarten to Grade 5. The school was built in 1958 and was frequently under construction. Within the last 5 years, a two-story building was built, housing kindergarten, fourth, and fifth-grade classrooms. In addition, a new media center, art and music wing, and an Exceptional Student Education (ESE) wing were constructed. A larger cafeteria and a new two-story building for primary grades were scheduled for construction in the next 2 years.

The elementary school was a community-based school with 98% of the students residing in the neighborhood. The student attendance rate was 82%. The assigned program capacity was 757 students with a total student membership of 894. The student ethnography was as follows: 36.5% white non-Hispanic, 33% Hispanic, 26.5% black, 2.8% multi-racial, and 1.3% Asian. Sixteen percent of the students were classified as having Limited English Proficiency (LEP). Pullout resource services were provided for the 14.9% of student membership who were classified with exceptional needs. This included learning disabled, emotional handicapped, autistic, and gifted students.

The total staff membership was 46 with a distribution of 2 administrators, 2 pre-kindergarten/Place teachers, 6 kindergarten teachers, 7 first-grade teachers, 6 second-grade teachers, 5 third-grade teachers, 5 fourth-grade teachers, 4 fifth-grade teachers, 12 ESE and support-staff personnel, 9 paraprofessionals, 4 office personnel, 6 cafeteria workers, and 4 facilities workers. The staff ethnography was 78% white, 13% black, and 9% Hispanic. In 2002, the staff-return rate was 87%. The staff’s education level was 36.8% with Masters degrees, and 63% with Bachelors degrees. Four teachers were in the process of working on Doctoral degrees.
Sixty-four percent of students at the school qualified for the national free-and
reduced-priced lunch program. Due to this high percentage of students, the school was
classified as a Title-one school. The funds generated from this program were used to
reduce class size by paying for an additional teacher’s salary in first and second grade.
Parent programs, teacher-training materials, and technological software were also funded
with Title-one money.

The mission of the school was to develop an effective learning environment
through strong relationships between teachers, staff, students, parents, business partners,
and members of the community. Staff members believed that all students could learn in a
safe, standards driven, technologically advancing, culturally diverse school. These
beliefs were infused into all areas of the curriculum, as reflected in the School
Improvement Plan. The School Improvement Plan consisted of yearly goals and
objectives. Strategies to improve student achievement were listed in the areas of reading,
writing, and mathematics.

The School Advisory Council (SAC) created the School Improvement Plan. SAC
was made up of a variety of stakeholders with the goal of increasing student achievement
in all tested academic areas. Staff representatives, parents, business partners, and
community members met monthly to discuss curriculum, student programs, and academic
achievement. The SAC members were responsible for the implementation of county and
state mandates.

Staff members at the school were also represented on a Shared-Decision-Making
(SDM) Council. Membership was comprised of grade-level team leaders, administrators,
and non-instructional staff. This council met monthly to discuss and decide issues related
to school procedures, budget, and facilities. Concerns were brought to SDM Council
with suggested solutions, and decisions were made by consensus.

Additionally, small committee groups met regularly to generate, organize, and implement activities to increase academic achievement in specific areas. Staff members created the committees and then chose which committee to serve on. Curriculum, parent involvement, discipline, staff celebrations, and technology were the focus committees for the 2002-2003 school year.

**Researcher’s Role and Responsibilities**

The researcher’s role at the school was diverse including teacher, leader, and facilitator. Curriculum was developed and implemented in a general-education classroom. Information was disseminated and concerns were addressed at weekly team meetings. Furthermore, staff-development opportunities were facilitated at the school and county level.

For the past 10 years, the researcher has worked as a fifth-grade teacher. The curriculum in the classroom was determined through state and district standards. Using these state standards, interdisciplinary thematic units were created on a variety of levels to meet the diverse needs of students. The state mandated an annual set of standardized achievement tests. These test results ranked and graded the schools in the state and were used as promotion criteria for students.

The researcher was also a trained clinical educator. This gave students from local universities opportunities for classroom experiences. Associate/student teachers and field experience students observed instructional techniques and implemented teaching practices in the researcher’s classroom. As a New Educator Support System member, the researcher mentored and coached first-year teachers. The researcher supported the new teacher’s goals while observing teaching practices and modeling effective instructional
techniques. In addition, the researcher also facilitated county level New Teacher Academies. New Teacher Academies offered training and support to educators new to teaching or new to the county.

As the fifth-grade team leader, the researcher facilitated weekly team meetings, ordered and organized instructional materials, analyzed student data, and disseminated information. Curriculum was researched and developed with the three other teachers on the team. Instructional manipulatives and materials were created and shared. The researcher was responsible for bringing team member concerns about curriculum and student achievement to the monthly SAC meetings and issues about procedures and facilities to the monthly SDM Council meetings. In addition, the researcher played an active role in the creation of the School Improvement Plan and developed curriculum for the entire school.

The researcher was also identified by the school district as a Demonstration-Mathematics Teacher. In that role, effective teaching practices were modeled and creative mathematics techniques were demonstrated to colleagues. Staff development opportunities in mathematics were facilitated at the school site as well as at the county level. The continual collaborations with colleagues as team leader, SAC and SDM member, and staff-development trainer reflected an openness of the researcher to embrace and facilitate innovation and change.
Chapter 2: Study of the Problem

*Problem Statement*

The problem to be solved in this applied dissertation was that fifth-grade students failed to achieve at grade-level standards in mathematics.

*Problem Description*

The problem at the school site was low-student achievement in mathematics on the Florida Comprehensive Assessment Test (FCAT). The FCAT was administered annually in March. The school’s scores had declined over the last 3 years and fell below county and state averages. This resulted in a C rating according to the state’s grading criteria. FCAT results from 2002 indicated that 49 of the 127 (38 %) fifth-grade students and 57 of the 121 (47 %) fourth graders scored below a Level 2 in mathematics. Level 2 was the minimum score recommended by the county for promotion to the next grade.

*Problem Documentation*

At the start of the 2002-2003 school year, only 110 of the original 121 fourth graders at the school returned for fifth grade. Fifth-grade students not achieving at grade-level standards was evident by FCAT and STAR Mathematics results (see Table 1).

Table 1

<table>
<thead>
<tr>
<th>Students</th>
<th>Level of achievement</th>
<th>Assessment tool</th>
</tr>
</thead>
<tbody>
<tr>
<td>32 of 110</td>
<td>scored at the Level 1</td>
<td>FCAT Mathematics test</td>
</tr>
<tr>
<td>23 of 110</td>
<td>scored at the Level 2</td>
<td>FCAT Mathematics test</td>
</tr>
<tr>
<td>39 of 120</td>
<td>scored one level below grade level</td>
<td>STAR Mathematics test</td>
</tr>
<tr>
<td>41 of 120</td>
<td>scored two or more levels below grade level</td>
<td>STAR Mathematics test</td>
</tr>
<tr>
<td>64 of 120</td>
<td>scored below 70 %</td>
<td>SBG textbook pretest</td>
</tr>
</tbody>
</table>
Florida Comprehensive Assessment Test (FCAT). The purpose of the FCAT was to measure student achievement of the Sunshine State Standards. The Sunshine State Standards provided expectations for student achievement. The Standards format was chosen by the state to provide flexibility to school districts in designing curriculum based on local needs. The Sunshine State Standards included grade level expectations. These grade level expectations as well as state standards were the basis for the state’s assessment (Florida Department of Education, 2002).

STAR Mathematics. Standardized Test for Assessment in Reading (STAR) and mathematics, by Advantage Learning Systems, was a computer-adaptive mathematics test used to assess students’ progress between standardized testing cycles. The program determined placement levels for students and generated immediate achievement data. Reports indicated students’ percentile range, grade-equivalent scores, and historical data.

Silver Burdett Ginn (SBG) test. The SBG mathematics textbook pretest and posttest correlated to the Sunshine State Standards. The tests were designed to simulate the content and format of the FCAT. Each item on the test was correlated to a strand of the standards. The five mathematical strands assessed were (a) number sense, (b) measurement, (c) geometry, (d) algebraic thinking, and (e) data analysis and probability.

Causative Analysis

The causes of the problem at the school site were varied. Presently, most fifth-grade teachers implemented only traditional instructional methods in the classroom. Students worked independently, without peer interaction, to solve mathematics problems. Fifth-grade students rarely used hands-on manipulatives to reinforce mathematics skills and were not provided with a variety of mathematical experiences. In addition, teachers did not have the knowledge and materials necessary to teach mathematics effectively.
while students participated in an average of only 1-hour of mathematics per day.

Analyses of the problem indicated, internal staff conflict, lack of true-learning communities, inconsistent student mastery of skills, and test-item teaching perpetuated students low-mathematics achievement. The school was fortunate to have expert teachers with valuable experience and expertise on staff, yet underlying conflict existed between those teachers who consistently had higher test scores and those who do not. Although on the surface the staff appeared supportive, tensions and resentment increased between teachers and grade levels when the FCAT scores were reported each year and the school grade was assigned. The school rating has bounced between a D and C since the initiation of the state’s grading system.

Achinstein (2002) believed the micropolitics of teaching must be investigated to discover a true learning community. Although the school was a community of learners, it was not a true learning community. Teachers did attend weekly meetings with their team and curriculum support members. The goal of these meetings was to discuss curriculum implementation and to increase teacher effectiveness while raising student-achievement scores. Teams members tended to work in a cordial professional manner; however, teaching and learning was still isolated in individual classrooms behind closed doors. Gullant and Lofton (1998) maintained that “A school cannot succeed if everyone is going in his or her own direction” (p. 14).

Ineffective and inconsistent teaching strategies led to inequities in student learning. Students’ mastery of content became less of a focus then teachers’ coverage of material. Some teachers continued on with course work before all students mastered the present skill or content being taught. Folpoles (2000), stated that “Learning math[ematics] is a cumulative process. If a concept is not mastered before moving on, it
becomes a series of ideas with no connecting theme, which only hinders development” (p. 150). Building student confidence and increasing student achievement was impossible without student understanding of mathematical concepts. While teachers were rushing though curriculum and students were failing to master content, students acquired negative feelings about mathematics. Stuart’s (2000) investigation revealed that students who liked mathematics were more likely to be confident in their mathematics abilities. Students who did not like mathematics reported that they were worried when required to do mathematics tasks.

Strong, Silver, and Perini (2001) believed curriculum standards mandated by the state can be a foundation for an effective program, however, in some cases they can be the cause of a problem. This was the case at the school site. An appropriate use of standards in education should be to provide a clear and manageable vision of what students should understand and be able to do. Standards need to be used as a framework to plan and organize curriculum. Unfortunately, some teachers at the school did not use curriculum standards as a foundation for student learning and other teachers use curriculum standards to drive assessments based on only rote learning. Wilson and Tienken (2002) supported Strong, Silver, and Pereini stating that a restructuring and rethinking of system standards was necessary.

Many teachers at the school were teaching the test, not the skills represented on the test. Instead of engaging in standards-based-curriculum teaching, many teachers succumbed to testing pressure and were engaged in test-item teaching. Popham (2001) described these teacher actions as a reprehensible misbehavior. Instructional practices should be standards based and focus on process and real-world problem solving. Herrera and Owens (2001) supported the standards-based pedagogy embraced by Popham and the
National Council of Teachers of Mathematics (NCTM).

Founded in 1920, NCTM is the world’s largest mathematics education organization. NCTM’s Principles and Standards for School Mathematics, published in 2000, provided guidelines for excellence in mathematics education. In addition, the organization demanded that all students be engaged in more challenging mathematics (National Council of Teachers of Mathematics, 2003). The NCTM believed that communication, reasoning, connections, and representations should be the cornerstone of mathematics instruction and practice.

Staff-development opportunities were also ineffective at the school site. Teachers had not gained the skills and knowledge necessary to implement effective teaching strategies in order to increase student-mathematics achievement. Training was usually directed to a large group of teachers using an oral-presentation format. The participants were at varying degrees of knowledge and proficiency. The format of staff development did not meet the individual needs of teachers. Participants were unable to practice and apply new skills taught in the context of the workshops. Classroom implementation was not monitored or supported with follow-up measures. Teachers should be presented with opportunities for continuing knowledge and growth. The context of staff-development opportunities should engage teachers in rigorous examinations of teaching with substantive knowledge and with sustained analysis of instructional practices (Goldberg & Gallimore, 1991).

Relationship of the Problem to the Literature

Inadequate instructional practices and student achievement were caused by a number of widely held beliefs about mathematics. These beliefs adversely affected the ability of children and adults to experience mathematics in productive, meaningful ways.
According to Merseth (1993), “These beliefs profoundly influenced the way in which mathematics is taught, studied, and understood” (p. 548). Campbell and Silver (2000) found that

For many students, mathematics often serves as a stumbling block to academics success. This outcome was often a factor of (a) prior negative experiences; (b) content that was distant from students’ experiences; (c) an unfocused, repetitive curriculum; and (d) a lack of understanding about the role and power of mathematics. (p. 9)

Substantial research supported that student mathematical achievement has been associated with the demographic variables of socioeconomic status and race/ethnicity. As stated previously, the school site was located in a low-socioeconomic status area with an ethnically diverse population. Campbell and Silver (2000) discovered, in recent years, the differential performance gap among black, Hispanic, and white students has been closing with regard to basic procedural knowledge and skills. Differential performance in conceptual understanding, mathematical reasoning and problem solving has, however, increased. Campbell and Silver pointed out that “Although race/ethnicity has frequently been used as a basis for examining poor school achievement, many have argued that poverty was actually a more important demographic factor” (p. 2).

The NCTM has been a leader in calling for reform in mathematics curriculum, instruction, and assessment to improve the mathematics achievement of all students. According to Campbell and Silver (2000), “If the broad educational goals of increased access and achievement for all students are to be reached, it is essential that policies be put in place and actions are undertaken to enhance the teaching and learning of mathematics in poor communities” (p. 2). Continued efforts are needed to improve
mathematics teaching and learning in the American educational system.

