

Intervention Methods for Struggling Intermediate Grade Students

by

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Table of Contents

List of Tables	i
Abstract	ii
I. Introduction	1
Statement of the Problem	1
Null-Hypothesis	2
Operational Definitions	2
II. Review of the Literature	3
Proficient Mathematical Achievement	3
Challenges in Math Achievement	5
Current Interventions Being Used	9
Implications for Future Studies	14
III. Methods	15
Design	15
Participants	15
Instrumentation	16
Procedure	17
IV. Results	20
Analysis of the Data	20
V. Discussion	21
Implications of Results	21
Theoretical Consequences	21
Threats to Validity	21
Connections to Previous Studies/Existing Literature	23
Implications for Future Research	24
Summary	24

List of Tables

1. Measures of Central Tendency	20
2. Dependent t Analysis	20

ABSTRACT

The purpose of this study was to examine the impact of computer programs on the mathematics content and skills of third grade students who have difficulty with mathematics; such students might profit from additional tutoring and interventions utilizing technology. Amongst students participating in study achievement scores demonstrated a mean overall increase of 10.65 points. This study strongly suggests student's skills in mathematical achievement can be strengthened through the utilization of the computer programs combined with the added support during completion of homework.

CHAPTER I

INTRODUCTION

Accountability has never been so prevalent in public education as it is currently in the United States. With No Child Left Behind and now Race to the Top, the emphasis on student performance has never been greater (Herner-Patnode, 2009; Department of Education, 2009). One area of academic performance that has been an obstacle for many students is mathematics. Students struggle to make sense of the word problems before they process through numerical equations and solve the calculations. They lack fluency in the numerical calculation. This creates hardship for students in processing the more advanced processes. There has been great progress in utilizing the diverse instructional methods to forward student reading abilities. The time has come to give attention to the diverse ways and approaches to reaching the mathematical mind.

One way to achieve this is to utilize the technological advances. Many of these technologies are readily available. This study looked at the utilization of the computer programs as one of the methods to advance the student mathematical achievement.

Statement of the Problem

The purpose of this study was to examine the impact of computer programs on the mathematics content and skills of third grade students who have difficulty with mathematics and might profit from additional tutoring and interventions utilizing technology.

Null Hypothesis

The achievement level of third grade mathematics students who receive additional tutoring support and computer program will not be significantly different than the achievement level of those who received regular instruction.

Operational Definitions and Limitations

This study is limited by first the period of time covered by the literature review; which was from September to December. Additionally, in this study mathematics achievement refers to early fall through winter of 2012 and tutoring refers to meeting with students and concentrating individual student needs and co-operative peer tutoring along with explicitly designated computer program use for set periods of time. The independent variable used in this study was the special after school tutoring program with the use of the computer based program FirstinMath.com. After school tutoring was conducted in Monday through Thursday afternoon from 3:40 p.m. until 5:15 p.m. with the group of sixteen African American general education students. The dependent variable of this study was academic achievement measured by the Measures of Academic Progress® (MAP); MAP online assessment scores. The first pretest was administered in the early fall (September) with all students having tested by the first week of October for the 2012-2013 school year. The post assessment was administered during the winter of 2012.

CHAPTER II

REVIEW OF THE LITERATURE

The last decade has featured considerable advances in the teaching of reading and it the time is upon us as teachers to make similar progress in mathematics. Using proven teaching techniques, curriculum designers must move forward to ensure that students get the instruction they need to excel and to build the mathematical skills necessary to gain success in both their scholastic world and within their future careers (Reys, 2007). This calls upon skills in five strands of mathematics Number and Operations, Algebra, Geometry, Measurement, and Data Analysis, and Probability according to the National Council of Teachers of Mathematics in Principles and Standards for School Mathematics published in 2000. Technology brings new demands (Furner, 2005).

In order to keep up with the changes in the technology and changes in educational standards the call for elementary teachers to continue professional development and increase their mathematical pedagogy mandates teachers continue to seek professional development in their delivery and in the uses of technology to enhance and improve students' knowledge (Reys, 2007). The No Child Left Behind project also places the demand for teachers to bring statically proven methods to the classroom. It increases the drive to seek new and innovative methods to insure all students obtain the foundation to and possess the necessary knowledge to attain success. This includes providing methods that bridge the gap between the diverse populations (Herner-Patnode, 2009).

