Running Head: Touch Math

The Effectiveness of the Touch Math Program with Fourth and Fifth Grade Special Education Students

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Abstract

The math achievement of third and fourth grade special education students has been identified as an area of concern within a public school located in a small rural town located on the east coast. The purpose of this action research study was to investigate whether or not the Touch Math strategy increased the math ability of third and fourth grade Special Education students. Using convenience sampling, third and fourth grade Special Education students were given a teacher made test , Test of Mathematical Ability 2nd Edition (TOMA-2), pre and post instruction, and observed before, after, and during instruction. This data was analyzed through the use of a t-test. Data was examined to determine whether or not students showed an increased score on both the teacher made test as well as the TOMA-2. Furthermore, observations were analyzed to see if student frustration and avoidance behavior had been reduced. The results indicated an increase in math achievement on both the teacher made test as well as the TOMA-2. Students also showed a decrease in avoidance behavior and frustration.

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Introduction

The idea for this research project came to light while working within a public school system in a Special Education setting. By observing a number of IEP and Child Study Team meetings it became apparent that there was a need for a supplemental math program that would improve the academic achievement of these elementary students who receive special services.

Students who are struggling with basic math skills is not a unique problem. There is a need for math instruction that supplements the current math program. The purpose of this study was to investigate whether or not the Touch Math program used as a supplement to the current Everyday Math program is an effective tool in increasing Special Education students' math achievement.

Problem Statement

Introduction

The problem statement was developed while working with a variety of Special Educations students in grades three through five within a public school. These students were performing below grade level when compared to their general education peers and required an intervention to increase their academic achievement. While developing this problem statement a needs analysis was conducted to determine the needs of these students.

With the introduction of high stakes testing within our public schools many teachers become overwhelmed with the further task of ensuring that their students achieve the required progress on the standardized tests, as well as their general academic development. Most teachers are more comfortable with the supplemental reading

instruction than they are with supplemental math instruction, thus math has taken a back seat to reading. “Math interventions are much less common for young learners than are reading interventions (Jordan, 2007, p. 64). Teachers, in general, have the skills and knowledge to create meaningful and targeted instruction in all areas of reading, when it comes to math, however, the instructors are likely to be less creative. We do not always see the use of supplemental math instruction in our math classrooms like we see the use of programs in our reading classrooms. One such successful math supplement is the Touch Math multi-sensory system of using dot notation to solve computation problems.

The need for a supplemental math program became evident when a discrepancy was found between the use of supplemental instruction in reading and math. An informal observation of math and reading classes was conducted within the school community during the winter of 2009. These observations were required as part of a professional improvement plan, and although they gave the observer an opportunity to see the best practices of others, it also illuminated the discrepancy between math and reading instruction. All the teachers that were observed were using a variety of techniques to teach reading. The multi-sensory Wilson Reading System was being used as a supplement to the schools reading series, a variety of small group instruction targeted at specific skills, as well as center activities geared around targeted instruction were observed. When math classes were observed, most were being taught using only the adopted math series, Every Day Math (Bell, Bretzlauf, Dillard, Hartfield, Isaacs, Mcbride, Pitvorec, Saecker, Balfanz, Carroll, & Sconiers, 2004), with little or no supplemental instruction. Although this is a well-tested program, there are those at-risk

students who are struggling and are in the need of a more creative program, which would improve both their confidence and math computation abilities.

After observations were completed informal meetings were held with colleagues. Through these informal meetings with the professional community of the school the same theme was prevalent, teachers were more comfortable with reading supplements, and readily put them to use. The opposite was noted when it came to teaching math skills.

Through informal interviews, it became clear that the school was in need of a supplemental math program. Discussion of observations and concerns with colleagues began, which turned into a brainstorming session of ideas that could be presented to the principal and would help improve the math achievement of the students within the school community. This provided further evidence, along with informal observations and interviews that the elementary school was in need of a supplemental math program, such as Touch Math, which involves a multi-sensory approach to solving computation problems.

Many students, those who qualify for Special Education services and those who are slow learners, are struggling with the basic computation skills necessary to be a successful math student. There is much emphasis placed on using multi-sensory instruction for reading. For example, the Wilson Reading System is a research-based program that provides instruction on the basic elements of reading, phonics and phonological awareness. The program teaches the necessary foundation skills required to be able to be a successful reader (Wilson, 1996). This program is very successful so the same should be true for a program that utilizes the same multi-sensory approach for math instruction. Touch Math provides students an opportunity to utilize a multi-sensory

approach to solving math problems. Using a dot notation with consistent placement of dots provides children with the visual cues necessary to recognize numbers. They can also "touch" the dots to further understand the concept of numbers (Bullock, 2005). The Touch Math program will provide students with a multi-sensory approach that can increase their math computations skills, achievement, as well as confidence with the subject. This was proven through my own research on the use of multi-sensory strategies, such as Touch Math, and its effectiveness with in an elementary math classroom.

Research Questions

Does the Touch Math system increase the formal assessment math scores of Special Education Elementary School students in the fourth and fifth grade?

Is the Touch Math system an appropriate supplemental math program for Special Education Elementary School students?

When implemented with Special Education Elementary students who are struggling in math, does the Touch Math multi-sensory system used as a supplement to the current Everyday Math program increase students' self concept as a math student?

Literature Review

Introduction

The following literature review was conducted to determine what has been done to help struggling math students achieve success. The review included literature obtained

from Educational Resources Information Center and Academic Search Complete that focused on multi-sensory approaches to learning; more specifically Touch Math as well as the characteristics of those students that are struggling.

The Effectiveness of Using a Multi-Sensory Approach, Such as the Touch Math Program, to Teach Math to Academically At-Risk Students: A Review of the Literature

Student achievement in math is a primary concern of most educators. There is a consistent need to help academically at-risk students increase their math scores on high stakes testing, but more importantly, their individualized mathematics achievement. It is hypothesized that supplemental math instruction is not always apparent in our math classrooms. "Math interventions are much less common for young learners than are reading interventions (Jordan, Kaplan, & Hanich, 2002, as cited by Jordan, 2007, p. 64).

Teachers, in general, have the skills and knowledge to create meaningful and targeted instruction in all areas of reading, however, when it comes to math the instructors are likely to be less creative. "Most (teachers) were strongest in language arts and very few favored mathematics" (Shafer, 1998, p. 5) It has been hypothesized that using the Touch Math multi-sensory program as a supplement to the current math program will increase math achievement in the skill areas of addition, subtraction, multiplication and division among those Special Education elementary students identified as being below grade level in math by at least one grade level. The following review of the literature will support the hypothesis.

History of Touch Math

The Touch Math program was developed in 1975 by elementary school teacher Janet Bullock. She found that many students were struggling with math concepts and were in need of an intervention that would increase their math skills as well as their confidence in the subject (Bullock, 2009). Bullock (2009) began experimenting with a few struggling students by placing counting points on numbers. She began to see immediate results with her students; they were beginning to make the transition from concrete to symbolic learning. Much of the program is based on a report released by Kramer and Krug (1973) where dots were placed on numerals in a pattern modeled off of dice and dominoes. Kramer and Krug (1973) contend that many different children, both handicapped and non-handicapped, have developed the technique on their own; Kramer and Krug (1973) have observed the creation of this technique among various types of students.

The Touch Math program is also based on the research of both Jean Piaget and Jerome Bruner (Bullock, 2009). Bruner and Piaget both suggest that learning concepts should follow a predicted set of stages: Concrete, pictorial, and symbolic. This idea was the basis of the Touch Math program.