*Educational factors influencing student achievement.* Through research, many factors have been found to influence student achievement. Students' ethnic background and/or gender, mobility rates, educational financing, low-socioeconomic status, and learning styles were strong indicators of student success in schools. Ethnic minorities and women have historically not excelled in science, mathematics, and computer technologies. Effective educational programs and policies to teach science and mathematics to at-risk students are needed. According to Schwartz, (1988) female and minority students were placed at a disadvantage in the present educational system based on cognitive, social, and organization differences.

Manger and Eikeland (1998) supported Schwartz's early findings, concluding that female students have more problems with conceptual understanding and strategic choices. Curriculum, teacher bias, and parental support must change in order to decrease the present inequalities in education. With curriculum reform that accounts for students' cognitive differences, learning tasks would be mastered using the students' innate way of understanding. Educational policies that support long-term programs that help females and minorities reconceptualize information would reduce mathematical anxiety. These practices would improve educational inequalities and help bridge the achievement gap.

Student mobility was an issue that has been described as a cause of the achievement gap. Wright (1999), however, provided strong results indicating that temporal mobility (moving before or after the assessment measure) has no substantiated influence on academic achievement across large groups of students. Location mobility (intra-district and inter-district), on the other hand, appeared to have a moderately consistent effect on student achievement. This significance of mobility as a predictor was
subordinate in its effects on achievement to ethnicity and low family income factors. Wright concluded that the existing practices of explaining away low assessment achievement scores based on mobility, might be removing poor and minority-status students from intervention considerations.

Recent changes in educational funding have attempted to bridge the gap between wealthy school districts and poverty districts. Owens and Maiden (1999), however, found evidence of inequality in instructional-expenditure funding in Florida for schools with high percentages of low-socioeconomic-status students (SES). The instructional expenditure differences between schools and districts were systematically related to non-educational characteristics of students. Teacher salaries comprise much of the instructional expenditures. Owens and Maiden recognized that

It might well be that districts have teacher placement policies that give some priority to senior teachers. As these teachers are typically the most highly paid and have the most control over school assignment, it would not be surprising that we find less-experienced, lower-degreed faculties in traditionally minority and low SES schools. (p. 507)

To counter this problem Owens and Maiden suggested the restructuring of district funding for schools with large populations of low-socioeconomic status students.

According to Slavin (1998), the present educational system has the ability to reduce the equity gap among students. Research on programs like the Abecedarian Project, Success for All, and other programs demonstrated successful increases in achievement for disadvantaged children. Slavin maintained that education should insist on high-quality instruction with an expectation of high performance during the initial stages of student learning instead of the present focus on compensation and remediation
during the middle stages.

An example of a program with high academic expectations was the Calvert Private School curriculum, which was introduced over 90 years ago. It maintained a traditional approach to education. Rose (1996) found that “Major modifications to the program were rare. There was almost a disdain for academic ‘fads’ and a belief that you don’t replace materials until you’ve found something better” (p. 14). This expensive and highly academically demanding curriculum was implemented in two public schools in Baltimore. The academic achievement of the low-socioeconomic-status students at both public schools increased. The Barclay School reported significant gains in student achievement according to the results of The Comprehensive Test of Basic Skills (CTBS) over a 4-year period. Woodson School first graders also increased reading comprehension 20 points on the CTBS after the first year of implementing the Calvert curriculum.

Policy makers and educators must make a paradigm shift away from viewing students’ at risk, to viewing students with potential. Slavin (1998) maintained that by giving high-poverty schools the resources typical of middle class schools and by focusing educational efforts on proven practices and programs, a profound change in the achievement of at-risk students can occur not only in the schools but also in society.

An additional paradigm shift was necessary in school integration policies. It was suggested by research that school integration should be based on socioeconomic status not ethnic/minority status. This was supported by Menacker (1990) who reviewed test scores from Chicago Public Schools to examine the relationship of income level to test performance. A significant difference was discovered between the test-score-achievement levels of students enrolled in schools with high and low levels of low-income students.
Students from schools with high percentages of low-income students scored lower than students from schools with fewer low-income students. The achievement of disadvantaged students was enhanced when small numbers of them were educated with large numbers of non-poverty-level students. A clear pattern was formed and supported by a larger elementary school sample population. According to Menacker (1990), “The results suggested that it was of critical importance that socioeconomic integration of student bodies should become a higher priority than racial/ethnic interaction” (p. 325).

Menacher’s findings were supported by Wilson (2000) who examined the assumptions of the determinants of test score variations in Toledo, Ohio public elementary schools. Family background, unequal resources, concentrated poverty, and the culture of poverty and race were identified and examined as possible causes of test score variations. The results of the study indicated that low-income was the most serious problem associated with school performance. A correlation between the neighborhood demographics and the test scores of students in the neighborhood school was revealed. Schools in low-income neighborhoods were more likely to have teachers with less then a master’s degree and less experience. These teacher characteristics were weakly associated with test scores. Per capita income was more strongly associated with test scores than was concentrated poverty and no association between race and test scores was found when the study controlled for poverty.

Socioeconomic status (SES) has also been found to affect student behaviors and attitudes. Caldas and Bankston (1997) reported that peer groups affect behavior and attitudes in many ways. Results indicated that “attending school with classmates who come from higher SES backgrounds does tend to positively raise one’s own academic achievement, independent of one’s own SES background, race, and other factors” (Caldas
& Bankston, 1997, p. 275). Low-socioeconomic students who attended schools with high-socioeconomic peers tended to achieve higher academically while high-socioeconomic students who attended schools with low-socioeconomic peers tended to achieve lower. It was suggested that student population at any school be comprised of no more than 30% of the students classified as poverty level, based on participation in the federal-free-and-reduced-price lunch program. Individual academic achievement was influenced by the characteristics of student populations and individual schools.

Caldwell and Ginther (1996) maintained that low-socioeconomic-status students who drop out of school have learning styles that were mismatched with the instructional models in school. A learning-style inventory was administered to 82 subjects in third and fourth grade identified with low-socioeconomic status through participation in the free-and-reduced-priced lunch program. External environment and internal motivation factors were identified. Internal motivation factors predicted achievement for low socioeconomic elementary students. As with Fotoples’ findings, Caldwell and Ginther stated that student achievement could be improved when instruction was given consistent with a student’s learning style.

Kletzien and Bendar (1990) characterized at-risk learners as students who do not understand their ability. These learners are unable to realize their individual learning style because they have been continually discouraged. The Dynamic Reading Assessment Procedure was suggested as a way of identifying effective skill strategies used by students in order to correct deficient ones. Students gained confidence in their ability as they recognize strategies they already used. Teacher and student collaborate on the acquisition of new strategies. The authors’ suggested that at-risk students had control and understanding of their abilities when they were taught how and when to use appropriate
and effective strategies.

Individual school climate was also an indicator of academic achievement. Esposito (1999) investigated the relationship between school climate and children's academic and social development in the early elementary years. Longitudinal data were gathered from kindergarten through second-grade years. The participants of the study were low-income, minority children with families living in chronically poor urban neighborhoods. Parent and teacher viewpoints of children's school functioning were used. Parents reported on school adjustment and teachers reported on social skills, academic competence, and behaviors in the classroom. A powerful and constant relationship between school climate and children's school adjustment was the strongest finding of the study. Teacher/student relationship influenced the overall impression of school climate. It was found that underlying school climate factors also substantially predict mathematics and reading achievement scores in first grade and social skills in first and second grades.

Additionally, research found that academic achievement and social skills were correlated with self-esteem. Howerton, Enger, and Cobbs (1994) examined the relationship between self-esteem and academic achievement of at-risk adolescent black males. The Stanford Achievement Test and battery composites of school grades in reading, language, mathematics, science and social studies were analyzed. Significant correlation existed between overall grade average and Stanford Achievement Test scores, the Coopersmith Self-Esteem Inventory and school grades. Howerton, Enger, and Cobbs suggested that educational programs include activities that enhance self-esteem, as well as improve academic performance.

A comprehensive plan that utilizes successful research-based long-term programs
is needed to meet the variety of needs of at-risk students (Menacker, 1990; Rose, 1996; Slavin, 1998). Learning took place when content was embedded in the context of students’ lives. Achievement increased because curriculum required personal connections making content application immediate and practical for students (Esposito, 1999; Schwartz, 1988). Improving students’ self-concept, attitudes towards learning, and rate of successes decreased the number of at-risk students who fail (Howerton, Enger, & Cobbs, 1994).

*Factors influencing mathematical achievement.* The gender gap, student attitudes towards mathematics, student learning styles, teacher beliefs, and assessment practices impacted student-mathematical achievement. Gender differences in mathematics achievement have been a controversial topic of academic interest since the early 1970s. Several theories have been proposed to explain the differences in achievement in mathematics by the respective genders. Friedman (1989) observed that the theories on this subject were varied and that no one theory was accepted throughout the educational system. Biology versus environment was a predominate theoretical framework that prevailed at the time. Gershwind (as cited in Friedman, 1989) proposed a biology-based theory of hormonal influences of testosterone in the womb to explain the higher achievement of males in mathematics. Environmental studies by Fennema and Sherman (as cited in Friedman, 1989) viewed the role of socialization of girls and boys at an early age that predispose males to do better in mathematics than do girls. In 1978, the Women in Mathematics Survey found a correlation between mathematics achievement, socialization, and role expectations for women.

With a growing number of conflicting theories, Friedman explored completed studies examining this phenomenon in order to see if the gender gap could be explained.
The results of Friedman’s study indicated there was evidence that differences in achievement between males and females in mathematics were decreasing over time. In addition, environmental, not biological, factors played the major role in mathematical achievement. Through meta-analysis, Friedman observed that there was a great deal of evidence to discredit the theory that women are biologically inferior to males in regard to mathematical ability and achievement.

Ma and Kishor’s (1997) meta-analysis of 113 studies supported Friedman’s conclusion. Findings showed that the link between attitudes in mathematics and achievement in mathematics were very similar. The meta-analysis of gender differences in the area of performance and mathematical skills was either very small or declining over time. The most significant finding of Ma and Kishor was the impact of attitudes in mathematics and achievement in mathematics in the secondary school setting. The relationship between attitudes in mathematics and achievement in mathematics was intensified by 367% in a comparison with lower-elementary grade levels. This had significant implications in practice for educators. These findings were supported by Elmore, Broadbook, Pedersen, and Bleyer (as cited in Ma & Kishor, 1985) who have identified junior high school years as crucial in the development of attitudes toward mathematics.

Some students who are academically capable still struggle with mathematics. The methods used to teach mathematical concepts affected students’ feeling of success and mathematical self-confidence. Stuart (2000) investigated the levels of mathematics confidence among fifth-grade students. Results revealed that students who liked mathematics were more likely to be confident in their mathematics abilities. Students who did not like mathematics reported that they were worried when required to do
mathematics tasks. When the data were analyzed by gender, a larger percentage of boys than girls thought they were good at mathematics. Stuart concluded that people like to do things that they know they are good at. Therefore, in order for students to be good at mathematics, they must believe that they are good at it.

Ma (1999) found consistency in the relationship between mathematics anxiety and mathematics performance across gender groups, grade-level groups, and ethnic groups. This study predicted that intervention programs such as anxiety-reduction techniques, desensitization, and inhibition conditioning resulted in significant improvement in mathematical performance. This meta-analysis demonstrated that anxiety reduction in average students resulted in improvement from the 50th to the 71st percentile in mathematics achievement. This suggested that the negative impact of mathematics anxiety was a significant problem for today’s educators. The development of programs aimed at reducing mathematics anxiety had a positive impact on the average student’s achievement in mathematics. Cognitive-based-intervention programs such as self-management of emotional stress empowered students and educators to positively impact mathematics performance. Ma suggested that early screening and treatment of mathematics anxiety benefited students’ progression into more advanced mathematics courses in the upper level grades.

Fotopoulos (2000) described methods of overcoming mathematics anxiety by looking at inhibitors to success; strategies for teachers, parents, and textbook companies; and differing learning styles. According to Fotopoulos, “Learning mathematics is a cumulative process. If a concept was not mastered before moving on, it becomes a series of ideas with no connecting theme, which only hinders development” (p. 150). Building student confidence in order to reduce mathematics anxiety was impossible without
student understanding of mathematical concepts. By using a positive, proactive approach, teachers of mathematics worked with students creating understanding and limiting student’s problem areas. In addition, teachers accepted different methods used to solve problems and incorporate different learning styles in instruction.

Existing teachers’ beliefs about student-learning styles, the nature of mathematics, mathematics pedagogy, and teacher practices must be altered to comply with NCTM Standards. Research supported that this was a challenge for traditional and nontraditional teachers. Raymond (1997) found that beginning teachers entered the teaching profession with nontraditional beliefs about mathematics, but when faced with the realities of classroom constraints, teaching practices were more traditional. These beliefs about mathematics and mathematical practices were not consistent. Results of Raymond’s study implied that even when teachers hold nontraditional beliefs about the mathematical pedagogy, traditional beliefs about the nature of mathematics have the potential to perpetuate traditional mathematics teaching. Raymond concluded that “Early and continued reflection about mathematical beliefs and practices, beginning in teacher preparation, may be the key to improving the quality of mathematics instruction minimizing inconsistency between beliefs and practices” (p. 571).

On the other hand, Stipek, Givvin, Salmon, and MacGyvers (2001) designed a study in order to develop a measure of teacher beliefs about mathematics learning and teaching and to address the association between beliefs and classroom practices. Results of the study indicated substantial coherence among teachers’ beliefs and consistent associations between their beliefs and their practices. Student learner self-confidence was significantly associated with teachers’ mathematics instructional self-confidence. This research supported the NCTM standard stating that mathematics instruction should
be a dynamic tool for thought with opportunities to communicate mathematical ideas while solving problems. Stipek, Givvin, Salmon, and MacGyvers concluded that an inquiry-oriented approach to mathematics instruction built students' mathematical confidence and enthusiasm and that teachers must focus on concept understanding while valuing and rewarding student effort and persistence.