Proficient Mathematical Achievement

In order for students to be considered proficient in mathematics they must be able to apply their knowledge of numbers as well as explain the relationship between numbers. In order

for students to be able to demonstrate proficiency in the higher problem solving skills, they must have number sense (Reys, 2007). Students must be able to discuss and describe the pattern of numbers, the method they used to calculate and solve algorithms. This includes addition, subtraction, multiplication, and division problems. Students must be proficient in mathematics in order to progress to the higher level processes involving real life problems relating to mathematics and the concepts of mathematical processes. These demands students know number concepts, adding, subtracting, multiply, and divide with whole numbers, decimals as well as be able to manipulate fractions. Students must also be able to do these processes fluently. Students must be able communicate their processes in ways that demonstrate clear proficient understanding of the concepts (Reys, 2007).

Historically, the practice in special education was to teach students with learning differences in their own learning environments, instead of having them mainstream classroom. However over the past two decades, that trend has shifted dramatically, with many children who previously had been taught in isolation now receiving instruction in the mainstream classroom. This includes students who are English Language Learners as well as those who have disabilities. Instead of teaching separate classes in separate classrooms, many special education teachers now work as “inclusion” professionals focusing on working in the general education classroom with the teacher, moving among the students they serve and facilitating their participating in activities and assessments. Hudson and Miller (2006) put together a textbook that links the NCTM standards with instructional practices that are grounded in research and have been proven to be effective with outcomes. The primary use for this book is for those who are taking education classes in preparation for becoming a classroom teacher. The first section has section chapters and connects the NCTM standards with rudiments of planning, delivering

and assessing the results of instruction that is designated to instill knowledge of concepts, procedures, and problem-solving. The second section contains nine chapters and connects specific mathematical topics with the NCTM standards, with specific instructional strategies designed to work with each subject areas. This is a useful book that will help give teachers the tools they need to serve their diverse populations.

Challenges in Math Achievement

The difficulty to achieve serving such a diverse population is exaggerated in students who are challenged with a range of diverse learning abilities. Within schools, there is a determined population of students who are not meeting proficient standards for mathematical processes (Grouws & McNaught, 2008). This includes areas of critical thinking with mathematical processes, such as justifying their method of comparing and ordering numbers, number sense, algebra functions, geometric reasoning, and time and measurement. In order to be able to function in the mathematical environment students must be able to approach the subject with a reasonable amount of number sense. Many students demonstrate difficulty with retaining mathematical skills and solving problems. It is not necessarily a matter of decoding information; it is using knowledge to analyze or interpret information in questions that are the root of the difficulties (Seo & Bryant, 2010).

One of the fundamental difficulties with working word problems for students is their inability to move beyond computation competence to procedural and declarative knowledge in a particular area, according to a study by Miller, Stringfellow, Kaffar, Ferreira, and Manel (2011). Still others get stuck at one of the two other levels of knowledge, leading to classroom in which many students are held up at several different curricular points in the same classroom. This study

indicated that explicit instruction proved to be effective in mathematics instruction for high-risk students, both in elementary and secondary grades. For students with difficulties in basic areas, explicit instruction proved to be effective mathematics instruction for high-risk students, both in elementary and secondary grades. As well for students with difficulties in basic mathematical areas, explicit instruction also proved to close the gaps more quickly than those of the less structured more modern methods did. Another suggestion was to convert word problems into concrete thought patterns by using representational and concrete models. Students with learning disabilities who cannot read word problems and mentally convert them into representational models can often make the same leap, though, with concrete models. Combining an explicit sequence that moves from concrete to abstract with explicit instruction has been successful for high-risk students, as well as students with disabilities. In the electronic age, it is possible to use software applications to generate representational models for students that are more durable than the old “conic sections” model that sat on the trigonometry teacher’s bookshelf. Explicitly teaching cognitive strategies was another suggestion from this research project, as the results of such methods with students with disabilities have been positive- particularly in the independent solving of problems, including word problems. One might not automatically equate increased use of number sense activities with a greater ability with solving word problems. However, Yang and Wu (2010) took sixty third grade students in two classes and taught number sense activities along with the rest of the curriculum to one, while the other just used the traditional textbook. Using a pre-assessment and two post-assessments, as well as individual interviews, the students who had number sense mixed in with their math instruction had significantly better outcomes with the sorts of calculations associated with word problems than those who did not.