Bruner theorized that education is a process of personal discovery where students should learn to build their knowledge through teacher direction; not by being taught through rote memorization. He studied what he believed to be the three stages of understanding: enactive, iconic, and symbolic. The enactive stage is when children begin to develop understandings of concepts through active manipulation. During the iconic

stage children begin to make mental images of the material without the need to manipulate it directly. Finally, the symbolic stage is when students are able to use abstract ideas to connect and understand concepts (Arndts & Cabelus, 2009).

Piaget, very similar to Bruner, felt that education is best when the child learns through discovery. He identified four stages of cognitive development: sensorimotor, preoperational intelligence, concrete operational intelligence, and formal operational intelligence. During the sensorimotor stage, occurring during infancy, intelligence is demonstrated through motor activity with out the use of symbols. When children grow into early childhood they enter the preoperational stage. It is here that children begin to develop intelligence through the use of symbols. When children mature into the elementary years and early adolescence they enter the formal operational stage of intelligence. Children begin to manipulate symbols that are related to concrete objects. The final stage in Piaget's theory is formal operational when children develop into adolescents and young adults. It is here that the learners begin to demonstrate intelligence through the logical use of symbols related to abstract objects (Huitt & Hummel, 2003).

Bullock (2009) used the ideas developed by Bruner and Piaget when she began using points on numbers to represent the actual value of the number. The active manipulation of touching the points helps students to gain an understanding of the math concepts being taught: addition, subtraction, multiplication, and division; very similar to Bruner's enactive stage and Piaget's preoperational stage of intelligence. Next, the points are gradually faded out so that students begin to mentally visualize these points when solving computation problems, much like Bruner's iconic stage. Ultimately, students will

be able to understand the abstract: number and how they are used to solve mathematical problems, which is reminiscent of Piaget's formal operational stage and Bruner's symbolic stage.

Characteristics of Struggling Learners.

Many struggling learners have had trouble with math computation and problem solving. Subsequently, "many struggling students do not progress in math as quickly as their non-struggling counterparts" (Cawley and Miller, 1989, as cited by Miller and Mercer, 1997). Miller and Mercer (1997) wrote an article that discussed the educational aspects of mathematics disabilities. Miller and Mercer (1997) stated that students struggling in math have struggled since their early elementary school years and these students' struggles can be related to their math instruction. Students who struggle with learning disabilities tend to not be able to memorize and retain math facts. Sometimes they may also exhibit an inability to utilize a number line appropriately (Miller and Mercer, 1997).

Likewise, Wadlington and Wadlington (2008) stated that students who think they are not good at math will avoid it at all cost. These characteristics lead to the belief that a multi-sensory approach to math instruction will lead to a higher success rate in math for these struggling students, which, in turn, will create an environment where students will feel successful when it comes to math. "Whether using traditional activities, such as counting with beans or coins, or more sophisticated manipulatives, hands on learning helps students to more readily understand concepts and boosts their self esteem" (Santoro, 2004, p. 28). The Touch Math program provides the multi-sensory approach that struggling learners need to be successful. The program provides step-by-step

instruction that utilizes a dot notation for each number (not a number line) that can be of benefit to students who have trouble memorizing facts. Miller and Mercer (1997) went on to share recommendations that can help improve math education. They suggest a curriculum that is supported by research and that focuses on the four basic mathematical operations: addition, subtraction, multiplication, and division (Miller and Mercer, 1997). They further stated that strategies needed to be explicitly taught (Miller and Mercer, 1997).

Overall, Miller and Mercer (1997) supported the hypothesis that struggling learners need a supplemental math program to increase their academic achievement. Many students are faced with factors that can effect their overall academic achievement. The quality of help at home, the ability to gain access to outside services, and the environment in which a child lives can effect the academic achievement of a student. Touch Math can provide the needed strategies to help struggling learners succeed in math by providing lessons that focus on the four basic mathematical operations.

Strategies that Help Struggling Math Students

In research conducted by Wadlington and Wadlington (2008) intervention strategies were discussed that can help students with math disabilities succeed. There are uncontrollable human factors that lead to this struggle in math. There may be attention difficulties with the students that may create a barrier that makes learning the material in a traditional manner unsuccessful. Also, many students learn in different ways, while a lecture approach may work for one student, another may require teacher modeling, kinesthetic, or auditory strategies. Strategies need to be implemented that create a learning environment that can improve student's basic math skills. These strategies

should include aspects of Gardner's theory of multiple intelligences: linguistic, bodily kinesthetic, logical-mathematical, musical, spatial, intrapersonal, and interpersonal.

The use of manipulatives helps create instruction that incorporates multiple senses and provides the most optimal environment for learning. DeGeorge and Santoro(2004) stated that "hands on learning helps students to more readily understand concepts and boosts their self confidence"(p. 28). It can make abstract concepts much more concrete and understandable (Wadlington and Wadlington, 2008). Therefore, "Students should learn through multi-sensory strategies" (Clements, 2000; Marolda & Davidson, 2000; Spafford & Grosser, 1996; Tomey, Steeves, & Gilman, 2003, as cited by Wadlington and Wadlington, 2008, p. 5).

Using multisensory strategies can help students overcome certain factors that may inhibit them: attention difficulty, lack of help at home, and strategies that do not incorporate varying learning styles. The Touch Math program provides not only strategies that involve touch, but auditory, and visual strategies as well. Degeorge and Santoro (2004) believe that hands on instruction can benefit students by providing instruction that goes beyond the more traditional approach.

"Although the use of concrete materials may be beneficial to all students, it may be particularly important for handicapped learners"(Marzola, 1987, p. 9). Marzola (1987) explained that many teachers rarely use manipulatives in the classroom past first grade. This lack of use is attributed to the fear that students will become too dependent on the manipulatives and that manipulatives are only appropriate for younger grades. Marzola (1987) goes on to say that is it important to move the student on from concrete

to symbolic representations but it is more important to be sure that the connection is made between the concrete and symbolic.

Kerekes (2006) also discusses the importance of using manipulatives in the classroom. She cites personal experience as a classroom teacher to attest to the effectiveness of manipulative use within the classroom. She also describes many activities that teachers can use to enable their students to become literate math students. Kereke's (2006) ideas and professional experience support the methods behind the Touch Math program: teach children hands on math so that they can gain a deeper understanding of mathematical concepts.

DeGeorge and Santoro (2004) in their article *Manipulatives: A Hands-on Approach to Math* discussed the impressions of various educators who have moved from the classroom to administrative positions. The importance of encouraging staff and faculty to use manipulatives was discussed as well as the need to provide support and training for teachers. The article went on to examine a study, *The Academic Value of Hands-on Crafts Projects in Elementary Schools*, conducted in 2001 by Rockman Inc an independent educational research company. This study looked at the value of using hands on projects in the elementary school. The study found that hands on math is an excellent strategy for visual and kinesthetic learners and those learners that require a more non-traditional approach to math instruction.

Stein and Bovalino (2001) addressed the impact the use of manipulatives has on many students: "manipulatives can be important tools in helping students to think and reason in more meaningful ways" (p. 356). They went on to discuss how students,

especially struggling learners, require a concrete way to develop math skills so that abstract concepts become more meaningful to the student.