As classroom practices and curriculum shift towards cohesive, relative, and conceptual mastery, so must assessment practices. Educational assessment should allow educators and parents to make precise inferences about the level mastery of a student's cognitive skills or body of knowledge. Due to the tremendous pressure placed upon teachers to raise test scores, some teachers are engaging in item teaching instead of curriculum teaching. Popham (2001) defined item teaching as the use of actual test items or clone-type items for instruction. He believed that inappropriate test-preparation practices by teachers must be identified and discontinued. Detection procedures are unrealistic and inappropriate; therefore, assessment literacy through staff development should be undertaken. Popham maintained that teachers would change their test-preparation tactics once educated about the negative effects it has on students. Instruction would then be directed to a body of knowledge or set of cognitive skills that are represented on a test, not on the test itself.

The NCTM standards explicitly stated that assessment should be used to enhance mathematical instruction and learning. Three major uses of assessment are as (a) evidence of learning achievement, (b) feedback to teachers, and (c) accountability. Warren and Nisbet (2001) explored mathematics-assessment methods and the uses of assessment data. The study found that teacher-assessment practices varied and significant differences in assessment practices were found across Grades 1-7. Lower-grade teachers
used more observation, informal interviews, oral testing, and practical work. This was coincident with their instruction. Middle-grades teachers placed more emphasis on informing learners about learning and in the upper grades no relationship was found between assessment practices and the use of assessment data. The most common forms of assessment used in the upper grades were observation and practical work, followed by tests. Projects and journals were not widely used; however, Warren and Nisbet stated that these would be worthwhile forms of assessment.

Student grouping was also researched to determine its effect on student achievement. Lou, Abrami, and Spence (1996) conducted a meta-analysis to develop a model of factors that contribute to the variability of student achievement after the implementation of within-class grouping. The researchers searched various databases in the topic areas of small-group instruction, within-class grouping, homogeneous instruction, heterogeneous instruction, and cooperative grouping. After exposing the studies to determined criteria, 51 studies were analyzed for results on student achievement. The overall effect, +0.16, indicated a significantly positive outcome of within-class grouping over small-group instruction on student achievement. The effect size was larger for homogenous grouping than for heterogeneous grouping. Lou, Abrami, and Spence concluded that within-grouping effects can be maximized when “teachers are provided with appropriate training, students are placed in groups based on ability, as well as other considerations for group cohesiveness, and cooperative learning strategies are used to facilitate student learning in interactive small groups” (p. 12).

The causes for students failing to achieve grade-level standards in mathematics were various and plenteous. Mathematical achievement has been influenced by students’ feelings towards mathematics and teacher instructional practices. Students who feel
successful in mathematics tend to achieve success. Educational programs should develop student self-confidence while alleviating mathematics anxiety (Friedman, 1989; Ma & Kisher, 1997; Stuart, 2000). Early intervention programs aimed at reducing mathematics anxiety should incorporate different learning styles while teaching students to solve problems in a variety of ways (Calwell & Ginther, 1996; Fotopoulos, 2000; Kletzien & Bendar, 1990; Ma, 1999). Students gain control over their learning when they understand their abilities and are able to choose from effective solution strategies. Teacher-instructional belief and assessment practices should support the NCTM standards with an inquiry-oriented approach to building student success, confidence, and enthusiasm towards mathematics (Raymond, 1997; Stipek et al, 2001; Warren & Nisbet, 2001).
Chapter 3: Anticipated Outcomes and Evaluation Instruments

Goals

The goal of this applied dissertation was that at the end of implementation, fifth-grade students achieved at grade-level standards in mathematics.

Expected Outcomes

The following outcomes were projected for this applied dissertation:

1. Sixteen of the 32 fifth-grade students who scored at Level 1 will increase two levels to Level 3 on the FCAT.

2. Twelve of the 23 fifth-grade students who scored at Level 2 will increase a minimum of one level to Level 3 on the FCAT.

3. Twenty of the 39 fifth-grade students who scored one level below grade level will score at or above grade level on the STAR computerized mathematics assessment.

4. Twenty-one of the 41 fifth-grade students who scored two or more levels below grade level will score at or above grade level on the STAR computerized mathematics assessment.

5. Thirty-two of the 64 fifth-grade students who scored below 70% on the SBG mathematics textbook pretest will score at or above 70% on the SBG mathematics textbook posttest.

The researcher and classroom teachers assessed the outcomes. Outcomes were recorded in weekly logs and on a computer database.

Measurement of Outcomes

Outcomes documentation were collected throughout the implementation process. The SBG mathematics textbook pretest was administered during the first week of implementation. Each teacher collected student work samples during implementation.
Midpoint benchmarks were assessed in order to monitor student progress. Peer interactions and products were observed and documented by each teacher. The FCAT was administered during the 4th month of implementation. The STAR Mathematics test and the SBG mathematics posttest was administered at the end of the 6th month. During the 7th of implementation, student data was disaggregated and analyzed. Point specific program evaluation workshops were held during the 7th month and extensive teacher training took place during the 8th month of implementation.

**FCAT.** The FCAT evaluated five mathematics strands: number sense, measurement, geometry and spatial sense, algebraic thinking, and data analysis. Fifty-percent of the assessment was based on knowledge, comprehension, and application skills and 50% was based on analysis, synthesis and evaluation skills (Florida Department of Education, 2002). The test questions consisted of 25-30 multiple-choice question, 15-23 gridded-response questions, 8-10 short-response performance tasks, and 2-3 extended-response performance tasks.

According to the Florida Department of Education (2002), “FCAT demands an in-depth understanding and application of information that was not typical of most standardized test” (p. 1). The mathematics assessment required students to analyze, synthesize, and evaluate information presented while applying mathematical strategies and procedures. Application skills were presented in cognitively challenging situations and included constructed-response questions that required students to demonstrate their understanding of mathematics concepts.

**STAR Mathematics.** STAR Mathematics assisted teachers in the identification of student weaknesses and strengths in mathematical achievement (Parmigiani, 2001). The STAR Mathematics reports helped drive student instruction. Teachers were able to match
instruction to individual needs while monitoring student progress. The scores were correlated to standardized norm-referenced tests and provided objective information to help students, teachers, administrators, and parents see what needed to be done to make academic progress (Richards, 1998). Assessment questions continually adjusted to each student's response pattern and the test typically took 15 minutes.

*SBG test.* The SBG mathematics pretest and posttest were textbook tests approved by the school district. The SBG tests were supported by rigorous research and field tests. The tests and the SBG mathematics program were adopted by the county and have been applied in classrooms for the past 3 years.

*Mechanism for Recording Unexpected Events*

Unexpected outcomes were recorded in journals and the information was placed on a database. The journals and database were reviewed and updated throughout the implementation process. Student work samples, photographs of student products, and videos of classroom interactions were also documented.
Chapter 4: Solution Strategies

Discussion and Evaluation of Solutions

The problem that was solved in this applied dissertation was that fifth-grade students failed to achieve at grade-level standards in mathematics. The problem extended beyond fifth grade to the entire school. The school’s scores had been declining and the school’s rating based on the state’s grading system was average to below average. Factors that influenced student achievement were explored and student low-socioeconomic status was found to be the most significant factor associated with academic failure. Curriculum reform efforts needed to support effective long-term programs designed to close the achievement gap. Effective educational programs needed to focus on high-quality instruction with active student participation.

This form of education at the school was described by Marshall (1997) as a linear system based upon predictive models of change with a belief that learning was incremental. In fact, change was nonlinear and learning was dynamic and patterned. A paradigm shift to an “integrated, holistic and systemic vision of a sustainable learning community” (Marshall, 1997, p. 182) was needed. Teachers’ beliefs at the school began to shift from conventional instruction in isolation to skill-level grouping with authentic assessment. Looking at the whole child with an eclectic approach to instruction was an initial step to building a learning community inside the classroom, as well as in the school. As a true learning community of mutual growth and understanding evolved, staff internal conflict subsided as professionals again focus on what was best for the students instead of what was easiest for the staff.

The curriculum at the school shifted towards a coherent vision. Beane (1995) defined a coherent curriculum as “one that holds together, that makes sense as a whole;
and its parts, unified and connected by that sense of the whole” (p. 3). This was supported by Rose (1996) and Gullant and Lofton (1998) who maintained the importance of a structured, consistent, core curriculum in order to increase student achievement.

Instructional staff members at the school refocused their efforts toward a common vision with manageable goals. In order for curriculum to be coherent for students, it was connected with their present experience. Students who made a personal connection with learning were able to apply their knowledge. The challenge to educators was the continuation of a connection made between purpose and activities. This connection maintained meaning for students during the learning experience which was essential for understanding and application. Students gained purposeful knowledge, which offset the need for teachers to focus instructional time on test-item teaching to improve achievement test scores.

Teachers and administrators determined and provided a coordinated set of interventions for students not achieving at acceptable levels. A comprehensive plan that utilized successful research-based programs was put in place. By using a positive, proactive approach, teachers of mathematics worked with students to create understanding and limit students’ problem areas (Fotoples, 2000). Effective, consistent teaching strategies focusing on student mastery of standards-based mathematical content increased student-academic achievement.

Existing teachers’ beliefs about the nature of mathematics, mathematics pedagogy, and teacher practices were altered to comply with the NCTM standards. The NCTM standards stated that mathematics instruction should be a dynamic tool for thought with opportunities to communicate mathematical ideas while solving problems. Stipek, Givvin, Salmon, and MacGyvers (2001) supported an inquiry-oriented approach
to mathematical instruction. When teachers focused on concept understanding while valuing and rewarding student effort and persistence, students’ mathematical confidence and enthusiasm increased. Raymond (1997) concluded, “Early and continued reflection about mathematical beliefs and practices…may be the key to improving the quality of mathematics instruction minimizing inconsistency between beliefs and practices” (p. 571). The weekly team meetings that teachers and support staff attended were altered to incorporate individual and group reflections.

_Innovative mathematics as an alternative instructional method._ The NCTM has set standards that have influenced a decade of curricula. The organizational goals progressed towards setting standards for teaching goals, connecting mathematics to students’ interest, exploring mathematics as an experimental science, and needing for teachers to understand the level of all students’ mathematical growth. These standards have been used as a guide for building excellence in mathematical instruction. Recent mathematics reform efforts placed priority on student conceptual thinking and other curriculum implementations based on these standards.

According to Manouchehri (2001), “Mathematicians observe phenomena, look for patterns, formulate questions about what they observe, and try to answer those questions” (p. 180). Although NCTM standards stated that students should act as mathematicians, most mathematical instruction at the school site focused on contrived problem-solving questions with assigned solution strategies. The way in which most students were expected to do mathematics in the classroom was radically different than that of actual mathematicians. Problem solving, inquiry-based-learning environments and open-ended questions that allowed students to formulate conjectures became the new basis of mathematics instruction.
Genuine mathematical inquiry through problem posing and problem solving was illustrated and described in Manouchehri’s Four Point Instructional Model. The teacher asked students to pose questions about mathematical topics. Then students broke into small problem-solving groups based on question choices and shared their findings and mathematical work with the class during a whole-group discussion. Finally, students were asked to select problems from the class collection to work on as homework assignments or special projects. This instructional model assisted teachers in fostering mathematical thinking and discourse resembling that of mathematics.

Teaching practices based on NCTM standards were also described in a study by Kazemi and Stipek (2001). The purpose of this research was to explore methods of promoting conceptual thinking within the framework of sociomathematical norms in elementary classrooms. Interactions between student-to-student and teacher-to-student were videotaped and analyzed to determine levels of conceptual understanding. All classrooms posed open-ended questions, documented work both graphically and numerically, and encouraged students to describe the problem-solving process.

Quantitative findings showed a significant positive correlation between degrees of interaction in the observed lesson and growth in students’ conceptual understanding of fractions. In the high interaction exchanges, the students exceeded the point of describing the steps to the problem by linking their problem-solving strategies to mathematical reasoning. The teachers created discourse by posing questions that focused on justification, verification, graphical representations, and ideas about the basis of fractions. Kazemi and Stipek’s (2001) results indicated that classroom efforts need to go beyond superficial teaching practices to examine the nature and degree of the conceptual thinking among the students.
In a meta-analysis of the field of knowledge on problem solving, Hembree (1992) established that IQ was not a significant factor in problem-solving abilities among students. Heuristic-teaching methods were the most effective in problem-solving abilities when abstract-thinking skills were more fully developed. This effect was typical in the later Grades of 5 through 7, and especially elevated in high school students. The area found to produce the most significant level of improvement in problem-solving skills was in instructional methods; specifically, use of diagram drawing in the problem-solving process. This improvement was further enhanced when teaching methods included pictures with full problem statements attached.

George, Hall, and Uchiyama (2000) believed that a significant difference exists between research-based and research-verified educational innovations. Direct assessment of implementation practices in the classroom was necessary in order to measure the effects of the innovations on student accomplishments. The implementation process of a new mathematics curriculum with a constructivist approach to teaching and learning mathematics was examined for Grades K-8. In addition, the extent of relationships between student outcomes and the classroom implementation was explored. The content of the mathematics program was based on the 1989 NCTM standards. The implementation data from the Hessen School District of the US Department of Defense Dependent Schools in Germany was examined and a relationship was found between the extent of implementation of classroom practices and student outcomes. George, Hall, and Uchiyama suggested that it takes several years to implement comprehensive change and the more fully the program was implemented by the teachers, the greater the student gains.

Ward (2001) also explored constructivist approaches. Constructivism was defined
as “a belief that all knowledge was necessarily a product of our own cognitive acts” (Confrey as cited in Ward, 2001, p. 107). This alternative instructional method offered promising new approaches to teaching. Ward suggested that students develop critical-thinking skills, as well as enhance knowledge transfer and retention with this experiential-learning environment. Constructivist methods allowed students to integrate concepts within and between disciplines while promoting critical thinking. Students were then able to represent concepts in multiple forms and to justify, defend, and reflect on the concepts. Ward supported these ideas by stating that “by building on previously constructed knowledge, students can better grasp the concepts and can move from simply knowing material to understanding it” (p. 95).