Based on the interviews, it appeared that the number sense led to greater student ability to use number flexibility.

The need for general improvement in the overall teaching of mathematics in the public schools has been made obvious by the recent upsurge in reading instruction quality that has followed the emphasis that cultural planners have placed on it. Grouws and McNaught (2008) discuss the historical shift away from separating students into those who need mathematical skills and those who do not to realizing that the entire population needs mathematical skills in order to find success in their careers. It is not, they assert, just to provide of engineers and scientist to further the course of the nation's economy. In order to succeed personally and professionally, they find that all students must have robust mathematics in their education. This is a problematic statement on several fronts, as there is much in the way of assessment results and research that shows that many students struggle with mathematics, beginning with the very earliest years of school. The concepts of mathematics occur quite easily to some- and utterly mystify others. If one is to assemble a mathematical curriculum that brings success to all students, then one has to analyze all of the elements of mathematics and education in order to find delivery methods that will benefit students from a variety of backgrounds and learning differences. According to Grouws and McNaught , this means that curriculum planners must take curriculum, teaching and assessment all into account. This might seem self-evident, but traditional practice has been to view assessment as something that will take care of itself with proper instruction and curriculum has also been seen as a tool that can be made to fit any instructional situation (What Works Clearinghouse, 2012). However, this study finds that all three elements must be taken into consideration for a successful mathematics program to appear. The teaching of mathematics must be designed on the basis of the assessment; instead of drilling

test- based questions over and over, this means that teachers and curriculum planners must take the concepts that will be tested in assessments and assemble a variety of activities, tailored to take into account a variety of learning styles and preferences, when designing instruction. These ideas should also be a part of selecting curriculum (Bailey, 2010).

As one might imagine, the use of technology is a powerful tool for helping differentiate instruction for students with learning disabilities. State and federal law has mandated that teachers provide appropriate education for the disabled; as the years have gone by, the laws in place have evolved, as have the expectations for the learning of the disabled. In years past, state assessments exempted many students who had a variety of disabilities or challenges, ranging from qualifying as ESL students to a range of learning differences (Bailey, 2010). In the era of the federal No Child Left Behind (NCLB) legislation and its interactions with the Individuals with Disabilities Education improvement Act of 2004 , those exemptions are at a bare minimum (No Child Left Behind Act of 2001: Qualifications for Teachers and Professionals, 2004) (Lee, & Herner-Patnode, 2007). This means that educators must improve overall access to the general curriculum for students with disabilities (Bailey, 2010).

Bley and Thomton's (2001), *Teaching Mathematics to Students with Learning Disabilities*, contains a wide variety of methods that teachers can use to help their students find success- at all levels of ability, including the use of computers and other forms of technology. Additionally, the authors list different types of learning disabilities and, the difficulties can cause and specific methods for helping students with specific computer programs. Included are suggestions for available shareware and software for helping students with specific disabilities. The authors discuss the precedence of using computer assisted instruction- with success- to serve

students with disabilities. This lends itself to the premise computer technology used for intervention stands to positive outcomes compared to students who do not receive any intervention (Bley & Thomson, 2001).

Current Interventions Being Used

Not surprisingly, one of the areas of research with the most effort and focus has been in the area of word problems. Griffin and Jitendra (2008) studied the effectiveness of strategy instruction in classrooms featuring students with mixed ability levels. The comparison featured the performance of word problem solving and computational skills between students who had general strategy instruction (GSI) as opposed to schema based instruction (SBI). The pool included sixty third grade students who were randomly assigned to one of the treatment groups. The study featured a pretest as well as a posttest with mathematical test of problem solving and computational skills, with periodic assessments during the 18-week testing period. Both instructional environments produced significant improvement in the students' problem solving and computational skills. The SBI group had a significantly higher increase in word problem solving skills at the first assessment during the testing period; however that advantage was not maintained during the entire 18 weeks. The researchers acknowledged that the 100-minute instructional sessions could have affected the differential effects. This length of instruction is not typical for elementary schools, because students have much shorter attention spans and therefore have difficulty maintaining focus for this length of time. Regardless, the students did show to benefit from both approaches to instruction. With today's classrooms diversified in terms of ability levels, though, the need to tailor instruction to meet the needs of each individual student has increased tremendously. It was encouraging that the improvements in both sets of skills held for 12 weeks after the initial assessment; the implication is that strategy instruction is

necessary to boost the retention of these skills for a significant period of time beyond the intervention period. These findings are useful in promoting SBI and its uses for mixed ability students; even though the difference between SBI and GSI did not hold up over time, it is worth looking to see whether SBI would be more effective with mixed ability classes (Griffin & Jitendra , 2008).