Moch (2001) went a step further and explained how the brain works in regard to memory. There are two memory systems in the brain: episodic and semantic. The episodic memory is the memory of specific events that take place at a certain time and place, while the semantic memory is factual information and general knowledge independent of personal relevance. “Using manipulative activities in the classroom engages both memory systems, further enhancing the opportunity for retention” (Moch, 2004, p. 84).

Wadlington and Wadlington (2008) stated the importance of more efficient and effective mathematics instruction in detail and that discussion supports the theory that there is a need for Touch Math in our classrooms. Much of the math instruction that is presented to our students is based only on the textbook being utilized by the teacher. Many of these textbooks lack the strategies that are needed to help those students struggling with math (Witzel and Riccomini, 2007). The problems with text books that Witzel and Riccomini (2007) identified, illuminates the need for a supplemental math program in our math classes. One of the strategies they suggest is to “identify additional instruction to complement the current text or curriculum” (Witzel and Riccomini, 2007, p.15).

Touch Math provides supplemental instruction that will help students with the basic computation skills needed to become better math students, thus, bringing the additional instruction that is needed and suggested by Witzel and Riccomini (2007) to our

classrooms. Improving instructional delivery is a matter of using not only textbooks, but supplementary programs as well (Witzel and Riccomini, 2007).

Jitendra (2002) conducted a study that measured the effectiveness of using graphic representations in math problem solving with fourth through seventh grade students. Jitendra (2002) emphasized that using graphic representations can significantly help children who are struggling in math. The Touch Math program uses a series of dots on specific spots on each number 1-9. These dots represent the number; for example, the number 4 has 4 dots. Although Jitendra (2002) used a graphic organizer approach, the study did suggest that a visual representation could help students with learning problems in math succeed.

The results of the study found that when 10 elementary and middle school students were taught to use a graphic representational approach to solving math problems the students' problem solving scores improved. This approach worked with learning disabled students as well as non-disabled students (Jitendra, 2002). These findings suggest that the use of a math strategy that utilizes a graphic representation can help students improve their math achievement whether they have a learning disability or not; very similar to the approach the Touch Math program uses with dot notation. The study was limited however, in that it dealt with an approach to solving word problems effectively, but not on the prerequisite skills needed to actually solve those problems: addition, subtraction, multiplication, and division. Math is a sequential process with new knowledge being built on previously learned concepts. Teacher's need to be able to assess their students' needs through the use of criterion referenced tests so that these lacking skills can be remediated. Basic math skills are the building blocks of algebra,

calculus and trigonometry, therefore students need to attain proficiency in addition, subtraction, multiplication, and division in their elementary school years in order to be successful in their later school years.

Along with Jitendra (2002), Marilyn Burns (2007) offered suggestions on how to help struggling students succeed in math. Unlike Jitendra (2002), Burns (2007) in her article, *Nine Ways to Catch Kids Up*, focused on the basic skills needed to succeed in math. She contends that the importance of students' math understandings being built on the foundation of their prior learning. The students need to not only get the right answer but also understand the explanation behind the right answer (Burns, 2007). Further more, it is emphasized that supplemental instruction is needed so that students gain proficiency in computation and calculation fluency. This instruction must be geared towards the students' needs and individual successes (Burns, 2007).

It is believed this is a problem within our classrooms because supplemental instruction is not always being done in our math classrooms. Burns (2007) went on to describe ways to improve math instruction. She discussed making connections explicit: making connections among mathematical ideas such as 6 X 8 is 6 groups of 8. Burns' (2007) article was limited in that it did not provide discussion about the use of manipulatives or multi-sensory approaches to math instruction. It focused mainly on the need for specific supplemental instruction but did not provided specific program examples. It is believed that the Touch Math program can improve students' mathematical skills through the use of a multi-sensory approach that utilizes many of the strategies suggested by Burns (2007): mental math, providing skills practice, and encouraging connections among mathematical ideas.

Burns (2004) also argued that manipulatives make abstract math concepts more concrete. The importance of manipulatives being introduced in the early grades was stressed but also to keep that use going up into the higher grades as well. It is important to "encourage different ways of thinking" (Burns, 2004, p. 19).

Rule (2005), unlike Burns (2007), provided specific examples on how to increase the basic subtraction skills of struggling students. The strategies suggested all used concrete objects to enhance the understanding of subtraction among elementary school students (Rule, 2005). Rule (2005) went on to describe the importance of understanding different situations when subtraction is needed: completion, comparison, and whole part analysis. Rule (2005) presented examples that used items such as pom poms, coins, erasers, and small toys.

Her discussion on the use of concrete objects highlighted the need for a math program that utilizes a graphic approach to solving computation problems. The major draw back of Rule's (2005) article is that utilizing concrete objects is appropriate for the beginning of math instruction, but it does not provide real life skills that can be utilized for students who are still struggling after the concrete objects are taken away. It may be okay to use pom poms to subtract in first grade, but a struggling student is going to be very embarrassed to use those same pom poms in fifth grade. The Touch Math program provides graphic representations that are not conspicuous to others and can be used as a life long strategy.

"Teachers need a large repertoire of instructional strategies and techniques if they are to meet the learning needs of all their students" (Fleischner & Manheimer, 1997, p. 401). Fleischner & Manheimer (1997) believe that it is important for students to be

proficient in the basic math operations: addition, subtraction, multiplication and division. Much like Jitendra (2004) and Burns (2007), Fleischner & Manheimer (1997) stated that it is important to utilize a variety of approaches to develop mastery in basic math skills, with manipulative instruction being one way to foster this mastery.

Similar to Rule (2005), Jordan (2007) provided details on how struggling students use their fingers to solve computation problems and the downfall to that: less reliability. Jordan (2007) went on to state how it is very important for supplemental interventions in our math classrooms. Jordan's (2007) article supports the theory that there is a need for math interventions that increase weak computational fluency.

Wadlington and Wadlington (2008), Witzel and Riccomini (2007), Jitendra (2002), Burns (2007), Burns (2004), Rule (2005), Fleischner & Manheimer(1997), Marzola (1987) and Jordan (2007) all offered strategies that can help the struggling math student. There is one common theme prevalent through out each of these articles: students are struggling in math and there is a need for an intervention. Although there are different strategies offered in each article they all tie together in that there is a need to be more creative and look outside the box. Strategies should be utilized that increase math achievement for the struggling student. These strategies should also be implemented with out the need for human influence, such as help from the parent. Touch Math is a researched based program believed to increase the math achievement for struggling students, more specifically, special education students.

Cain-Caston (1996) conducted a study that compared standardized test scores of third grade students who were taught math using manipulatives and third grade students who were taught using just worksheets. Four third grade classrooms were used in the

research, two taught math utilizing manipulatives while two taught math utilizing just worksheets. The California Achievement Test was used to determine if there was a difference between the classes. The study found that students understand math and show a greater gain when manipulatives are used in instruction. Students who were taught using manipulatives scored 2 grades above grade level while the students who were taught using just worksheets scored at grade level. This research clearly showed the benefit manipulative instruction has with elementary students.

Seventy diverse third grade students from 4 different general education classrooms within an urban community in North Carolina participated in this study. The one limitation of the study is that it would have been relevant to see how the special education population within the participant pool scored. It was not revealed whether any of the participants received services from the special education department within the school. Overall, this study promotes the idea that the Touch Math program used as a supplement to the current math program, will help to improve basic math skills of elementary special education students. The program's use of multi-sensory strategies will help to improve math skills just like the manipulative use in Cain-Caston's (1996) study helped to improve scores on the California Achievement Test.