An experimental study to determine the role of constructivism and technology in an algebra course was designed by Pugalee (2001). At-risk students who were characterized with low-mathematical performance participated in this study. The study focused on developmental mathematics and the roles of discourse and technology were highlighted. Students expanded their mathematical skills by constructing their own knowledge. Discourse and questioning explored concepts and made connections. Technologies used supported major reform initiatives in mathematics education. The instructional activities implemented for the algebra course allowed students to actively engage in their own learning and to develop conceptualizations of mathematics. These practices were consistent with constructivism practices.

According to Lappan (1999), students develop at many cognitive, physical, and social stages. To ensure that all students are learning, mathematics must be connected to students’ interest in a tool-rich environment. Mathematics should be considered an experimental science where students make sense of concepts and ways of reasoning with
productive procedures. Lappan stated that “Every child deserves a high-quality mathematics program taught by a knowledgeable, caring teacher” (p. 131). To foster powerful learning for all students at the school site, present mathematics programs made fundamental changes in student-learning opportunities. Mathematics curriculum moved towards significant, powerful mathematics with an emphasis on topics relevant to students’ present and future.

A high-quality mathematics program needed to exist in every classroom where students learn to use mathematical knowledge to adapt, innovate, and invent new strategies and solutions. Mathematical methods and problem-solving strategies needed to examine the degree of student conceptual thinking (George, Hall, & Uchiyama, 2000; Kazemi & Stipek, 2001). The extent that teachers implement effective curriculum affected the extent of student outcomes. Constructivist approaches to problem solving, which are supported by the NCTM, helped students grasp concepts while actively engaging in their own learning outcomes (Pugalee, 2001; Ward, 2001).

*Programs and processes to increase mathematical achievement* Over the past 2 decades, rote computational mathematical learning has been devalued while multiple paths to complex problem solving has been advocated. Woodward and Baxter (1997) studied the effects of an innovative mathematics curriculum on students with disabilities and students at risk of academic failure. The yearlong study reflected on the conflicting movements of special-education inclusion and the NCTM standards. Two of the schools were selected because they used the Everyday Mathematics program, which focused on the NCTM standards. The third school, used for comparison, utilized the Heath Mathematics series (Bell et al., as cited in Woodward & Baxter, 1997). While using the Everyday Mathematics innovative curriculum, students at the intervention school
discussed multiple solutions, defended problem-solving methods and used an array of tools to work out solutions.

Data from the study suggested that the majority of the students in the intervention school benefited from the innovative curriculum. Average-ability-students' performance resembled high achieving students in their ability to restate and decompose problems; however, only marginal improvement was seen for academically low-achieving students and students with learning disabilities. Confusion and uncertainty were evident, as low-achieving students tended to repeat numbers rather than conceptualize. Woodward and Baxter (1997) concluded that the success of the majority of the participants gave cause for special-education programs to reexamine current instructional practices.

Peer tutoring, cooperative learning, and mastery learning were elements of an eclectic classroom model designed by Swineford and Holtan (1991) to increase student mathematical achievement. Students were given an additional chance with difficult content during a mastery week, as a follow-up to concept instruction that utilized project learning and alternative-instructional strategies. One week was set aside at the end of each instructional unit for peer-mediated, diagnostic-remediation, and enrichment activities for mastery learning. Students were partnered in order to correct mathematical errors, implemented remedial strategies, practice and apply problem-solving techniques, and pursue enrichment interests. Swineford and Holtan concluded that “If permitted and helped to understand the objectives before going on to the next objective or unit, the child was better equipped to attach problems with both knowledge and confidence” (p. 313).

Opouni, Tullis, and Sanchez (1995) investigated the Houston School District’s Beating the Odds (BTO) program in its 3rd year of implementation. This multi-leveled program provided supportive, nurturing environments at school and home. The goal of
the investigation was to evaluate the effectiveness of staff training and follow-up support services. The BTO program was implemented in six secondary schools. Eighty-eight teachers were trained in identification and instruction of at-risk students. A full-time social worker and part-time educational diagnostician were assigned to each school. The BTO program provided the following services: (a) counseling and guidance during school hours, (b) community outreach and family services, and (c) specialized training for teachers of at-risk students. The findings of the study suggested that the teacher training and the student-support services yielded benefits. The services provided during the summer were found to be the most effective. The BTO program developed students’ competence and attitudinal resilience. In addition, students enrolled in the BTO program experienced higher promotion rates and lower failure rates than the comparison group.

Additionally, Fuchs and Fuchs (2001) investigated a program that supported increases in students’ achievement. Mathematics Peer-Assisted Learning Strategies, was developed to help teachers differentiate instruction in the classroom. The program focused on providing students with a classroom routine where they could work on a variety of activities at one time. The researchers used the Juniper Gardens Classwide Peer-tutoring program (Greenwood, Delquadri, & Hall, 1989, as cited in Fuchs & Fuchs) to guide instruction. Teachers in each classroom implemented two 35-minute peer-tutoring sessions each week into the allocated mathematics time. Every child in the class was paired to work with another child in the same class to mediate verbal rehearsal, step-by-step feedback by the tutor, verbal interaction, explanations of problem solving, and reciprocity. The program increased mathematics achievement in a range of students and classrooms.

David and Caparo (2001) recognized “Teachers are faced with the extraordinary
challenge of creating a classroom that enables children from diverse backgrounds to
develop optimal learning tools applicable to the challenges of our post-industrial world”
(p. 80). Academic achievement increased as students participated in the IMPROVE
(Introducing new concepts, Metacognitive questioning, Practicing, Reviewing and
reducing difficulties, Obtaining mastery, Verification, and Enrichment) process. As
students placed in heterogeneous-small groups interacted, their responses diversified and
critical thinking increased. Students developed thought processes, problem/solution
skills, and peer interactions. They gained empathy, compassion, sharing, and
understanding through the development of this classroom community. The diversity of
students’ responses enhanced peer interaction through metacognitive questioning, as
teachers introduced and explained new topics, modeled solutions processes, and designed
practice activities.

The Cognitive Assault Strategy process yielded promising achievement results.
Miles and Forcht (1995) outlined this approach to learning. The strategy had students first
solve the problem and then verbalize the process used. In the final step of the process,
the students wrote the step-by-step process used for solving the problem. A mentor met
one-on-one with a student for 1 hour twice a week. Four to 10 problems were explored
during a given session. The mentor used the Cognitive Assault Strategy to (a)
demonstrate and model problem-solving strategies, (b) comprehend mathematics
vocabulary, (c) develop and verbalize individual strategies, and (d) create a written model
of the strategy used. Miles and Forcht maintained

The intent was to maximize attention and minimize passivity by actively
involving the student in the process, maximize learning and concept formation
through the use of verbal mediation, and circumvent the effect of memory deficits
by providing an external model of reference. (p. 94)

Student self-confidence and mathematical competence increased as a result of this model.

The NCTM maintained that all students can learn mathematics. Burks (1994) pointed out that “all students” included low and high-ability students, whites and non-whites, males and females, and students of low and high-socioeconomic status. This idea that all students, including those from disadvantaged backgrounds, can learn mathematics was not conveyed in the current practice of tracking. Data were analyzed to determine the extent to which ability grouping mediated background differences at the 8th grade level. Burks maintained that students were not provided with equal educational opportunities due to tracking. Ability grouping does help students who were already performing well in mathematics. However, placement in low-level mathematics ability groups hinders low-performing students’ achievement. High-and low-mathematics ability grouping significantly affected mathematical attitudes, behaviors in mathematics, and amount of homework. Burks concluded that ability grouping magnifies the differences which socioeconomic status causes in mathematics and does not reduce differences in mathematics achievement caused by racial differences.

Davenport’s (1993) earlier study supported that the present practice, seen in many school districts, of tracking students by ability level fails to increase student learning in mathematics. Results of recent research indicated inequities in the access of strong mathematics programs, well-qualified teachers, and classroom opportunities for low-level homogeneous-grouped students. Homogeneous grouping failed to increase student achievement and widened the gap between high-and low-ability students. Characteristics such as minority status, gender, and socioeconomic status affected the distribution of students in ability groups with minorities and females often placed in low-level groups.
Street mathematics as an alternative to traditional-mathematical instruction was investigated by Smalley and Moch (1999). This study examined the impact of street mathematics at an inter-city elementary and high school. Based on observations by the authors, an incongruity appeared between students' mathematical performance in the classroom and real-life mathematical situations. Students were able to respond correctly to real-world problems involving mathematical concepts but did not perform the same functions in mathematics class. Smalley and Moch believed that students had been disempowered by school-mathematics instruction resulting in the inability to internalize abstract concepts and student frustration.

Traditional methods of mathematical instruction should, therefore, be replaced with more real-world applications that connect with students' daily lives. In addition to an instructional pedagogical shift, a more realistic mathematical-instructional format was needed to bridge the existing gaps of students' school performance and real-world situation tasks (Miles & Forcht, 1995; Opouni, Tullis, & Sanchez, 1995; Smalley & Moch, 1999; Woodward & Baxter, 1997). The recent reform efforts in mathematics that focused on the NTCM standards have increased mathematical achievement for all students (Burks, 1994; Swineford & Holton, 1991). These standards describe exemplary classroom practices with a strong focus on diversity of approaches. Once applied at the school site, student mathematical achievement was expected to increase.

*Change theory.* The conventional view of teacher training as isolated bite-size pieces of knowledge needed to be rethought. This view implied limited conceptions of teacher learning and was not supported with current research. These narrow assumptions have been challenged as far back as 1957 with the National Society for Study of Education. It was proposed at the time, that staff development be a collaborative effort
Professional development needed to be viewed as an integral part of the school culture. The life span of learning opportunities needed to be extended for more than just 1 or 2 days. Application of new knowledge and skills needed to be applied in the context of the classroom over a substantial period of time. Participatory learning opens teachers to new knowledge and broadens thought and action. Development and learning becomes varied and engaging for teachers in the same way as it would for students. Lieberman (1995) suggested

As opportunities for professional development moves away from the traditional inservice-training mode and toward long-term, continuous learning in the context of the school and classroom and with the support of colleagues, the idea of professional development takes on even greater importance. (p. 595)

Significant and lasting change depended on an expanded conception of teacher development.

Fullan (1996) maintained that the two major barriers to educational reform, overload and fragmentation, were related. Overload was defined as continual unplanned and planned changes effecting a school. Fragmentation occurred when reform pressures and opportunities were incoherent and disjoined. These factors combined to reduce educators’ motivation towards reform and represented a fundamental flaw in system alignment. Systemic reform was necessary to align the parts of the system and focus resources in a common direction. During implementation, clarity and coherence in the minds of the majority of teachers was necessary for success. When the critical masses became the majority, systemic change began.

According to Fullan (1996), a need existed to break away from the current beliefs
of systemic thinking and shift towards a new theory, which stretched the system and achieved continuous change. Fullan recommended using the strategies of networking and reculturing to promote growth and change. Networking linked schools to one another eliminating isolation. Reculturing involved changing the core beliefs of a school that prevent members from initiating new ideas. Methods of accountability ensured the success of these strategies. In addition, assessments and disaggregated data aligned procedures and policies thus providing networking opportunities that monitored teachers’ understanding of their role.

Silva (2000) reported the experiences of three teams of teachers, located at different elementary schools, implementing an American history curriculum. The prescribed curriculum unit was created by a small group of teachers and was “based on the following assumptions about learning: Learning was a holistic process. Learning was an active and interactive process. Conceptual understanding was built on repeated contact with a variety of real people, places, and events” (p. 281). Each team worked with the same curriculum, the same materials, and the same curriculum specialist. The difference was the way each team implemented the curriculum and the experiences the individuals had with the fifth-grade unit. The results in the classroom directly related to teacher beliefs about teaching and teacher understanding of the role of the curriculum implementor. The process of implementation did not just focus on student learning but also on teacher learning. Evidence from the study suggested that teachers do not enact curriculum, instead they are the curriculum decision-makers.

Cognitive Coaching was defined by Garmston (1993) as “a process during which teachers explore the thinking behind their practices” (p. 57). Garmston maintained that teachers should investigate their unexplored capacities while focusing on existing
strengths. A coach helped teachers improve instructional effectiveness using a three-phase cycle of pre-conference, observation, and post-conference. The process was non-evaluative and focused on teacher reflectiveness. Garmston stated that “The ultimate goal of Cognitive Coaching was teacher autonomy: the ability to self-monitor, selfanalyze, and self-evaluate” (p. 58).

Fullan (1993) maintained that the moral purpose that most teachers embrace was a natural progression towards becoming a change agent. Many teachers enter the teaching profession in order to make a difference. This difference brings about improvements and improvements engage change. Fullan presented “four core capacities for building greater change capacity: personal vision building, inquiry, mastery, and collaboration” (p. 12). Personal vision gave work meaning and was independent of the organization forming within the individual. Inquiry formed and reformed personal purpose from within and from the environment. Mastery was a step beyond exposure because teachers must be skilled and know where to fit in new ideas. Collaboration on a small and large scale merged personal and group mastery. Fullan concluded “In sum, the moral purpose of teaching must be reconceptualized as a change theme... In combination, not only are they effective in getting things done, but they are good at getting the right things done” (p. 14).

Repeated school-reform efforts have failed because the approach to reform was fundamentally flawed. Present reform efforts are still “Based on an industrial and bureaucratic model, [and] school systems are ill-suited to respond rapidly to a changing environment” (McAdams, 1997, p. 141). On-again, off-again-reform initiatives were direct results of political instability. The relative short tenure of political officials makes it difficult to initiate positive lasting change.
McAdams (1997) stated that “Teachers and school officials are inclined by temperament and experience to adopt an incremental rather than radical approach to reform” (p. 141). Successful reform required an understanding of the interplay of factors such as leadership theory, local politics and governance, state and national school politics, organizational theory, and change theory. The interaction of teachers and students, major changes in curriculum, standards of achievement, and the ability to integrate knowledge into a systemic reform effort were necessary for real and lasting change.