The advent and swift sophistication of mobile technology have also made their mark in instruction, in just about every curricular field. Kiger, Herro, & Prunty (2012) performed a nine week study of four classes of third grade students at an elementary school in the American Midwest. In two of the classrooms students and teachers used common everyday math and the traditional rote methods such as flash cards with their daily practice sessions. Conversely the other two classrooms worked with the everyday math along with web-based applications for the i-touch. These were considered to be the MLI (mobile learning intervention) group. After the period was over, the researchers performed a multiplication test that gave a balance controlled for such covariates as home i-touch use, prior achievement levels, and prior teacher technology experiences. The advantage in performance for students in the MLI group was significant as the demographic profile for the student or the teacher's possession of an advanced degree in educational technology. Further research is needed in this area to evaluate long-term benefits for students in diverse groups and settings, as well as to explore the ways in which teaching and learning take place in a mobile learning environment .

For the school districts with the funding and wiring infrastructure to front the costs of the computer-based learning on a one to one basis though, the benefits of a computer aided instruction (CAI) have been verified by research. Seo and Bryant (2010) performed a study of

the effectiveness of Math Explorer for students with mathematics difficulties, focusing specifically on word problem solving. This study lasted eighteen weeks, and it involved four student in second and third grades who had been identified as having mathematics difficulties (MD). At the end of the study, all of them were able to utilize their four-step cognitive and three step metacognitive strategies to solve word problems involving addition and subtraction, and all of them boosted their results on the computer based and paper based assessments. After the intervention ended, three of the students were able to maintain their improved performance with word problem solving during and after the follow-up phase (Seo & Bryant, 2010).

These findings are consistent with existing research regarding both metacognitive and cognitive strategies for students who have MD. Explicit teaching that focuses on those strategies has been shown to be a successful approach for boosting those students. This study fills a gap in the existing literature though, because the vast majority of studies on MD students have focused on secondary grades rather than elementary. This study fits together with other research finding that CAI features and instructional principles contribute significantly to the success of students (Compton, Fuchs, Fuchs, Lambert, & Hamlett, 2012).

In the short term, the implications mean that adding mobile devices to existing curricula may be more cost-effective (and more effective in total) than changing curricula to address problem areas in student performance. While cost should be the only driver in boosting student performances, combining the metrics of cost and effectiveness should provide compelling motivation for administrators to consider solutions. The researchers identified an MLI cost to considerably less than laptop programs and other programs that need a lot more support. This article makes a powerful argument for incorporating mobile programs; it would be important to

ensure that the school district also had a robust wireless internet system, so that widespread use of the devices would not slow the entire network down (Kiger, et al. 2012).

Another way to improve mathematical instruction is to utilize tools that analyze instruction for quality. Boston (2012) writes about the instruction Quality Assessment (IQA) Mathematics toolkit, analyzing its effectiveness with identifying classroom instruction in terms of quality. The purpose of the IQA is to examine the levels of instructional tasks and task implementation, as well as teacher expectations and chances for mathematical discourse in class. The article surveys thirteen middle school teachers in an urban district in an urban district of middle size, after the implementation of professional development program and a move to standards-based mathematics curriculum. In this study, the IQA reported that there were high-quality examples of assignments and student samples, and that the teachers who used tasks that were cognitively challenging could meet the challenges of cognitive demands when lessons were observed. However, the IQA also identified that instruction being observed was lacking in terms of whole group discussions that take place on a high level. One reason for this could be the fact that many campus administrators discourage whole group activities, preferring instead to see small-group instruction. The current trend in education is to have the teacher serve as a facilitator for student activity, instead of filling the more traditional lecturing role (Boston, 2012).