Adverse effects of Touch Math

Much of the research on math instruction shows that a manipulative and multisensory approach to math instruction is beneficial to struggling students. Flexer and Rosenberger (1987) both professors of mathematics education, felt that multisensory math instruction is beneficial but had some doubts about the Touch Math program as discussed in their article "Beware of Tapping Pencils". It was discovered through teacher

interview that third grade teachers found that the mechanical process of Touch Math and the method of tapping out sums and differences made solving two and three digit problems more complicated, thus, making keeping track of carrying and borrowing more difficult. This was especially apparent when subtracting across zeros. Flexer and Rosenberger (1987) found that many teachers reported that "many capable fourth through sixth graders continue to tap out sums and differences and don't know their addition facts" (p. 8). It was also expressed that children had no incentive to learn their number facts because it was much easier to tap them out. Flexer & Rosenberger (1987) point out that many advocates of the Touch Math program claim that there is nothing wrong with tapping out arithmetic problems because it is a replacement for finger counting. "Replacing one poor practice with another, however, is not making educational progress" (Flexer & Rosenberger, p. 8).

Flexer and Rosneberger (1987) identified several problems associate with the Touch Math program. First, it was found through teacher interviews that the method of tapping is not always abandoned by older children who are capable of learning their facts. Flexer and Rosenberger (1987) contend that tapping out math problems imposes an undue handicap on children who are capable of solving their math facts. Instead of using their ability to solve the problem by memorization or through the use of mental math they revert to using the touch point method even though they do not need to. Another problem identified with the Touch Math program is the slower pace at which children, who have been taught using the Touch Math method, solve math problems. Overall, Flexer and Rosenberger (1987) feel that the Touch Math program is not the answer for all students. Students "may be forever tied to tapping out sums and differences and to

tapping and skip counting to find products and quotients" (Flexer & Rosenberger, p. 10). Although Flexer and Rosenberger (1987) offered some compelling evidence to suggest that the Touch Math Program is not as effective as other programs, their article lacked the quantitative data to fully support the theory. They have not conducted any specific research on how ineffective the program is.

Effectiveness of Touch Math

Simon and Hanrahan (2004) conducted a study that evaluated the Touch Math method for teaching addition. The study hypothesized that students with learning disabilities in math that depended on the count all and/or count on strategy would be able to use the Touch Math program to solve addition problems. The subjects consisted of a group of 3 students identified as having a learning disability. They were performing below their fifth grade level in math. They were given instruction using the Touch Math Program 3 days a week for 40 minutes. They were then asked to solve addition problems using whatever method they wanted (Simon and Hanrahan, 2004).

The results indicated that the students were able to employ the dot notation placements required by the Touch Math program to solve addition problems. Furthermore, the students were able to use this approach after teaching was completed, four months later. They would often choose to use the Touch Math method over other methods. Before instruction subject B solved none of the problems correctly, but after two and half months of instruction using Touch Math the same subject scored one hundred percent. Results for the other two subjects were very similar: Subject C went from none correct to ninety seven percent correct and subject A went from twenty five percent correct to one hundred percent correct (Simon and Hanrahan, 2004). One

limitation of this study was that it was conducted in a Canadian school. It is not known if the standards for classification are the same as in the US or how school districts identify struggling students. Also, there were only 3 subjects; it would have been beneficial to see a broader range of grade levels represented. This study mentioned that the subjects of this study were selected from a learning disabilities primary school and were all considered to have a learning disability in math due to the discrepancy between IQ and mathematics achievement. Perhaps this lead to the small sample size and the limited number of subjects, although this was left to assumption because it was not discussed in the research findings.

Next, a study was conducted of how effective Touch Math was for improving academic achievement and completion time of math addition Mad Minute tests (Wisniewski and Smith, 2002). The researchers conducted the study using 4 third and fourth graders that were identified as having mild mental disability, learning disability, or other health impairment. The students were instructed for 45 minutes each day for 14 weeks. They were taught the Touch Math method and were given Mad Minute tests, timed math tests, before instruction and every Friday during instruction (Wisniewski and Smith, 2002). Mad Minute tests consisted of 25 math computation problems that need to be completed within a specified time limit; for this study students were given one minute to complete the addition problems.

The results indicated that utilizing Touch Math improved students' scores and time to complete the task on the Mad Minute Tests. Each of the four students increased their score from the pre test to the post test: Student 1 went for 85% in 5 minutes to 100% in 5 minutes, Student 2 went from 98% in 10 minutes to 98% in 4 minutes, student 3

went from 100% in 7 minutes to 100% in 4 minutes, and student 4 went from 23% in 8 minutes to 93% in 4 minutes (Wisniewski and Smith, 2002). One limitation of this study was that it only used a group of four students whom all had disabilities. A study involving more special education students would be beneficial. Also, there was no follow up to this study. Did the student's continue to excel in math utilizing the Touch Math method?

Kristen Scott (1993) conducted a study, much like Wisniewski and Smith (2002), that look at the effectiveness of the Touch Math program for teaching addition and subtraction to students with learning disabilities as well as cognitive delays. In a reflection of this study, Scott (1993) substantiated her hypothesis that Touch Math would be an effective approach for teaching addition and subtraction to third, fourth, and fifth grade students. Scott (1993) reflected on why Touch math was so effective; it "involves teaching students using three modalities: visual, auditory, and kinesthetic" (1993, p. 125). Scott's (1993) impressions of the Touch Math program support the theory that Touch Math is an effective supplemental program for at-risk math students.

Dulgarian (2000), conducted a study that compared intervention using Touch Math to an intervention using a traditional method. Two math groups were formed that consisted of special education fourth and fifth grade students. Both groups were given a pre-test that evaluated how well they could add and subtract with and without regrouping. Both groups were taught the skills necessary to solve these types of problems although one group was taught using the Touch Math method and the other group was taught using a traditional approach. Instruction lasted ten weeks with instruction occurring 45 minutes

3 days a week. The research showed that the Touch Math program was a more effective program.

Much like Dulgarian (2000), Lyn Strand (2001) conducted research that looked at how effective the Touch Math program was for first graders. Strand (2000) worked with a group of 59 first grade students: 37 from school A and 22 from school B. Group A was given instruction utilizing Touch Math as well as the Addison Wesley book series. School B was given instruction utilizing only the Addison Wesley Series. At the end of the school year both classes were given a one page math worksheet that involved single and double digit addition as well as single a double digit subtraction with and without regrouping.

It was found that group A scored significantly higher than group B: 92% of group A answered the questions correctly while 75% of group B answered the questions correctly. This study substantiates the effectiveness of the Touch Math program. It does present some limitations though. Only a math worksheet was used to determine the effectiveness of the program. A more substantial measurement such as a pre/post test or informal math test would have given the research more credibility. Overall, the research conducted by Strand (2001) highlights the need for additional research to measure how effective the Touch Math program is.

Berry (n.d.) conducted research that measure the effectiveness of Touch Math to teach addition and subtraction to ten students identified with Autism. This study was conducted over two school years. Pre and post teacher tests as well as work samples were used to detail student progress. Berry (n.d.) found that the Touch Math system increased all but one the students' addition and subtraction skills.

Marsh and Cooke(1996) also conducted research that looked at the effectiveness of using manipulatives to aid in the learning of math word problems. Their study centered around 3 third grade students who had a history of low achievement in math and were also classified as having a learning disability. They incorporated the use of manipulatives in their instruction of math word problems. A 10 item pre and post test was given to each student. Student 1 increased achievement by 58%, student 2 increased by 74% and student 3 increased by 77%. The study found that students did improve their word problem computation skills when instruction using manipulatives was utilized.