Description of Selected Solutions From Literature

Peer tutoring. According to Nazzel (2002), “Students who view school as relevant to their lives, view themselves as successful in school, and who have positive feelings of belonging in the school have been identified as more likely to remain in school” (p. 69). A quasi-experimental peer-tutoring model utilized quantitative and qualitative measures to evaluate school-attendance rates, incidents of misbehavior, academic performance, perceptions of school relevancy, perceptions of success in school, and feelings of alienation for students at risk for dropping out-of-school. At-risk students who participated in a 6-week tutoring project were compared to at-risk students who did not participate. A significant difference was found in academic performance in mathematics class and on the state standardized mathematics test. Positive effects on the tutors’ attendance, classroom behavior, perceptions of success in school, and feelings of belonging to the school community were also indicated. Nazzel maintained that peer-tutoring programs addressed the many factors that often cause students to drop out of school. Concluding that “In this age of accountability and standardized testing, it was an effective strategy to both increase test scores and to meet the needs of at-risk students” (p.
Barone and Taylor (1996) presented two peer-tutoring field studies yielding positive student achievement results. In both studies, teachers introduced concrete and engaging activities prior to the implementation of a peer-tutoring program. Once peer tutoring was in place, tutors modeled the use of effective problem-solving strategies. Journaling by all participants was used after peer-tutoring sessions to promote organization of the strategies. Prediction, analysis, and evaluation of the problem-solving strategies and of the tutoring process benefited students.

The impact of Reciprocal Peer Tutoring (RPT) on the mathematics performance of elementary students at risk for academic failure was examined by Fantuzzo, King, and Heller (1992). The RPT program was systematically dismantled in order to assess the efficiency of structure only, group-reward only, and structure plus group-reward interventions to enhance mathematics achievement. Participants were randomly assigned to four conditions: structure plus reward; reward only; structure only; and no structure, no reward. Findings indicated that students who received structure plus reward showed the highest levels of accurate mathematics computations. Students in the structured conditions reported higher levels of scholastic competency and self-control than did students in the nonstructural conditions. Successful reward contingency was further supported in that the academic progress yielded decreases in inappropriate classroom conduct and students reported higher levels of self-perceived-behavioral conduct and academic competency.

Earlier research was extend by Fuchs, Fuchs, and Hamlett (1997) who documented the design of effective tutoring lessons. Student collaboration was necessary for teachers to effectively meet the diverse needs of students who demonstrate a wide
range of academic competence. Fuchs, Fuchs, and Hamlett believed “As teachers increasingly rely on peers to mediate learning experiences, they need to incorporate explicit methods for ensuring high-quality interactions and explanations” (p. 243). Students needed to be given specific instruction to implement collaborative-learning methods. Without it, students will not develop effective interactions based on conceptual application. Analysis revealed that peer-mediated tutors with training in elaborative help and in methods for providing conceptual mathematical elaborations (PMI –Elaboration + Conceptual), asked more participatory, procedural questions and provided more conceptual explanations to tutees. Academic achievement gains were highest for this group and direct-observation data indicated a high consistency of teachers and student peer-mediated instruction.

Maheady and Sainato (1985) maintained that “Given the documented effectiveness of such programs and their relative ease of implementation, peer tutoring has become an effective educational alternative for the regular classroom teachers who must meet the individual learning of a diverse population of children” (p. 51). In their study, peer tutoring was initiated in three fifth-grade classrooms during a 30-minute daily independent seatwork routine. Tutoring was implemented initially for 2 weeks followed by a 2-week break. Peer tutoring was reinforced for 2 more weeks concluding with a 4-week follow-up. Peer tutoring generated significant increases in the daily accuracy-rates of tutored subjects and tutoring by high-status peers produced slight positive improvements in the sociometric standing of the low-status peers. The intervention also resulted in an immediate increase in the number of positive social contacts, and a concurrent reduction in the frequency of negative social interactions between low-status students and their peers.
A large number of students were unsuccessful with traditional-school curriculum. Urban students at risk for academic failure needed additional instructional attention because they often come to school with academic-skill and social-skill deficits. Classwide-peer tutoring utilized students’ strengths while promoting academic and social growth for students (Gardner, Carledge, & Seidl, 2001). Interpersonal-communication skills and teamwork were directly taught as students learned to praise others and give corrective feedback. The authors suggested “The use of peer-mediated interventions are cost-effective and are culturally sensitive strategies that can improve the academic and social skills of urban African-American children and youth who reside in communities with limited resources” (p. 31).

Classwide-peer tutoring was easily implemented and provided active learning that accelerated and maintained the academic mastery of students with or without learning disabilities. Mayer (1998) maintained that “It allows for early intervention, self-pacing, monitoring of students’ progress, direct teaching of academic and cognitive skills, teaching self-management, and offering positive consequences for improvement” (p. 89). Training for effective classwide-peer tutoring took place for tutors and tutees. After training, student tutors effectively created learning opportunities while increasing engagement time. Modeling with visual and verbal explanations was used to review and practice core concepts. Student tutees used auditory, visual, and writing modalities to learn and apply new skills.

These investigations extended the findings of earlier research. The studies exhibited social, as well as academic benefits of peer tutoring and suggested that these benefits may be derived using the existing structure within classrooms (Fantuzzo, King, & Heller, 1992; Maheady & Saintano, 1985; Nazzel, 2002). Substantial empirical
evidence was presented to support the use of peer tutoring as an effective-instructional intervention benefiting all students (Barone & Taylor, 1996; Fuchs, Fuchs, & Hamlett, 1997).

*After-school tutoring programs.* Educators are focusing on improving learning outcomes for students who are at risk for academic failure. Before-school and after-school programs have been identified through research as a possible solution to this growing problem. Strategic tutoring was an effective strategy to improve academic performance of at-risk students. The goal of strategic tutoring was to develop proficient and independent learners.

Two studies were conducted by Hock, Pulvers, and Deshler (2001) to determine the efficacy of an after-school-tutoring program. Trained adult tutors taught students learning strategies as they assisted in homework assignments. Four phases of the successful Strategic Tutoring program included; (a) assessment of student knowledge of the assignment and the effectiveness of their approach, (b) teaching a strategy for approaching the task, (c) demonstrating the strategy and check for understanding, and (d) planning independent application of the strategy. Hock, Pulvers, and Deshler stated that “By practicing the strategy repeatedly and under the direction of a strategic tutor who provided regular feedback, students learn to solve homework problems and, more importantly to solve problems, independently and successfully, on quizzes and tests in the classroom” (p. 50).

Some students applied the new skills in classroom situations and exhibited academic success even after the tutoring program ended. Results of the study indicated that at-risk students who participated in an after-school-tutoring program increased grades on tests and quizzes. Strategic tutoring was an effective method to improve the
performance of at-risk students. It helped close the gap between failure and success.

Engman (1992) detailed an after-school-tutoring program that was established to meet the needs of students scoring below the national norm on standardized tests or for students who had received D or F grades in reading and mathematics course work. Almost half of the school’s minority fifth graders, and 40% of the minority fourth graders, scored below the 35th percentile on the reading section of the Iowa Tests of Basic Skills. These same students tended not to complete homework assignments and most of the students’ parents were not home to supervise homework. Students lacked the motivation to complete work independently.

In order to raise students’ achievement scores, the school day was extended to accommodate more time and more teaching. Students attended thirty-eight, 70-minute tutoring sessions between November and April. Students met at the beginning of each session in the cafeteria. Half of the students would stay and work one-on-one with tutors and the other half would attend the computer laboratory. Results of Engman (1992) indicated positive achievement gains on the state’s standardized test and an increase in grades for tutoring participants.

Zuelke and Nelson (2001) explored an unsuccessful after-school-tutoring program operated by a nonprofit community-based agency called Quest for Excellence. Data were collected during a 4-year period of at-risk students in Grades 3 through 12. The goal of the program was to increase the grade-point averages of students’ at risk for academic failure. Tutoring sessions lasted 1 hour twice a week for the 2nd half of the school year. An analysis of the data indicated that tutees’ reading and mathematics grade-point averages did not improve during all 4 years of assessment. The authors’ concluded that the effects of tutoring were minimal, inconsistent, and overall did not benefit the
students' grade-point average. Zuelke and Nelson believed that the causes of the consistent lack of achievement gains of the students in the tutoring program were based on the lack of one-on-one tutoring and a lack of understanding of the roles and goals of the program. In addition, an absence of leadership, and little or no change in perceptions of partnerships existed between the Quest for Excellence community agency and the Monroe City Schools.

Cross-age tutoring. The instructional purpose of a cross-age tutoring-program was to incorporate knowledge with immediate feedback. Five key aspects were necessary to implement an effective cross-age tutoring-program: class preparation, tutor selection, tutor preparation, monitoring by the teacher, and continual assessment of student progress. Eggers (1995) reviewed these aspects and the use of the pause-prompt-praise system during cross-age tutoring with first and fourth graders over a 10-week period. Upper-grade-level students were carefully selected, trained as tutors, and matched with a first grader. Participants worked together for 40 minutes twice a week for 10 weeks. Learning processes and self-esteem gains in tutoring participants resulted. Eggers believed that "Students who participate as tutors refine and expand their problem-solving skills as they attempt to find alternative ways for younger children to understand mathematical concepts" (p. 218).

Bogan (1997) discovered that Montgomery Elementary's excellent scores on standardized tests overshadowed students scoring in the bottom quartile. A significant gap between the educationally able and the unable was revealed. In particular, mathematics scores of at-risk students were low year-after-year. Administrators and teachers realized that they had not successfully met the needs of this subgroup of students.
The faculty instituted three practical-tutoring approaches unitizing parents, students, and teachers in order to improve the mathematical achievement of at-risk students. Community volunteers met with students once a week for 30 to 40 minutes. During the 2nd year of implementation, the tutoring program expanded to include cross-age tutoring. The third approach to improving mathematical understanding included peer tutors. Results of Bogan’s (1997) study indicated that 63% of the students who participated in the tutoring program achieved a higher grade-point-average. Student scores on Iowa Test of Basic Skill did not, however, show a significant increase.

*Staff development.* Staff development should be aligned with the individual needs of teachers. Teachers should work with groups of other professionals with similar interests and desire for change (Goldenberg & Gallimore, 1991). Change should be gradual and incremental, giving teachers time to explore new instructional strategies and techniques while reflecting on successes and failures. Time devoted to exploration and practical application of new knowledge and skills will lead to lasting and effective change.

An effective means of staff development was inservice training that was followed by coaching. Job-embedded learning modes such as action research, small-group problem solving, peer observation, journal writing, cooperative lesson planning, critiquing of student work, and involvement in school-improvement projects were valuable to professional growth. Peer-coaching programs created consistent curriculum implementation while motivating and supporting colleagues (Guiney, 2001). As teachers worked together, institutional effectiveness, and student achievement increased. Peer coaches focused on individual goals and specific needs of teachers in a non-evaluative relationship.
Munro and Elliott (2001) maintained that teachers needed increased opportunities for sustained, intellectual study and application of the key ideas in their discipline. Educators were more apt to adopt new strategies and learn new skills when they were embedded in curricular content. Regular meetings that increased collaboration resulted in teachers receiving the practical assistance and emotional support they need. Making explicit changes in the classroom required support and pressure from colleagues.

Selected Solution Strategies

A high-quality mathematics program should exist in every classroom where students learn to use mathematical knowledge to adapt, innovate, and invent new strategies and solutions. Mathematical methods and problem solving should examine the degree of student conceptual thinking. When a student experiences success and strives towards excellence, academic achievement increases providing the motivation necessary to be an active learner. Teacher instructional beliefs and assessment practices should support the NTCM standards with an inquiry-oriented approach to building student success, confidence, and enthusiasm towards mathematics.

Professional development plan. The teachers involved in this applied dissertation project were trained based on the research of effective staff development and peer coaching (Goldenburg & Gallimore, 1991; Guiney, 2001; Munro & Elliott, 1987). Professional development opportunities presented to teachers the implementation of a three-tiered mathematics-tutoring program (peer tutoring, cross-age tutoring, and one-on-one after-school tutoring). Weekly fifth-grade team meetings focused on: (a) strategy discussion and implementation, (b) modeling of tutoring practices, (c) creating manipulatives, and (d) feedback and reflection on program implementation. Teacher feedback and input were solicited while student and teacher progress was recorded in
weekly logs. Teachers were given the opportunity to observe other classrooms to experience a variety of environments.

During the final phase of implementation, teachers evaluated the three-tiered mathematics-tutoring program. Strengths and weaknesses of the program were explored as teachers reflected on successes and failures. Staff-development opportunities with follow-up activities were developed based on specific points of the program’s weaknesses. Extensive teacher training created a consistent curriculum for the next year’s implementation.

*Components of mathematics tutoring programs.* The expected outcomes of this applied research proposal were realized with the implementation of research-based strategies. As a coach, the researcher helped teachers improve instructional effectiveness in a non-evaluative supporting environment (Garmstom, 1993; Munro & Elliott, 2001; Silva, 2000). Teachers were provided with more opportunities for student interaction during problem solving in the classroom and used manipulatives to reinforce mathematical skills. Teachers will also implemented a variety of instructional strategies to teach mathematics as students gained control over their learning.

A classwide peer-tutoring program was implemented in each fifth-grade classroom based on research-verified results (Barone & Taylor, 1996; Fuchs, Fuchs, & Hamlett, 1997; Gardner, Carledge, & Seidl, 2001). For a minimum of 30 minutes twice a week students collaborated on a wide range of academic competencies. The program utilized students’ strengths while promoting interpersonal-communication skills and teamwork. Tutors were given specific instruction to implement collaborative-learning methods. After training, peer tutors created learning opportunities during increased engagement time. Journaling took place after every tutoring session. This promoted
organization of strategies and reflection for tutors and tutees.

Cross-age tutoring took place between fifth-grade students and students in lower-grades. Based on research by Eggers, (1995) student tutors were trained to use the pause-prompt-praise system. Students refined and expanded problem-solving skills as they attempt to find alternate ways to understand mathematics concepts. As with peer tutoring, journaling took place after each tutoring session in order to evaluate and analyze effective strategies.