One setting in which peer-assisted instruction can be rewarding involves pairing students with disabilities with other students (often older) who do not have learning differences (Kushmuk, 1986). These sorts of mentor-based peer relationships can build student confidence both inside and outside the classroom, but can also produce strong outcomes in mathematics for

the student with the learning difference, as a study indicated by Kroeger and Kouche (2006). There is considerably more research about this sort of intervention in middle and high school than there is in the lower primary grades, but reading partners have long been a practice in many elementary schools across the United States pairing older elementary students with kindergarteners and first graders who are still struggling with beginning reading. The upshot of this sort of program is that both of the students benefit whether it is the younger student, who gains ability (and confidence) because of the time spent with the mentor student, or the older student, who gains interpersonal skills and the emotional confidence that comes with helping others.

Another form of peer-based assistance can come in a whole-group discussion of ways to solve certain problems. There are some problems which just about every student will be able to solve easily; there are others that only one of students will understand. As Albina (2012) indicates, the sort of conversation that this can create in the general education classroom can be quite helpful, as students, even in the early primary years, will listen to each other in ways that they will not use when listening to the teacher. Also the confidence that comes with explaining a particular problem to the entire class will be rewarding for the student, and the cognitive tasks associated with teaching others differ from those that accompany the simple retention of skills and abilities. As a result, the entire class benefits-and the children are doing the work. This can work with mathematics problems as well as with explaining how to access the technology-based applications that the class is using. For some students who struggle in other interpersonal areas, having the ability to explain a complex technological process can be a significant confidence-builder.

In order to improve student scores and make gains in closing the achievement gap and increase the academic foundation of all mathematical students more studies are needed in several areas of mathematical educational practices. Studies are encouraged in the areas of curriculum development to include activities for each domain in the areas mathematics. Professional development for teachers to be able to effectively implement the changes necessary to keep up with technological advances will call upon educational leaders and curriculum developers to incorporate these trainings into their designs.

CHAPTER III

METHODS

This study examines the impacts of computer programs on the mathematics content and skills of third grade students. In particular, the study looks at those students who have difficulty with mathematics and might profit from additional tutoring and interventions.

Design

This study was a “one shot” quasi-experimental case study using a pre- and a post-test. The first pretest was administered in the early fall (September) with all students having tested by the first week of October for the 2012-2013 school year. The post assessment was administered the winter of 2012.

Participants

The students of the study attended an elementary school in the Baltimore County Public School system. The school has a general education program consisting of a pre-school 3 and pre-K 4; a Gifted and Talented (GT) program; and special education program with related services delivered through inclusion, pull-out. The school also has a Functional Academic Learning Support Program (FALS). The school program of study was based on the Maryland Voluntary State Curriculum.

Participants in the study included seventeen third grade students (eleven boys 64.7% boys and six girls 35.3%). Of the seventeen students, four were eight years old and thirteen students were nine years of age. All students were African Americans. These students were offered to participate based on their low achievement scores on the fall otherwise known as Measures of

Academic Progress® (MAP); MAP online assessment, selected based on their placement in their third grade homeroom, student availability, and parental permission to participate in the program (Northwest Evaluation Association, 2012).

Instrumentation

The pre and post assessment was the MAP online assessment by the Northwest Evaluation Association (NWEA) ---Measures of Academic Progress® is a state-aligned computerized adaptive assessment program of which there are thirty questions 10 to 35 for mathematic, comprised of 52 (NWEA standard) or 48 (common core) questions. The pre- and post- test forms asked the same initial questions each time, but differed in the second half may present different questions (in random order). The difficulty of each question is based on how well a student answers all the previous questions. As the student answers correctly, questions become more difficult. If the student answers incorrectly, the questions become easier. In an optimal test, a student answers approximately half the items correctly and half incorrectly. The final score is an estimate of the student's achievement level. For students it presents an adaptive test that does not repeat a question to the student within a year. It is a screening skills assessment with goals assessing skill level foundational literacy and numeracy skills, that vary based on the skill selected and given in a range that adapts to the student's knowledge. Students used the computer under adult supervision in the school setting and took the assessment. Student MAP testing results are reported in RIT scores (short for Rasch Unit). A RIT score is an estimation of a student's instructional level and a measure of the student progress or growth in school. It is not a measure of intelligence or a capacity for learning. The MAP assessments are designed to provide highly accurate measurements on reliable scales, through tests backed by extensive research (Northwest Evaluation Association, 2012).

Students assessed are given instructions to take their time and read each question carefully then select the answer you feel is the best answer for the problem.