This study is very promising because it showed the ability for students with learning disabilities to master concepts that were previously a struggle for them. The Touch Math program uses a manipulative technique that will enable students to effectively solve math computation problems.

Overall, this literature review supports the need for a supplemental math program such as Touch Math. Miller and Mercer (1997) described the characteristics of struggling learners and the lack of progress they make in math when compared to their non-struggling counterparts. The characteristics described support the observations that there is a need to increase math achievement among all students within a variety of elementary classrooms. This affirms the need for supplemental instruction so that all students can succeed. Burns (2007), Jitendra (2002), Jordan (2007), Miller and Mercer (1997), Wadlington and Wadlington (2008), and Witzel and Riccomini (2007) all described strategies that could help improve students achievements in math. All suggestions shared the same theme: there must be supplemental instruction that incorporates problem solving and computation skills. As hypothesized, Touch Math can help improve the needed

problem solving and computation skills. The hypothesis is further supported by the research conducted by Scott (1993), Simon and Hanrahan (2004), and Wisniewski and Smith (2002).

Vinson (n.d.), discussed the research base that makes Touch Math an effective strategy and provided the foundational research base for implementing the program. Vinson (n.d.) went on to discuss how computational fluency is needed to be a successful math student. Vinson (n.d.) discussed how the need for computational fluency is further supported by The National Council of Teachers of Mathematics (NTCM). The Touch Math program closely meets this standard because it focuses on the development of basic math skills and fluency in these skills. "The NTCM describes fluency as having and using efficient an accurate methods for computing" (Vinson, 2004, p. 3). The Touch Math program provides this method through a hands-on manipulative approach. Vinson (n.d.), further explained the pictorial, concrete, and symbolic stages of development and how the research Bruner conducted supports the Touch Math program. Overall, Vinson (n.d.) used previous research to support the effectiveness of the Touch Math program.

Rains, Durham, and Kelly (n.d.) compiled a summary of the theory and practice in regards to multi-sensory material in k-3. It was found that 88% of the teacher's surveyed used some sort of supplemental material in their classrooms. Furthermore, 86% of the teachers surveyed had used Touch Math and would use it again. This study shows that there is a professional consensus that Touch Math is an effective tool in helping struggling students achieve their math goals. Rains, Durham, and Kelly (n.d.) also found that as the students' grade increased, teacher familiarity with multi-sensory math

instruction decreases, thus determining that there is a need for multi-sensory instruction in our upper elementary classrooms.

"Decades of research indicate that students can and should solve problems before they have mastered procedures or algorithms traditionally used to solve these problems" (Clements, p. 1). Clements (n.d.) discusses the strategies that can be helpful for special needs students in their math classrooms. He contends that many teachers believe that memory deficits require them to use repetition and drill to teach math. Clements (n.d.) goes on to examine the importance of mastering key ideas which are not arithmetic algorithms. "Even proficient adults use relationships to produce basic facts and tend not to use traditional paper and pencil algorithms when computing" (Clements, p. 1). Clements (n.d.) also discussed the importance of manipulative instruction to help learning disable students learn both concepts and skills. The article focuses on alternative ways to teach math to struggling students.

The Touch Math program supports Clements (n.d.) discussion in many ways. First, the program provides a relationship between the number and the touch points; the point represents the values of each number. Second, repetition is not required utilizing the program, students are employed with a strategy that can help them solve problems without the need to memorize facts. Most importantly, the Touch Math program provides students with an opportunity to learn a strategy that can be used well into adult hood. The touch points become engrained in the student's memory and can be visualized to help them as adults. Largely, Clements (n.d.) article outlines the need to evaluate the Touch Math program in respect to special needs populations.

Through the use of best practices the Touch Math program will improve the math achievement of academically at-risk students, more specifically, special education students. The future research should focus on the benefits Touch Math can provide to academically at-risk special education students in the upper elementary grades. The major limitation of the future research is the bias the researcher has towards the Touch Math program; who they feel is the most appropriate supplemental math instruction for struggling special education math students. This bias may influence the future data findings.

Goal Statement

Given computation problems involving addition, subtraction, multiplication, and division, 12 fourth through fifth grade Special Education students will utilize the Touch Math strategy to demonstrate their knowledge of basic math skills. The identified problem is the lack of a supplemental math program that will increase the basic math skills of Special Education students, therefore increasing student's ability to solve addition, subtraction, multiplication, and division computation problems through using the Touch Math program will offer a remedy to the identified problem. Furthermore, fourth and fifth grade Special Education students who receive supplemental instruction utilizing the Touch Math strategy in addition to instruction using the Every Day Math series will show an increased score on the Test of Mathematical Ability (2^{nd} edition) and a teacher made post test as well as exhibit less frustration when solving math computation problems.

Participants

Participants in this study were in grades four and five in an east coast elementary school which consists of forty-six percent female and fifty-three percent male. Caucasian students make up eighty percent of the 4th-5th graders while one percent are Hispanic and African American. Of the three hundred and five students enrolled in the school twenty-one percent receive free and reduced lunch; fifty-nine percent white, fourteen percent African American, and twenty-three percent Hispanic.

Each learner participating in this study was a Special Education student who enjoyed receiving positive feedback for excellent performance; they were highly motivated to do well. The learners encompassed a wide range of learner styles and abilities, although the help the students receive at home ranged from none to extensive.

Prior Knowledge and Skills

All students had the required understanding of math concepts: recognizing numbers, counting, and meaning of number representations. Some students employed math strategies that included manipulative use, finger counting, and well as graphic representations to help in computation problems. All learners were in the first semester of the school year and were placed in general education classrooms for most of the school day, with pullout services provided for Integrated Language Arts and Math.

Entry Level Knowledge and Skills

All learners were receiving Special Education pullout services in math. Students receiving Special Education services were referred previously to the Child Study Team for academic difficulties and through a series of tests conducted by the school psychologist and Learning Disabilities Teacher Consultant eligibility was determined. In

order for students to be considered eligible for Special Education Services in this particular state for Specific Learning Disability the student needed to show a discrepancy of at least eight points between IQ and academic achievement. For those students qualified for Special Education services under Other Health Impaired a neurologist was consulted after testing was completed to determine if there were neurological issues: attention or hyperactivity that may be having an impact on learning. If the neurologist determined that this issue did have an impact on learning the child was qualified for Special Education services under the classification Other Health Impaired. The Individualized Education Planning Team then met to discuss placement. Students were eligible for pullout services for math after it was determined by the IEP team that there was a need due to performance in the regular math class, such as failing grades and lacking of basic skills as determined by the general education teacher though observation and work samples. All students enrolled in the Special Education math class were at least one grade level below in math.

The State Assessment of Skills and Knowledge revealed that many students were scoring below the proficient level in math. Learners could count from rote, identify a set amount of objects, and understand that each number is a representation of a certain amount (4 = ////). Learners lacked the strategies needed to solve computation problems. They were unable to skip count numbers that were higher than two and in some instances had trouble counting up or back when starting in the middle of a set. For example, asking the learner to start at seven and count to sixteen or start at twenty-three and count back to ten. The learners were also lacking an understanding of the relationship between sets of numbers (fact families) involving addition, subtraction, multiplication, and division.