Students who scored in the lowest quartile on the Florida Comprehensive Assessment Test (FCAT) were identified to participant in an after-school-tutoring program. Each student was paired with an adult tutor for one-on-one instruction. Tutors met a minimum of 30 minutes a week. Hock, Pulvers, and Deshler’s (2001) four phases of strategic tutoring were used to teach students learning strategies that assisted them in mathematical problem solving.

Report of Action Taken

The duration of this applied research project was eight months. Pre-service data was collected and analyzed prior to the first meeting with staff participants. The data consisted of 2002’s FCAT, and 2003’s STAR and SGB pretest results. An initial meeting was held with school administrators, curriculum specialists, and fifth-grade teachers to establish a need for change based on the data and obtain buy-in for this improvement project. During this meeting, information was shared in an open, non-evaluative manner. Concerns and roadblocks to success were identified.

The applied dissertation consisted of a three-tiered-mathematics-tutoring program (peer tutoring, after-school tutoring, and cross-age tutoring). It also had three supplementary components: weekly team meetings, mathematics instructional content
and practices, and classroom visitations. Fifth-grade teachers met weekly to review the project, discuss concerns, and support the use of new mathematics strategies. Research based effective mathematics instructional techniques and practices were identified, modeled, and implemented in the classroom. In addition, classroom visits were made by the researcher to further support the teacher and student participants.

During weekly meetings, the fifth-grade teachers at the work site met to review state and county mathematics curriculum mandates. Discrepancies between current practices and county and state standards were identified. The team came to the realization that current practices were in need of adjustment to better meet the standards and students' individual needs. Furthermore, a variety of problem-solving strategies were shared and practiced. The use of hands-on manipulatives was demonstrated with the focus of building student knowledge from the concrete, to the pictorial, to the abstract.

Prior to implementation, a calendar plan, an overview of the three-tiered-mathematics-tutoring model, and a summary of current research findings supporting the project were presented to the participating teachers. At subsequent meetings, teachers were presented each tier of the program separately with detail and discussion. The participants seemed open minded and interested in a staff development process of coaching, assessing, and sharing.

Informed consent forms were sent home to all fifth-grade parents. This fulfilled the ethical requirement for research with human subjects. The researcher attached a cover letter with a personal introduction and a general overview of the project. The researcher, on the phone or in person, addressed any concerns the parents had in regard to the plan. Informed ascent forms were given to students after parental consent was acquired. The researcher visited the students in each class, gave an overview of the
program, explained the students’ role in the improvement project, and addressed any student concerns. One hundred students of the 127 fifth-grade students enrolled returned both the informed consent and informed ascent forms.

The first tier presented and implemented of the three-tiered-mathematics-tutoring program was peer tutoring. Research was presented at a team meeting, introducing and describing effective steps to implement peer tutoring in a classroom. The process of student partnering for tutoring was explored. Pre-service student data, identifying specific student weaknesses, was gathered and analyzed. In addition, students at risk for academic failure were identified.

A 30 minute a week peer-tutoring lesson was implemented during the 1st month. The goal of peer tutoring was to utilize student strengths while promoting interpersonal-communication skills and teamwork. Tutors were given specific instructions to implement collaborative-learning methods. Both reciprocal and mastery tutoring styles were implemented. During reciprocal peer tutoring each partner took a turn acting as the tutor as the other was the tutee. Specific lessons were constructed with step-by-step instructions for the tutor. Mastery tutoring was utilized when one student mastered a specific mathematics concept and another did not. One of the participating teachers had difficulty distinguishing between mastery and reciprocal tutoring. Specific lesson plans were created to assist in instruction and the researcher modeled the appropriate use of each tutoring practice.

After the initial implementation, the teachers continued to meet weekly to reflect on peer-tutoring practices. In addition, existing instructional practices were discussed and critiqued while alternative practices were modeled. Teachers reflected on their practices and tried to identify traditional and non-traditional instructional techniques in weekly
logs. One teacher stated that using peer-collaboration as an instructional tool was a
difficult adjustment. The teacher was used to having students sit in straight rows and
work independently. Peer tutoring facilitated student movement and student discussions
in her class.

During the 2nd month of implementation, weekly team meetings continued and
student work was presented and critiqued. The teachers created hands-on manipulatives
in order to introduce a new skill. Examples of manipulatives included paper plates that
were cut and slid together to create different types of angles and a fraction man created to
illustrate equivalent fractions. Assessments were also created to check for student
mastery of skills. Specific problem-solving strategies were isolated based on student
need. In addition, students with similar deficient needs were grouped across the grade and
remediated in small groups.

Weekly team meetings also incorporated discussions of specific student and
teacher interactions during mathematics time. Mini-lessons were introduced and the
researcher modeled their use to introduce new skills, reinforce other skills, and remediate
deficient skills. Mini-lesson topics were discussed at the meetings and the researcher
observed the implementation of two different mini-lessons in the classroom as well as
teacher student interactions.

Students practiced the use of concrete examples for problem solving. Once an
object was used to teach an algebra skill, a picture was drawn to illustrate the outcome.
In the final stage, an abstract question was asked with a pencil and paper response. An
example of this was used during algebra instruction. A “Hands-on Equation” kit was
used to demonstrate the balance of equations. Students used blue pawns to represent the
unknown variable and number cubes to represent the known numbers. After manipulating
a problem, students drew the steps on a sheet of paper. After this practice, fifth-grade students easily solved problems like \(2x + x + 5 = x + 15\).

Teachers were surveyed to evaluate the beginning of the peer-tutoring program. Feedback was positive. All the teachers stated that the program seemed helpful in increasing student achievement. One teacher believed the program was having a positive impact of student self-esteem. The teacher stated that the program was an excellent tool to provide motivation. Another noted that “Students teach other students methods that enable them to understand a concept better.” Adding also that a problem might occur “If the students are close friends they may tend to get off task.” For the most part teachers were generally satisfied with the skill mastery of students but had concerns with negative peer interactions. For follow-up, teachers shared best tutoring practices and the researcher continued classroom visits during peer-tutoring session assisting with positive peer interactions.

The second tier of the three-tiered mathematics tutoring program was after-school tutoring for those students identified earlier as at risk for academic failure. The researcher asked for volunteers from the school’s staff to tutor one student 1 hour a week. Thirty-two staff members volunteered for the program. The staff selected a student from a list and took on a duel role as tutor and mentor. An introductory meeting was held with the tutors. At this meeting the facilitator presented current research on effective tutoring practices. The difference between homework help and strategic skill tutoring was established. The program goal was to participate in strategic tutoring. Strategic tutoring taught students ways of knowing how to learn and perform in mathematics. Utilizing this method, a problem solving strategy would be taught, demonstrated, and then applied.

Each tutor received an information packet on his or her selected student from the
researcher. The packet included a data sheet with student achievement scores from the FCAT, SBG Pretest, and STAR. Deficient skills were isolated based on test scores and teacher comments. The researcher met with the classroom teachers of the students selected for tutoring to explore classroom performance in mathematics and to add the teachers' perspective to the data. In addition, the information packet given to tutors included mathematics vocabulary, suggested activities to remediate deficient skills, and sample lessons with hands-on extensions.

The tutors were trained to assess student knowledge of a strategy, teach the necessary problem-solving strategy, demonstrate the use of the strategy, and support independent practice of the strategy. Initially a few teachers from primary grades were concerned with the level of mathematics knowledge necessary to instruct students for the fifth-grade assessment. Additional support from the researcher was given to the concerned teachers in the form of mini-workshops on difficult mathematics concepts, one-on-one assistance, and tutoring observations.

The 3rd month of implementation incorporated the continuation of weekly team meetings, classroom visitations, construction of more manipulatives, and creation of additional problem-solving mini-lessons. NCTM Principles and Standards were reviewed. The Principles reflected basic perspectives on which educators should base decisions about mathematics instruction. These Principles established a foundation for mathematics programs by considering the broader issues of equity, curriculum, teaching, learning, assessment, and technology. The NCTM Standards described the basic skills and understandings that students need to function effectively. The fifth-grade teachers adjusted mathematics instruction based on these standards.

In addition, a literature and mathematics connection was explored. Classroom
instruction incorporated the use of trade books to portray mathematics concepts. Teachers read the books to students to introduce and illustrate a new mathematics concept and then did a follow-up hands-on activity. The book “Sir Cumference and the First Round Table: A Math Adventure” by Cindy Neuschwander was used to paint a picture of the parts of a circle and the “Greedy Triangle” by Marilyn Burns was used to identify geometric shapes. After hearing the stories aloud and participating in a hands-on activity reinforcing mathematics vocabulary introduced in the books, students explored possible applications of the mathematics concepts. Ten books in total were used throughout the implementation of this applied dissertation.

During peer tutoring sessions, students were introduced to journaling. Journaling after peer-tutoring sessions promoted organization of strategies for tutors and tutees. Prediction, analysis, and evaluation of the tutoring process benefited students. Teachers also participated in reflective journaling. Following mathematics instructional lessons, teachers would journal reactions to activities and record their thoughts in regard to student progress and difficulties. Journaling gave the teachers the opportunity for active reflection of instructional practices and allowed for conscious adjustment for the next teaching session. This practice helped drive instruction to better meet the needs of the students.

Classroom observations continued focusing on student verbal interactions and tutor feedback during peer-tutoring sessions. Students were surveyed about their initial peer-tutoring experiences. One student thought that reviewing his weaknesses made him aware of them and was confident he would recall a newly taught skill when it came time for testing. Another student stated that peer tutoring helped her by showing step-by-step formulas for problem solving. A third student suggested that the program should
alternate from mathematics to reading. A suggestion was also given that teaches should switch classes and teach different students different skills. All feedback was deliberated with suggestions documented for possible revisions for the program.

Participation of students in the after-school-tutoring program was exceptional. Thirty of the 32 teacher tutors reported that student interactions were positive and attendance was consistent. Two teachers had initial difficulties getting permission for the students to stay after school and the students were not attending their tutoring time consistently. The researcher spoke with the students and the students’ parents. One of the student’s attendance improved but the other dropped out due to extracurricular activities and scheduling conflicts.

Participants in the after-school-tutoring program were surveyed based on the implementation process and interactions during tutoring lessons. Feedback was very positive although one teacher tutor observed that her student was rushing through his mathematics and she was having a difficult time slowing him down. Another teacher believed that her student had a difficult time staying on task and needed to be redirected several times during a tutoring session. Teacher tutors adjusted instruction to meet the individual needs of their student. The researcher continued to provide support through sample lessons, one-on-one assistance, and observation.

Additional data and resources were made available to tutors in the after-school-tutoring program. Students’ results from the CCC Success Maker program were distributed along with individualized worksheets of deficient skills. The CCC Success Maker program was a computer program that students use daily for 15 minutes during regular school hours. The CCC Success Maker program provided a balanced approach to learning incorporating both basic skills and opportunities for exploration with open-ended
instruction. CCC Success Maker incorporated a management system that controlled and coordinated the software. The program adjusts automatically to the level of student mastery while isolating and practicing deficient skills. This allowed the researcher to monitor and direct the progress of each student.

At the end of the 3rd month of implementation the STAR was administered to all fifth-grade students as a benchmark assessment. The researcher compared results with the pre-service data. Patterns of learning were explored across the grade and in individual classes. A plan for adjusting classroom instruction and peer-tutoring lessons to meet the needs of students, based on the benchmark, was created. The STAR diagnostic report was used by the researcher to conference individually with students.

The 4th month of implementation began with the researcher sharing the results of midpoint benchmark data with the fifth-grade team. Teachers noted student progress. In general, the fifth-grade students scored high in geometry concepts but scored below level on number sense. Instruction across the grade shifted emphasis to reviewing number sense concepts. Base 10 blocks were used to demonstrate decimal numbers and students were shown how to construct a place value chart to compare and contrast numbers.

Specifically, two of the four classes scored above level in algebraic thinking on the benchmark. These two teachers had continued the use of the Hands-on Equations kits and believed that students had made the connection between concrete and abstract thinking. The classes that were confident in the use of the kits partnered with classes having trouble. The teachers team taught an algebra lesson and the more confident teacher modeled the use of the kit. The students enjoyed the new interaction with peers other than their classmates and the teacher felt more confident teaching algebra.

Data from the midpoint STAR also illustrated small groups deficient in specific
skills. As in the 2nd month on implementation, small groups were formed across the
grade and were instructed on the deficient skill. Each teacher chose a group based on
his/her strength. In addition, two support teachers, one the ESE specialist and the other
an ESE teacher, offered to take small groups. Results from the midpoint benchmark
assessment were also given to the after-school tutors to assist in altering instruction based
on student need.

During the 4th month of implementation, the focus of the weekly team meeting
included different learning modalities and metacognition. Each fifth-grade teacher
presented an example of a lesson utilizing audio, visual, and kinesthetic learning
modalities. The researcher introduced and modeled meta-cognition strategies because
metacognition played a critical role in successful learning. It was important to study
metacognitive activity and development to determine how students could be taught to
better apply their cognitive resources through metacognitive control. Metacognition was
defined as thinking about thinking. Activities such as planning how to approach a
learning task, monitoring comprehension, and evaluating progress toward the completion
of a task were metacognitive in nature.

Peer-tutoring lessons increased to 30 minutes twice a week. Fifth-grade teachers
reviewed student collaborative-learning methods including both mastery and reciprocal
tutoring methods. Students were partnered in order to correct mathematical errors,
implemented remedial strategies, practice and apply problem-solving techniques, and
pursue enrichment interests. Peer tutors' journals reflected that the experience was
enjoyable. Most of the students liked the feeling of accomplish it gave them to help
another student understand a mathematics concept. One student wrote that they had fun
tutoring a buddy and thought it was cool to act like the teacher. A second student said the
of mathematics concepts and extended student learning with real-life examples and application.

During this month, teachers also focused on defining and refining student problem-solving skills. In the classrooms, 1 week was set aside at the end of each instructional unit for peer-mediated diagnostic-remediation and enrichment activities for mastery learning. Because students understood one unit before going on to the next, they were better equipped to attack problems with both knowledge and confidence.