Procedure

Using the results from the MAP as a pretest students were identified as possible participants. Parental permission for students to participate in an extended afterschool program began with a letter sent home with the student, explaining the program. The program required students to remain at the school, Monday thru Thursday, extending their scholastic experience to 5:15, where parents came to pick them up. This letter also served as a contract between the parent and the intervention teacher. The parent agreed that his/her child would be in good attendance, otherwise would be considered for dismissal from the program. The letter also stipulated that the parent was responsible for transportation (i.e. picking the child up after the lesson) if the child usually rides the bus, and that someone would be available to meet the student who generally walked home following the program. Once this contract is signed, it served as an agreement between parent and teacher that they would do their best to provide the support the child needs to excel academically.

This was a “one shot” case study quasiexperimental group in which during each the session extra support was provided both individually to students who requested or demonstrated deficient in the daily subject content covered. After consuming a snack students settled into completing the daily homework. During this time student support was provided through a systematic set of activities. Both reteaching and extending activities provided building on what students learned during the school day and to extend the knowledge they already had. Strong

encouragement to utilize peer modeling and to use problem solving strategies as well as instructional reteaching provided means to engage every student.

Of the seventeen participants, during each session at least eight students would rotate through a complete twenty minute session on the program. The goal was to raise the mathematic fluency of the students in the intervention group to increase their overall mathematic academic achievement. Specifically, the students in the control group participated in dedicated computer time to “play “Firstinmath.com,” (<http://www.firstinmath.com/>) an online computer program dedicated to mathematical games on the computer where one of the requirements was for students to work with the mathematic facts beginning with solving as many addition facts within three minutes as possible. The students attempted to complete the one hundred addition facts within the three minutes, continuing to progress to the subtraction facts and onto the multiplication and division facts. The student logged onto the site and selected. Students participated in a self progressive paced engaging set of games. Students began with single step addition problems and progressed to more complex algebra problems. Within the program students were required to build their proficiency through practice of basic facts, including addition, subtraction, multiplication, and division. The standard “Just the Facts” module tested the facts using a 13 x 13 grid (0 to 12 for the Whole Numbers unit). Within each operation, the student was presented a total of 169 facts housed in four quadrants: Quadrant 1 contained 49 facts. Quadrant 2 and 3 each had 42 facts. Quadrant 4 had 36 facts. Students did not have to complete the four quadrants in one sitting. Following their fifteen minutes of Just the Fact’s practice, students could continue in the program by selecting a game within whole numbers, decimals, integers or fractions, each designed to assist in building automaticity. The possible

skill sets included games that were organized into eight skill sets with each subsequent game built on the achievement and success of the previous skill. Each skill set consisted of seventy-two games, broken into three sets of twenty four games. Students advanced at different rates, according to their individual skill levels, but all the students experienced improvement in numerical fluency, and increased speed. Students received reinforcement through immediate feedback in the form of electronic stickers after they completed a series of complex problems. There was no penalty for incorrect responses. Students were motivated to collect stickers that were cashed in for “Bonus Games”. These games offered sequential skill building activities targeted on the same skills included in the advancing skill set. Student achievement is encouraged through frequent computation without fear of retribution. Each session included a student assessment of progress. Areas of the program included games that incorporate problem solving skills with sections that focused on time, money, and measurement that are aligned with the NCTM standards as well as the Common Core Standards. Students who had difficulty acquiring new mathematical skills, this provided a breakdown of the complicated skills into smaller sequential steps that were differentiated and master able. The additional bonus was the academic enrichment and support with homework while keeping these students engaged in safe academic development while their parents worked.

CHAPTER IV

Analysis of the Data

This study examines the impacts of computer programs on the mathematics content and skills of third grade students. In particular, the study looks at those students who have difficulty with mathematics and might profit from additional tutoring and interventions. Seventeen students participated in a special after school tutoring class and these students took a pre test and a post test. Data were analyzed using a dependent or paired t test. Significant differences were found between the pre and post test. Table 1 displays the measures of central tendency for the pre- and post-test scores and Table 2 displays the dependent t analysis.