Attitudes and Motivation

Learners in grades 4-5 enjoyed math class although many did think it could be hard. At times, students did exhibit avoidance behavior such as leaving to use the bathroom, inappropriate behavior, or exhibiting a frustration level that inhibits them from continuing with instruction. When students were given work that they felt success with many of the avoidance behaviors ceased. Fourth through fifth grade students were given a survey (appendix A) to elicit how they felt about math. Sixty-six percent answered that they liked math while forty-two percent felt that math was hard. These answers indicate that there is a motivation to do well in math. An overwhelming amount of students, seventy-seven percent, wanted to get good math grades. These results indicate that the students are highly motivated to do well in math; therefore extra instruction would be an effective technique to increase math achievement.

Methodology

Introduction

This methodology was developed to be utilized within a small suburban elementary school located in an east coast state. The researcher is also the teacher utilizing classrooms within the school.

Participants

Pre-formed groups within an elementary school were used in this research; a fourth grade Special Education math class as well as a fifth grade Special Education math class. This convenience sampling technique is appropriate for an action research method because a teacher cannot randomly assign students to groups; it is illegal to discriminate against a group of students. Also, it provides an opportunity for the teacher to find

solutions to the educational problem being studied, math achievement, because the pre-formed groups are those students that are in need of an intervention. A convenience sample provides the researcher with an opportunity to sample the population of interest, Special Education students, within their own instructional setting while at the same time finding a solution to the identified educational problem, low math achievement.

The participants in this study consisted of four fourth graders; two boys and two girls and eight fifth graders; two girls and six boys. Of the four girls, two are African American, one is Hispanic and one is Caucasian. All four girls come from homes considered to be within the low socio-economic range; receiving free/reduced lunch. Of the eight males represented, two are African American, one is Hispanic, and five are Caucasian. Three of the males come from low socio-economic homes. All students are receiving Special Education services for math and are classified under the Specific Learning Disability or Other Health Impaired category.

Role and bias of researcher

The role of the researcher is that of actual researcher and teacher; providing the intended instruction utilizing the Touch Math approach as well as collecting the needed data. There is bias to this design however, being that the educator has pre-formed relationships with the participants in this study and will have to take that in to account when conducting assessments. For example, the researcher had to be sure the participants are accurately assessed with out any unintentional coaching from the teacher. One way that this bias was mitigated was by having a colleague from the same grade level without ties to the research assess the student's pre and post instruction. These assessments

followed strict guidelines that were provided to the assessor previous to the actual assessment time.

Research Design

This research proposal was prepared so that research could be conducted to establish whether or not the Touch Math program will be an appropriate supplement to the current Everyday Math program. Special Education students were in need of a program that would increase their math skills as measured by pre and post assessments. For this study an action research design was implemented. This design was chosen because it is the best choice for exploring a classroom problem, in this case, is Touch Math an appropriate intervention for Special Education students. A true experimental design requires that one group of students be a control group while the other group is the experimental group. Students who receive Special Education services cannot be denied instruction that is tied to their IEP or free and appropriate public education, which would compromise their civil rights; therefore a true experimental design is not feasible. Action research provided an opportunity for the researcher to evaluate the effectiveness of the Touch Math program without the constraints of a true experimental design. A classroom is a very complex place made up of many different behaviors, isolating all those variables is not the intent of this research study.

Data Collection Instruments

Three instruments were used to collect data related to student's math ability: teacher made pre and post tests, the Test of Mathematical Ability 2nd edition (Brown, Cronin, and McEntire, 1994), and teacher observation. All data was collected through-out the regular class day by the teacher researcher.

Pre and Post Test. A teacher made pre and post test (see appendix A) was used to gather information on how well students can solve basic math problems; addition, subtraction, multiplication, and division. This data served as a baseline of the student's ability before being introduced to the Touch Math strategy. The data was in the form of a raw score, number of questions correct. The test was then given again after instruction to determine if the Touch Math strategy was an effective approach for increasing math ability. These pre and post tests were given in a classroom setting as part of the regular classroom day. This testing was within the realm of a standard classroom day.

Test of Mathematical Ability 2nd Edition. The Test of Mathematical Ability, 2nd ed, (TOMA-2) published by Pro Ed, was given to assess the overall math ability of the students. This test was used to measure the computation ability of the students by obtaining a raw score. This standardized information was used to determine student's ability before instruction utilizing the Touch Math strategy. The test was then given after instruction so that scores could be compared to see if the Touch Math strategy made a difference in mathematical ability. This test was given one on one in a classroom environment to ensure that the results will be valid. The testing instructions were followed exactly as was described in the examiner's manual.

Observation. Teacher observation was used to collect data about student's behavior and frustration level during math class. For example, are they paying attention in class, exhibiting avoidance behavior such as asking to go to the bathroom during math class or fooling around to avoid their math work; also do they seem frustrated with the work they are completing. An individual student anecdotal form was used to collect the needed data (Appendix B). These observations were conducted during the math class by

the teacher researcher before instruction, during instruction, and after instruction. These observations were then compared to determine if there was a difference pre and post instruction. Each observation was conducted during the regular math class for approximately 20 minutes. These observations were conducted on three separate occasions: before, during, and after instruction.

Research Procedure

Students were given a Teacher made pre test as well as the Test of Mathematical Ability before and after instruction. Student observation was conducted before, during, and after instruction as well. Students in 5th and 4th grade Special Education math classes were given instruction utilizing the Touch Math strategy as a supplement to the Every Day Math series over a six week period. Pre and post test scores as well as observations were compared to determine if the Touch Math program is an effective supplement to the Every Day Math series.

Data Analysis

The qualitative data collected through observation was first coded to determine if there were patterns present among the various observations. The information was then sorted utilizing colored index cards according to relevant themes that were prevalent. After the information was coded and themes were determined the information was used to develop a concept map where connections could be determined. This analysis technique was chosen because it was the most appropriate for qualitative data. The intent of this study was to examine whether or not the level of student frustration decreased after instruction was implemented.

The quantitative pre and post test scores were analyzed using a t-test for non-independent samples to determine if there was a significant difference in means. The level at which significance was determined was as follows: with a probability level of .05 the expected score for the t-test would be $t \geq 2.201$ so the null hypothesis would be rejected. First, the scores from the pre test were listed and a mean was calculated. The same procedure was done for the post-test. The following formula was then used to determine if there was a significant difference: $t = \frac{\overline{D}}{\sqrt{\frac{\sum D^2 - \left(\sum D\right)^2}{N(N-1)}}}$, where D stands for the difference and N stands for the number of participants in the group. From this analysis findings were examined to determine whether there was a significant difference from the pre test score to the post test score. The t-test for non-independent samples analysis method was chosen because this test is used to compare a single group's performance on a pre and post test. Furthermore, a t-test was used to determine whether two means are significantly different and since the crux of this research is whether or not the Touch Math strategy is effective at increasing math achievement, post test scores, the t-test was most appropriate for the confines of this proposal.

After the T-test is conducted to reject the null hypothesis, Touch Math does not increase math achievement, the scores from the pre test of both 4th and 5th grade students were listed randomly with students being assigned numbers. These scores were then graphed utilizing a line graph: vertical axis was the test scores and horizontal axis was the students. The same procedure was completed for the post test as well. Both sets of scores were then graphed in a line plot with the pre test scores being blue and the post test scores being red so that any change can be noted. These graphs provided a visual format

where a change from the pre and post tests could be easily seen as well as providing a visual representation that can be used to share the data with colleagues and other professionals within the school community.