Teachers reviewed student and peer-questioning techniques. Teachers had noticed that a few students had regressed and were asking only superficial yes and no questions. It was necessary to re-train the students in ways to pose open-ended conceptual questions. Student questions needed to focus on justification and verification of mathematics answers. Students who were asking higher order questions during peer tutoring were videotaped. The video was used as a model for other students.

Peer tutoring and cross-age-tutoring also focused on problem solving during the 5th month of implementation. Tutors worked on using appropriate supportive feedback and discussed multiple solutions to mathematics problems. Tutees were asked to defend the problem-solving strategy used. Journaling continued as a reflective practice after each tutoring session. The researcher visited classrooms during cross-age tutoring to support problem-solving skill development and to videotape students engaged in effective peer-tutoring interactions. The videotapes were then shared with students and teachers.

Cross-age tutors also diagrammed problem-solving strategies and reflected in their journals. One student wrote in her journal how she enjoyed meeting a new child and she felt that both of them were learning together. She was impressed with the willingness of her partner to learn. Many students wrote that the experience with third
experience was a pleasant feeling and should continue the entire school year. A third student thought the use of food was the best thing about the tutoring process. He felt that the use of pretzels and marshmallows to make geometric shaped was the “best”.

The researcher met with tutors in the after-school-tutoring program for a reflective seminar. While most teachers’ felt that the tutoring program was beneficial and was improving student confidence and knowledge, some felt that the students had hard time focusing. One teacher reported that she spent a majority of the time refocusing her student rather than instructing. Most teachers had very positive comments. One stated that she was seeing her student blossom and another teacher commented on the large gains he had seen from his student.

The third tier to the mathematical tutoring program was introduced during the 4th month of implementation. An initial meeting was held with participants to present current research and discuss procedures for implementation. Teachers selected a buddy class and cross-age tutoring with third grade students took place once a week. Fifth-grade students were partnered with a third grader based on the fifth-grader’s strength. This afforded fifth graders the opportunity to act as a mathematical expert of sorts. Through the cross-age tutoring process, fifth-grade students synthesized and applied mathematics knowledge.

The 5th month of implementation began with the fifth-grade teachers sharing successful lessons with mini-lesson follow-ups. Discussions consisted of classroom instructional practices focusing on traditional verses nontraditional teaching strategies. Two fifth-grade teachers’ reported that they primarily used a lecture style of instruction. One other teacher stated that she taught mostly from the textbook. The researcher modeled alternative-instructional practices that engaged students with hands-on practice
grade made them feel important and they were having fun.

The after-school-tutoring program ended in the 5th month of implementation. Participants summarized and reviewed the program practices. All participants completed a reflective survey on the program. Tutoring was well received by both teachers and students. All participants agreed that the one-on-one structure made a difference. Many teachers were comfortable acting in a dual role of tutor and mentor. A teacher wrote that she felt that she counseled her student as much as she tutored him. Students felt that the one-on-one approach allowed them to understand the skill more easily. One student stated that going step-by-step made the lessons make sense. Another student commented that he felt comfortable talking to his tutors and expressing what he needed help with. Overall, participants felt the program was beneficial to all involved.

Celebrations were held for all the participants of the after-school-tutoring program. The researcher created a goody bag and a certificate for each of the student participants. The bags were passed out to the teachers to be given to the students on the last day of tutoring. Many of the teacher tutors gave additional gifts and tokens of good wishes to the students. The students met in the researcher’s classroom for a party and to create thank you cards for their tutors. The students also constructed little trains from candy lifesaver rolls and attached a message of “You’re a lifesaver”. The students presented their gifts at the last session with their tutor. An after-school celebration was also held for the teacher tutors. The researcher met with the principal to generate certificates of appreciation for each of the tutors and presented each teacher with a pot of candy wrapped in gold with a message stating “You are worth your weight in gold.”

During weekly team meetings, in 6th month of implementation, teachers shared students’ mathematics progress and successes. Peer tutors sessions continued until the
end of the 6th month. Each classroom had a celebration and all participants completed a survey. The peer-tutoring program had been the cornerstone of this applied dissertation and all participants completed a reflective survey of the program. Teachers felt that the program allowed students to display their strengths and use those strengths to help others that were lacking. The teachers observed student improvement in areas that the student had previously displayed weakness. Having students teach other students enabled both to learn more while having a positive impact on self-esteem. One teacher commented that the peer tutoring was an "excellent motivational program". Another teacher wrote, "it helped students achieve at a higher level in class." The students felt they were making a difference and helping others learn. When asked if the students would recommend the program continue the next school year, one student stated, "yes, because it helps a lot of kids that need help to pass the FCAT and to learn beyond it." The peer-tutoring program benefited student tutors and tutees. One student proclaimed, "they should never stop the peer tutoring program."

Cross-age tutoring also ended in the 6th month of implementation and a celebration was held at the last meeting of the classes. The teachers brought in treats and the students participated in learning activities using food. One class used gram cracker squares to explore area and another class used caramel candy cubes to demonstrate volume. A third class charted and graphed M & M candies and the forth class used teddy grams to compare and contrast on a Venn diagram.

At the end of the month, all participants completed a survey about the program. Teachers commented that tutoring had afforded older student the opportunity to interact with younger students. All the teachers felt that cross-age tutoring increased students' acquisition of mathematics concepts and would have a positive affect on standardized test
achievement. Fifth graders were seen as role models for third graders. Both teachers and students wrote that students felt free to express themselves and ask questions without intimidation. Teachers noticed that students’ social skills developed and students formed friendships outside their regular circle of peers. One of the teacher tutors wrote that peer tutoring was well received by the students and that it taught other students “methods that enable them to understand a concept better.” She added, “students seemed less intimidated by those student who seemed smarter.” One student wrote that strength of the program was that both himself and third grade buddy were learning. He continued “I helped my partner learn what she wanted to learn.”

The 7th month of implementation incorporated teacher staff-development opportunities. The first of two workshops was held with fifth-grade teachers. The existing peer-tutoring program was compared to current research and field studies on peer tutoring. In addition, the teachers met to review participants’ surveys and reflection logs. Pros and cons of each of the three tiers to the tutoring program were charted. Specific strengths and weakness of the program were discussed. Overwhelmingly, teachers thought that the entire program should continue the next year. Suggested changes to the program included, starting earlier in the school year and incorporating more grade levels. It was also suggested, to recruit more adult after-school tutors utilizing parents, teacher assistants, and community representatives. In this way, more students would be serviced by one-on-one instruction.

The second workshop for fifth-grade teachers focused on the dissemination and analysis of student achievement data from the STAR computerized test, SBG textbook test, and FCAT. The researcher created a database of all student participant results. Individual teachers then created a spreadsheet of their class’s results. Teachers looked for
patterns to draw conclusions of concept successes and student achievement gains. Teachers were impressed with the mathematics gains of their students. Exceptional achievement growth was evident in each of the measures. Results of the predicted outcomes from this dissertation and the results of the outcomes of each measurement instrument were displayed and would be used later in a staff presentation.

At the end of the 7th month of implementation, the researcher met with the administrators of the school. A brief overview of the program's action steps and results were shared. A synopsis of the participants' surveys was presented and an outline for follow-up workshops was discussed. The administrators was excited with the applied dissertation results and requested that the program be continued the following year. It was also requested that other grade levels and teachers of special needs children be invited to training seminars over the summer.

The researcher created and facilitated a learning community during the 7th and 8th month of implementation. Fifteen staff members signed up for a 30-hour inservice course based on this applied dissertation. The participants included representatives from four grade levels and teachers of the exceptional student programs. The learning community met four times in person for 1 day training seminars. Participants reviewed research findings on peer tutoring, after-school tutoring, and cross-age tutoring programs. Then the three-tiered tutoring model implemented in this applied dissertation was presented. Each component of the program was isolated and reviewed. The action steps, predicted outcomes, and results were discussed. The program was broken down step-by-step for easy implementation in the participants' classrooms. At the end of each seminar, a follow-up activity for application was given.

In addition, to the face-to-face meetings, the participants of the learning
community did independent research on effective instructional practices and participated in on-line chat sessions. The researcher created a web site for the group, posting feedback from current research and reflective practices input. The web site was undated weekly with new research, new discussion topics, and new suggested lesson plans. Participants of the learning community shared lesson plans and created a binder for each strand of mathematics. Additional training was offered on instructional delivery methods to meet the individual needs of students.

The learning communities culminating activity was the practical application of research and tutoring practices. Each of the participants submitted a lesson plan to the researcher and the group. Then the researcher observed the lesson in the participants’ classroom. The participants of the learning community were eager and enthusiastic throughout the process. They felt that peer tutoring was a valuable addition to their classroom instruction and found the additional resources helpful in planning classroom activities.

At the end of the 8th month of implementation, a final workshop took place with the participants of the after-school-tutoring program. The participants reviewed and reflected the effectiveness of after-school-tutoring program. The data showing mathematics gains of student participants were presented. All students who participated in the after-school-tutoring program made substantial progress. It was agreed that the after-school program would continue the following year.

The success of this applied dissertation was due in a large part to the supportive culture of the school. Throughout the implementation process, the staff at the school site was enthusiastic and devoted. Teachers were willing to participate to the fullest extent. Students were also eager participants and the relationship between students and teachers
was caring and supportive. Through this applied dissertation, students’ mathematics achievement increased. Problem solving, inquiry-based-learning environments and open-ended questions that allowed students to formulate conjectures, was the new basis of mathematics instruction at the school site.
Chapter 5: Results

Results

The problem investigated by this applied dissertation was that fifth-grade students failed to achieve at grade-level standards in mathematics. The causes of the problem at the school site were varied. Fifth-grade teachers implemented only traditional instructional methods and lacked the knowledge and materials necessary to teach mathematics effectively. Students worked independently, without peer interaction, to solve mathematics problems rarely using hands-on manipulatives to reinforce mathematics skills.

A comprehensive mathematics program was created to meet the needs of the fifth-grade students. Teachers implemented a three-tiered mathematics-tutoring program including peer tutoring, one-on-one after-school tutoring, and cross-age tutoring. Three supplementary components to the program included weekly team meetings, mathematics instructional content and practices, and classroom visitations. Fifth-grade teachers met weekly to review the project, discuss concerns, and support the use of new mathematics strategies. Researched based, effective mathematics instructional techniques and practices were identified, modeled, and implemented in the classrooms.

The goal of this applied dissertation was for fifth-grade students to achieve at grade-level standards in mathematics. Due to the high mobility and absentee rate of the school and the number of the students consenting to participate in the applied dissertation project, the predicted numbers for the outcomes were different then the actual results. This applied dissertation's results were converted into decimal form for comparison in order to demonstrate the percentage gains for each of the actual outcomes (see Table 2).
Table 2

**Outcome Gains by Percent of June 2003 Assessment Measures**

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Increases at each level</th>
<th>Gains</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outcome 1</td>
<td>FCAT Level 1 increases to Level 3</td>
<td>19 %</td>
</tr>
<tr>
<td>Outcome 2</td>
<td>FCAT Level 2 increases to Level 3</td>
<td>52 %</td>
</tr>
<tr>
<td>Outcome 3</td>
<td>STAR increases from 1 level below to on level</td>
<td>88 %</td>
</tr>
<tr>
<td>Outcome 4</td>
<td>STAR increases from 2 or more levels below to on level</td>
<td>64 %</td>
</tr>
<tr>
<td>Outcome 5</td>
<td>SBG increases from below 70 % to 70 % or above</td>
<td>55 %</td>
</tr>
</tbody>
</table>

The expected outcomes for this applied dissertation were:

1. Sixteen of the 32 fifth-grade students who scored at Level 1 will increase two levels to Level 3 on the FCAT. This outcome was not met. The results of the FCAT indicated that only five of 26 participating fifth-grade students who scored at a Level 1 increased two levels to Level 3. It was predicted that 50 % of the students would increase two levels. This was not the case. Only 19 % showed the two-level increase. Although the goal of a two-level increase was not met, nine students increased from Level 1 to a Level 2 on the FCAT. In total, 14 of 26 students scored at or above a Level 2 on the FCAT. Level 2 was the minimum required by the state for promotion to the next grade.

2. Twelve of the 23 fifth-grade students who scored at Level 2 will increase a minimum of one level to Level 3 on the FCAT. This outcome was met. The results of the FCAT indicated that 11 of 21 participating fifth-grade students who scored at Level 2 increased a minimum of one level to Level 3. It was predicted that 52 % of the students would show this increase. Actual results indicated an increase of exactly 52 %. The county recommends that all fifth graders achieve at or above a Level 3 on the FCAT.
3. Twenty of the 39 fifth-grade students who scored one level below grade level will score at or above grade level on the STAR computerized mathematics assessment. This outcome was met. The results of the STAR indicated that 28 of 32 participating students who scored one level below grade level scored at or above grade level. It was predicted that 51% of the students would show this increase. The actual results yielded an increase of 88%.

4. Twenty-one of the 41 fifth-grade students who scored two or more levels below grade level will score at or above grade level on the STAR computerized mathematics assessment. This outcome was met. The results of the STAR indicated that 25 of 39 participating students who scored two or more levels below grade level, scored at or above grade level. It was predicted that 51% of the students would show this increase. Actual results indicated a 64% gain.

5. Thirty-two of the 64 fifth-grade students who scored below 70% on the SBG mathematics textbook pretest will score at or above 70% on the SBG mathematics textbook posttest. This outcome was met. The results of the SBG mathematics textbook posttest test indicated that 32 of 58 participating fifth-grade students who scored below 70% on the pretest scored at or above 70% on the posttest. It was predicted that 50% of students would demonstrate this increase.

Five sets of data were collected during the implementation of this applied dissertation. All five measures demonstrated significant gains. Three sets of data came from the FCAT. The FCAT was comprised of two tests. The first was the Norm Referenced Test (NRT) that measured student achievement on a test given to a national sample of students. Percentile scores on a norm-referenced test showed a student's performance in relation to the performance of students in the national sample. For
example, a score at the 60th percentile means the student has scored higher than 60% of the students in the national sample.