Table 1

Measures of Central Tendency

	Mean	N	Std. Deviation
Pretest Score	182.47	17	14.001
Posttest Score	193.12	17	11.418

Table 2

Dependent t Analysis

	Paired Differences				
	Mean	Std. Deviation	t value	Degrees of freedom	Sig. (2-tailed)
Pretest Score - Posttest Score	-10.647	6.103	-7.193	16	.000

CHAPTER V

Implications of Results

This study examines the impacts of computer programs on the mathematics content and skills of third grade students. In particular, the study looks at those students who have difficulty with mathematics and might profit from additional tutoring and interventions. Seventeen students participated in a special after school tutoring class and these students took a pre test and a post test. Data were analyzed using a dependent or paired t test. Significant differences were found between the pre- and post-test. This researcher must reject the null hypothesis due to the data indication that the students' academic achievements did benefit from the additional tutoring and computer program intervention provided during the afterschool intervention program.

Theoretical Consequences

This supports the theory Piaget focused on in the overall cognitive change that occurs in the middle age child (Schneider, 2002). The use of the computer further set forth developing memory strategies to support the organization and recall necessary to perform basic mathematical facts. These facts underline the basis for multiple mathematical concepts (Schneider, 2002). The program supports what is also in the report by Canobi, Reeve & Pattison (2003) that documents the benefit in supporting the development in the poorly performing student in learning with support from guided participation in strategy utilization and repeated practice (Berk, 2007 pp. 307).

Threats to Validity

There are several threats to the validity of this study. Two of the most influential threats were that of consistent participation and sample selection. There were days when a small number of students were absent. This had a great impact on the validity of the experiment as there were a number of students who had unequal times on the computer programs and therefore the scores may have resulted in different outcomes. In addition, several students had missed the initial explanation of the program and therefore time for instruction and the activities were reduced due to the need to explain procedures and expectations. In addition, several students missed school due to illness. These absences led to an inconsistency of instruction. Since support could only be given when students are present the afterschool tutoring relies heavily on the time spent on reteaching and interaction with the computer program, it was imperative that all students are consistently present.

The external validity is also threatened by the limited sample size of the study. Due to the nature of this study, a truly random sample was not attainable. The school administration staff sets up a class based on the incoming needs and scores of students. This provides a convenient sample for this study, which could have also had a great effect on the outcome of the results.

Another threat to the internal validity of this experiment was experimental mortality. There was consistency amongst the students in terms of residential mobility; however several students were moved to other mathematics classes before and during the actual experiment. One student was moved into a higher mathematics class just after the initial sampling process and group selection, then returned to the group during the last two weeks of the study. The student continued to receive random intervention throughout the study. Another student was included during the latter half of the study as a request from both the administration and the student's

parents. These two students added to the rotation of computer use and increased the number of students receiving intervention services. Several students admittedly continued to practice and “play” within the program off-site throughout the study. Their scores may have been influenced by the increased practice. This too may affect the internal validity.

Connections to Previous Studies/Existing Literature

The current trend in education is to have the teacher serve as a facilitator for student activity, instead of filling the more traditional lecturing role (Boston, 2012). The small group support simulated in the afterschool intervention study provided the strong support for student meeting challenging demands when provided individual support master the their deficit skills. Students receiving adult support have more access to resources and allow for individualized and smaller group instruction, which may help these students catch up and begin to close the gap in their mathematic achievement scores. This further supports similar findings Cooper, Linsay, Nye, and Greathouse (1998) found in their report on the positive relationship between homework completion and achievement. Older children benefit more however their findings suggest the benefits are in the areas of learning study skills may have a positive on the younger student as well (Cosden, Morrison, Albanese, & Macias, 2001).

The interaction amongst students in the small supported tutoring group concurs with the students increased confidence and retention of skills when sharing and reaffirming their knowledge. The computer program and interaction with the complex technological processes may have provided the instantaneous gratification and confidence booster of the some students who have not yet reached the developed interpersonal area (Albina, 2012). The tutoring support produced similar results as the study by Kroeger and Kouche (2006), whereby the benefits were consumed by the students interacting together throughout the program.

This study also supports the study by Seo and Bryant (2010) of the effectiveness of Math Explorer for students with mathematics difficulties. Similar findings in gains by students who used computer based programs to aid the cognitive and metacognitive strategies needed to solve mathematical equations .

Implications for Future Research

Further research is needed in order to improve student scores and make gains in closing the achievement gap and increase the academic foundation of all mathematical students more studies are needed in several areas of mathematical educational practices.

Summary

While the findings of this study are limited to those of the elementary school in which the study took place, the results hold promise that the impact from utilizing a computer program such as FirstinMath.com coupled with the additional small intervention support grouping can effectively help close the achievement gap of struggling mathematic students.

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