The quantitative data from the TOMA-2 was also be analyzed using a t-test as well. The same procedure aforementioned with the pre and post test was used utilizing the same formula: $t = \frac{\overline{D}}{\sqrt{\frac{\sum D^2 - \left(\sum D\right)^2}{N(N-1)}}}$. The raw scores pre and post testing were used for this t- test. The t-test for non-independent samples analysis method was chosen because, just like the pre and post test mentioned earlier, this test is used to compare a single group's performance on a pre and post test (TOMA-2 before and after instruction). Furthermore, a t-test is used to determine whether two means are significantly different and since the crux of this research is whether or not the Touch Math strategy is effective at increasing math achievement, post test TOMA-2 scores, the t-test was most appropriate for the analysis of this data.

To display this data, the pre and post test raw scores were randomly listed and then graphed with the raw score lying on the vertical axis and the student lying on the horizontal axis. To further compare the findings the pre and post test raw scores were then graphed on the same graph utilizing different colors to clarify the differences in scores. Much like the rationale behind utilizing a line graph for the pre and post test scores mentioned earlier, this method was chosen because it provides a visual format where a change from the pre and post tests can be easily seen as well as providing a visual representation that can be used to share the data with colleagues and other

professionals within the school community. The researcher examined the findings to determine whether the Touch Math strategy helped to increase the formal, standardized math scores of struggling students, more specifically, Special Education students.

Interpretation of Results

The qualitative data collected through observation was analyzed to answer the question: When implemented with Special Education elementary students who are struggling in math, does the Touch Math multi-sensory system used as a supplement to the current Everyday Math program increase students' self concept as a math student? The analysis of the post instruction observations explored whether or not students avoidance behavior had decreased and their completion rate increased as well as their overall negative behavior during math class answering the question, does student's self concept increase when the Touch Math strategy is implemented with Special Education students.

The TOMA-2 results were analyzed using t-test for non-independent samples to determine if there was a significant difference in pre and post test scores to answer the question: Does the Touch Math system increase the formal assessment math scores of Special Education elementary school students in the fourth and fifth grade? It was examined whether or not there was a difference that is significant enough to answer, yes, the Touch Math system does increase the formal assessment scores of Special Education fourth and fifth grade students.

The pre and post test scores were also analyzed using a t-test for non-independent samples to answer the question: Is the Touch Math system an appropriate supplemental math program for Special Education elementary school students? In order to determine

that there was a significant difference on the TOMA-2 and the pre and post test scores on the teacher made test the results of the t- test were compared to the values on the distribution of t chart displayed by Gay & Arasian (Fisher &Yates, 2000, as cited by Gay & Arasian, 2000, p. 615-619).

An action research design to examine the effectiveness of the Touch Math program through observation and pre and post test assessments was utilized to answer the following questions: Does the Touch Math system increase the formal assessment math scores of Special Education Elementary School students in the fourth and fifth grade? Is the Touch Math system an appropriate supplemental math program for struggling Elementary School students identified as needing Special Education services? When implemented with Elementary students who are at risk academically, does the Touch Math multi-sensory system used as a supplement to the current Everyday Math program increase students' self concept as a math student? Data was collected and analyzed that was used to determine whether or not the Touch Math program is an appropriate intervention to meet the needs of the Special Education population represented in this study.

Materials

The needed resources for this plan consisted of the Test of Mathematical Ability 2nd Edition as well as the Touch Math program materials. All the materials were available within the school community therefore financial resources were not required.

Project Time Line

The time line for this study was November 23, 2009 through December 22, 2009. Permission (appendix D) was obtained from parents of research participants at parent teacher conferences. All participants will remain anonymous; only first names will be used on all research material to ensure anonymity. Students were given a teacher made pre test as well as the Test of Mathematical Ability before and after instruction. Student observations were conducted before, during, and after instruction as well. Students in 5th and 4th grade Special Education math classes were given instruction utilizing the Touch Math strategy as a supplement to the Every Day Math series over a 4 week period. Pre and post test scores as well as observations were compared to determine if the Touch Math program is an effective supplement to the Every Day Math series.

November 2009

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	2	3	4	5	6	7
8	9	10	11	12	13	14
15	**16**	17	18	19	20	21
22	23 Class observation **Pretest Given TOMA-2 Given by colleague**	24 Instruction on Touch Points begins	25 Instruction on Touch Points	26	27	28
29	30 **Assessment on Touch Points**					

December 2009

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	30. Instruction Subtracting single digit Class observation	1 Instruction on adding single digit numbers Instruction on adding triple digit no regrouping Instruction on adding double digit No regrouping Class observation	2 Instruction Adding with regrouping	3 **Assessment on adding with regrouping**	4 Instruction Counting Back	5
6	7 Instruction Subtracting single digit	8 Instruction Subtracting double and triple digit no regrouping	9 Instruction subtracting double and triple digit with regrouping	10 **Subtraction Assessment**	11 Instruction Skip Counting 1-9	12
13	14 Instruction Skip Counting 1-9	15 Instruction Skip Counting 1-9	16 **Skip Counting Assessment**	17 Multiplying and dividing evenly instruction	18 Multiplying and dividing evenly instruction	19
20	21 Multiplying and dividing evenly instruction Class observation	22 **Post Test TOMA-2 Given by colleague** Class observation	23	24	25	26
27	28	29	30	31		

Results

Prior to the beginning of instruction students were given a teacher made pre test as well as the TOMA-2 computation test. Students were also observed during their regular math class. After instruction was completed the students were given the same teacher made test and TOMA-2 computation test as well as being observed. Observations also took place through out instruction. A t-test for non-independent samples was used to determine significance with the pre and post tests. The level at which significance was determined is as follows: with a probability level of .05 the score for the t-test would be $t \geq 2.201$. The t-test for non-independent samples found that yes, the difference between the pre and post tests was significant. Teacher made pre/post test

found that t = 8.61 and TOMA-2 pre/post test found that t = 3.63, therefore the null hypothesis, Touch Math does not increase math achievement, was rejected.

Table 1
Teacher Made Pre and Post Test Raw Scores

Student	Pre Test	Post Test	D	D^2
1	57	65	+8	64
2	36	62	+26	676
3	26	59	+33	1089
4	20	61	+41	1681
5	48	62	+14	196
6	34	54	+20	400
7	34	56	+22	484
8	36	67	+31	961
9	37	53	+16	256
10	40	59	+19	361
11	46	63	+17	289
12	33	59	+26	676
Total			273	7133

D = Difference

Table 2
TOMA 2 Computation Raw Scores

Student	Pre Test	Post Test	*D*	D^2
1	12	15	+3	9
2	13	14	+1	1
3	10	14	+4	16
4	9	12	+3	9
5	13	15	+2	4
6	0	13	+13	169
7	9	12	+3	9
8	8	15	+7	49
9	9	13	+4	16
10	12	12	+0	0
11	13	14	1+	1
12	9	12	+3	9
Total			44	292