The second FCAT test was the Sunshine State Standard (SSS) that measured student performance on selected benchmarks defined by the state’s standards. The FCAT SSS reported student scale scores ranging from 100 to 500. Results from the FCAT SSS test were also reflected in levels from 1 to 5. A score of Level 1 indicated that the student had shown little success in meeting the basic skills they were supposed to know at their grade level. A Level 2 indicated that the student had limited success with the challenging content of the test while a Level 3 showed that the student had some success with the challenging content of the test, but performance was inconsistent. Level 4 indicated that the student was successful answering the challenging parts of the test and a score of Level 5 showed that the student was successful answering the most challenging parts of the test.

Pretest and Posttest scores from the FCAT NRT, FCAT scale score, FCAT level score, Silver Burdett Ginn, and STAR were statistically analyzed to determine significance between fifth-grade students prior to and following the implementation of this applied dissertation. Mean scores of each measure were used in a two-tailed t test to determine statistical significance. Significance of difference was found at the < .05 level for the FCAT NRT results and at the < .01 level for the scale and level scores. The Silver Burdett Ginn mathematics series was the county adopted program for the fifth-grade classrooms. The pretest and posttest from the series was also administered to the participants. Significance at the < .01 level was found. In addition, the fifth set of data was collected from the STAR computerized test. Pretest and posttest results also indicated significance at the < .01 level (see Table 3).
Table 3

2002-2003 Pretest and Posttest Mean Scores on Five Measures

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Mean</th>
<th>Number</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FCAT NRT</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretest</td>
<td>51.7412</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td>Posttest</td>
<td>57.1058</td>
<td>85</td>
<td>0.014*</td>
</tr>
<tr>
<td><strong>FCAT Scale Score</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretest</td>
<td>283.3953</td>
<td>86</td>
<td></td>
</tr>
<tr>
<td>Posttest</td>
<td>328.1860</td>
<td>86</td>
<td>0.000**</td>
</tr>
<tr>
<td><strong>FCAT SSS Level</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretest</td>
<td>2.1988</td>
<td>83</td>
<td></td>
</tr>
<tr>
<td>Posttest</td>
<td>2.7229</td>
<td>83</td>
<td>0.000**</td>
</tr>
<tr>
<td><strong>Silver Burdett Ginn</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretest</td>
<td>60.2222</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>Posttest</td>
<td>74.9444</td>
<td>90</td>
<td>0.000**</td>
</tr>
<tr>
<td><strong>STAR</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretest</td>
<td>4.3763</td>
<td>97</td>
<td></td>
</tr>
<tr>
<td>Posttest</td>
<td>7.0423</td>
<td>97</td>
<td>0.000**</td>
</tr>
</tbody>
</table>

*Note.* Means of pretest and posttest measures differ significantly at *p < .05* and **p < .01.}

The FCAT SSS level results were used by the state to grade individual schools. The state's grading system resembled that of a report card with a grade from A to F. The school where this applied dissertation took place was graded a C last year and bounced between a D and C in preceding years. In order to receive an A grade from the state, the school must demonstrate student declines at Level 1 and student growth at the upper
levels. A comparison of pretest and posttest scores by frequency of students’ scores at each level was conducted (see Figure).

![Bar chart showing comparison of pretest and posttest FCAT Scale Scores.](image)

*Figure.* Comparison of pretest and posttest FCAT Scale Scores. The frequency of student achievement at Level 1 decreased indicating a decline in students achieving below grade-level standards. Increases at Level 4 and Level 5 indicated achievement growth above grade-level standards.

Participants in the applied dissertation demonstrated exceptional growth on FCAT level scores. Over 50% of the students who scored at a Level 1 increased to at least a Level 2. Large increases were seen at both Level 4 and Level 5. Only 8% scored at a Level 4 and 0% scored at a Level 5 on the pretest measure. The posttest measure yielded 23% of students scoring at Level 4 and 5% of students scoring at Level 5 on the posttest measure. Based on these increases in student mathematics achievement on the FCAT SSS level scores, the school received an A grade from the state. Additionally, the state
calculated points gained for increases in student achievement. The school had a 262-point gain over last year. This was the second highest gain in the county.

In summary, four of the five outcomes predicted were met and five of the five measures used showed significant gains. Based on the five measures, an increase in scores from the pretests to the posttests was observed. This increase is considered statistically significant and shows that it is not likely that this increase has come about by chance. Therefore, it is reasonable to believe that the outcomes of this applied dissertation could be applicable to other fifth-grade classes with similar student populations in the county.

**Discussion**

Based on the findings of this applied dissertation, a three-tiered mathematics-tutoring program was successful. Peer tutoring, one-on-one after-school tutoring, and cross-age tutoring were effective practices in regular education classrooms meeting the individual learning needs of a diverse population of children. Concordant with Barone and Taylor (1996) “It allow[ed] for early intervention, self-pacing, monitoring of students’ progress, direct teaching of academic and cognitive skills, teaching self-management, and offer[ed] positive consequences for improvement” (p. 89). The outcomes of this applied dissertation were consistent with those found in literature (Fantuzzo, King, & Heller, 1992; Maheady & Saintano, 1985; Nazzel, 2002; Fuchs, Fuchs, & Hamlett, 1997; Gardner, Carledge, & Seidl, 2001).

Classwide-peer tutoring was easily implemented and provided active learning that accelerated and maintained the academic mastery of mathematics concepts. As with Nazzal (2002), student use of concrete and engaging activities during instruction and peer tutoring sessions led to increases in achievement while the practice of journaling
extended discussions and ingrained reflection. Results of this applied dissertation were similar to R Hock, Pulvers, and Deshler (2001) and Engman (1992) studies indicating that at-risk students who participated in an after-school-tutoring program increased mathematics scores on standardized tests. The strategic tutoring strategy used by tutors was an effective method to improve the performance of fifth-grade at-risk students and helped close the gap between failure and success. Learning processes and self-esteem gains in cross-age tutoring participants were seen through observation and students journal responses. Consistent with Eggers (1995) “Students who participate as tutors refine[d] and expand[ed] their problem-solving skills as they attempt[ed] to find alternative ways for younger children to understand mathematical concepts” (p. 218).

Staff development was aligned with the individual needs of teachers. Change was gradual and incremental, giving teachers time to explore new instructional strategies and techniques while reflecting on successes and failures (Goldenberg & Gallimore, 1991). To improve instructional effectiveness in a non-evaluative supporting environment, the researcher acted as a coach using job-embedded learning modes such as peer observation, journal writing, and cooperative lesson planning. Regular meetings increased collaboration and resulted in teachers receiving the practical assistance and emotional support they need. Consistent with Guiney (2001), as teachers worked together, institutional effectiveness, and student achievement increased.

As stated previously, four of the five predicted outcomes of this applied dissertation were met. The first predicted outcome of 16 of the 32 fifth-grade students scoring at Level 1 will increase two levels to Level 3 on the FCAT was not met. Only 5 of 26 made a two level increase. In retrospect, this increase might have been too optimistic and the standard set too high. Although the county recommended that all
students achieve at a Level 3, Level 2 achievement is required for promotion. Growth within the same level or growth to the next level shows adequate progress meeting state and county mandates. A more realistic outcome might have been that 50% of the students scoring at Level 1 will meet promotion criteria and increase to a Level 2. This outcome could have been met because 14 of 26 students scoring at a Level 1 did increase to a Level 2 or 3.

In each of the outcomes predicted, a difference in projected numbers and actual numbers occurred. A decrease in numbers was due to the school’s high mobility rate, student absenteeism, and the number of consent forms obtained. Many of the students that the original data was based on were not part of this applied dissertation. The data collected was based on 100 participants. Within the 100 participant group, comparative data measures ranged from 85 to 97 on a given instrument (see Table 3). This was due in large part to the school’s mobility rate of 33% and absentee rate of 18%. Some students that began the implementation process where not enrolled at its conclusion and some students were not in attendance during all measures. Therefore, some measures did not have both a pretest and posttest score. Due to this limitation, each of the outcomes was converted to percentage and the gains presented (see Table 2).

All of the participants in the tutoring program demonstrated gains in targeted areas. The largest percentage gains were on the STAR computerized assessment. STAR results indicated an average student gain of 2.6 levels. Both outcomes utilizing the STAR as a measure were met. Eight-eight percent of the students scoring 1 level below grade level on the STAR increased to at or above grade level. Sixty-four percent of students scoring 2 or more levels below grade level scored at or above grade level.

The after-school-tutoring program yielded some unexpected events. One such
event was that 99% of the student participating in the program made gains on all measures. This could possibly be due to the remarkable commitment of the tutors. Thirty-two staff members volunteered to work one-on-one with an individual student. Many of the teachers put in many additional hours working on other subjects and social growth. Teachers embraced the duel role of tutor and mentor for the students. A remarkable bond formed between many of the participants.

It was unexpected to get such a large number of volunteers for the program. Teachers were willing to put in a minimum of 1 hour a week after-school one-on-one with a student and then put in additional time reviewing data and creating individual lessons without payment. Because there were more students in need then were tutors, some tutors offered to take on an additional student. The principal of the school was so impressed with the willingness of 80% of the instructional staff to participate in the program, that school accountability funds were used to pay the teachers for their time. This was an unexpected surprise for the teachers.

Through this applied dissertation students learned to use mathematical knowledge to adapt, innovate, and invent new strategies and solutions. Teachers’ instructional beliefs and assessment practices shifted to support NCTM standards with an inquiry-oriented approach to building student success, confidence, and enthusiasm towards mathematics.

Recommendations

Recommendations can be made from this applied dissertation that further improve mathematics achievement at the school site and benefit others in similar situations. Continuation of this program for the new school year would benefit the school. Students currently entering fifth grade are also not achieving at grade level standards. It is
reasonable to predict that with the continued implementation of this comprehensive mathematics program including the three-tiered tutoring model student mathematics achievement will continue to increase.

The maintenance of a teacher support system is an important component of continued implementation. The researcher supported participating teachers during weekly team meetings and classroom observations. Weekly team meetings were ideal to build trust and support between the researcher and the participating teachers. The consistent interaction throughout implementation made it possible to identify weakness and discuss concerns. However, availability of time for in-depth conversations was limited. In the future, it would benefit the participants to have more time to meet as a team and one-on-one with the researcher. Providing substitutes for classroom release time would maintain and enhance a teacher support system.

The time of the day the researcher was able to observe classroom teachers and students was also restricted. The researcher had only a daily lunch and break time available. This limited the study because classroom observations were always done at the same time during the day. It would benefit a continued study if release time were given to the researcher creating a more flexible observation and support time.

This applied dissertation’s mathematics program should be extended to other grades at the school site. The successful implementation of this program can increase mathematics achievement as well as student success and enthusiasm in intermediate and primary classrooms. Students increased successes in mathematics will benefit the school and help students enter fifth grade with the requisite skills necessary to achieve at grade level.

Students enrolled in Exceptional Student Education (ESE) classes were not
considered participants of this study. Although these students were engaged in some of
the activities in the regular education classroom, the majority of their mathematics
instruction was in an ESE resource room. According to the state, the ESE population at
the school site did not make adequate progress in achievement on the state’s assessment.
The school will not be able to maintain the grade of A without achievement improvement
by this population. It is, therefore, recommended that the teachers of the ESE students
implement this program in their classrooms.

Future research could increase the strength of this study. The relationship
between adult tutors and students could be further explored. Social interactions between
peer and cross-age tutors could be qualified and quantified. In addition, the research
could be analyzed based on gender, ethnic background, and socioeconomic status. Future
research could also replicate this study with a larger sample population or compare this
study’s findings with those of similar demographics.

Dissemination

The findings of this applied dissertation will be presented to the teacher
participants, school administrators, and other interested faculty members at the school
site. Teacher participants will receive a copy of the data gathered and the results of the
outcomes for their individual class and the grade as a whole. An overview of the project,
action steps taken, solution strategies employed, and the results of the outcomes will be
presented first to the administrators of the school, then to the curriculum support staff. At
a staff meeting, the measures indicating student-mathematics-achievement growth will be
presented from all the fifth-grade participants and then isolated for the participants of the
after-school-tutoring program. This information will be utilized to gain support for
program expansion to other grades and for continuation of the after-school-tutoring
program.

An overview of the applied dissertation and the results of the measures will also be presented to other schools with similar populations. The county is broken into nine intervention zones. Zones include all the schools in a certain area. Representatives from each school meet quarterly to share programs and activities at the schools. The researcher will attend the zone meeting and present this study to the zone coaches. Once presented to school representatives, the findings will then be presented at individual schools in the zone. Early release days are scheduled throughout the county for staff-development opportunities. The researcher will make additional presentations for interested schools on early release days.

The researcher belongs to the county mathematics cadre and is a trainer for the county’s Human Resource Department. County-level mathematics-curriculum specialists will be sent a synopsis of the research, solution strategies, and results of this applied dissertation. Components of this applied dissertation will be incorporated into county mathematics workshops. After final approval from the university, a copy of the entire applied dissertation will be presented to the county’s research department. The results of this applied dissertation will also be compiled into a document and submitted to a scholarly journal for publication. This will afford people in areas outside the county the opportunity to learn more about effective tutoring practices.
References


Appendix A

Mathematics-Tutoring Program

Student Survey
Mathematics-Tutoring Program
Student Survey

Name __________________________________________

Date __________________________________________

Tutor ___________________________ Homeroom Teacher ___________________________

How do you think the tutoring sessions helped your mathematics understanding?

What specific skills do you remember being taught?

Would you recommend this program continue next year? Why or Why not?

What should stay the same about the program?

What should change about the program?
Appendix B

Mathematics-Tutoring Program

Teacher Survey
Mathematics-Tutoring Program
Teacher Survey

Name____________________________________________________

Date____________________________________________________

Student Tutored__________________________________________

Please describe the strengths of the tutoring program?

Please describe the weaknesses of the tutoring program?

What changes did you observe in the student you tutored?

What impact do you think you made on the student’s achievement?

Would you recommend this program continue next year? Why or Why not?

In the space provided, please provide additional feedback on the tutoring program.