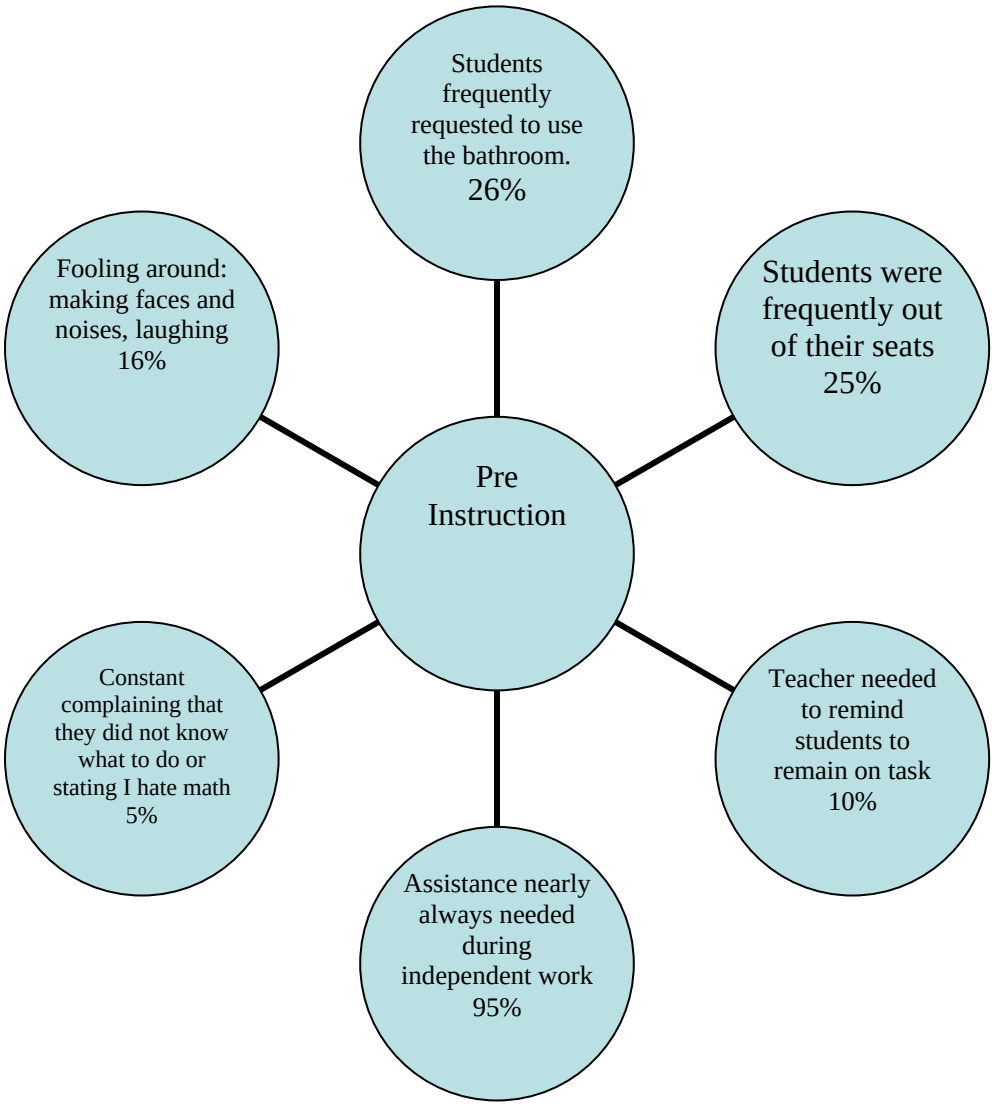
D = Difference

Observations were studied, coded, and themes were determined. Observation data was broken down into different behavior types and written on different colored note cards so that the data could be more easily evaluated. It was found that prior to instruction students exhibited a variety of behaviors that helped them to avoid work. It was observed that many students did not like math and would avoid it in what ever way

they could. Percentages were determined based on the minutes spent on each behavior out of a 60 minute math block.

Table 3

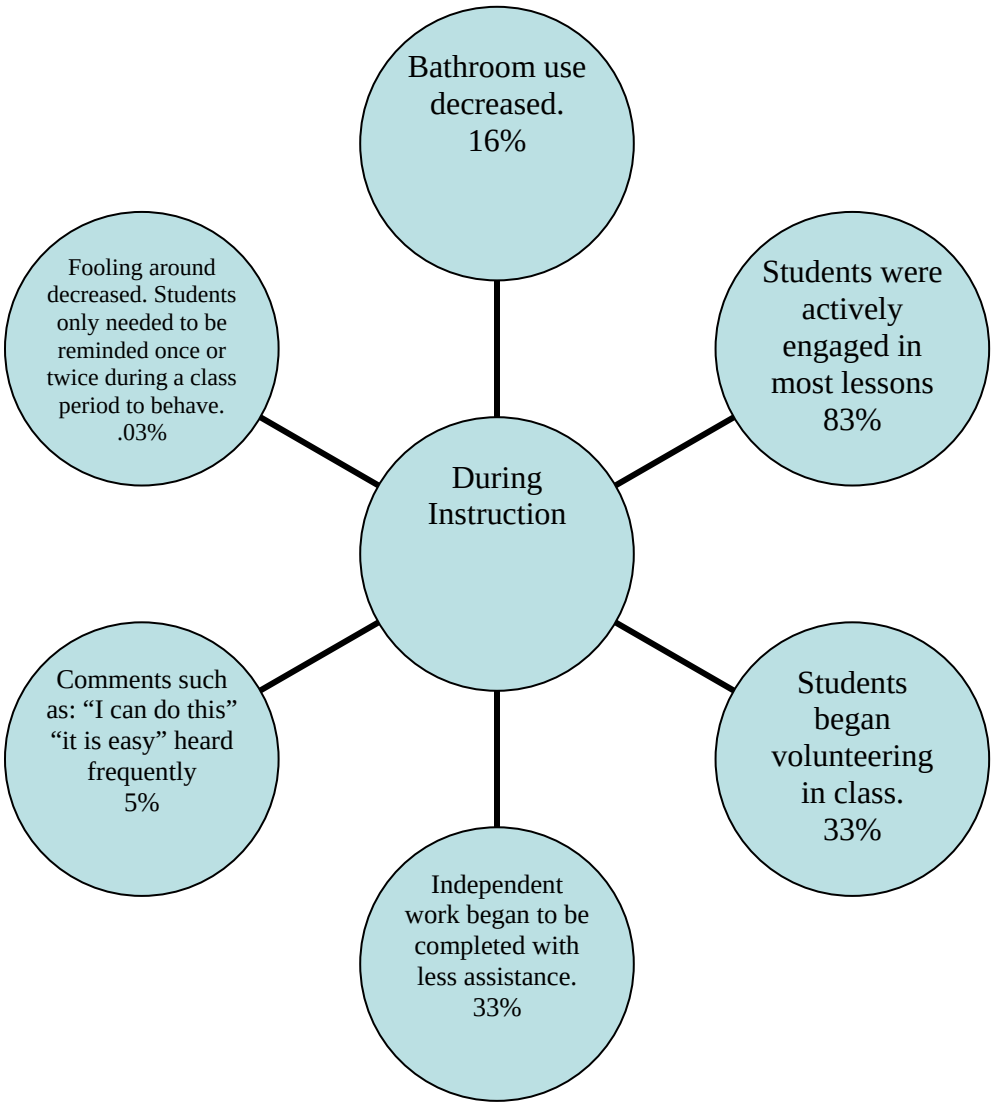
Pre-instruction observation



As instruction began, observations found that students began to enjoy learning the new concepts. At first students were hesitant to partake in the activities but as instruction went on they began to enjoy it. Students began to ask to use the bathroom less frequently. On several occasions students were observed stating, “This is easy” or “I can do this”. These comments were not observed pre instruction.

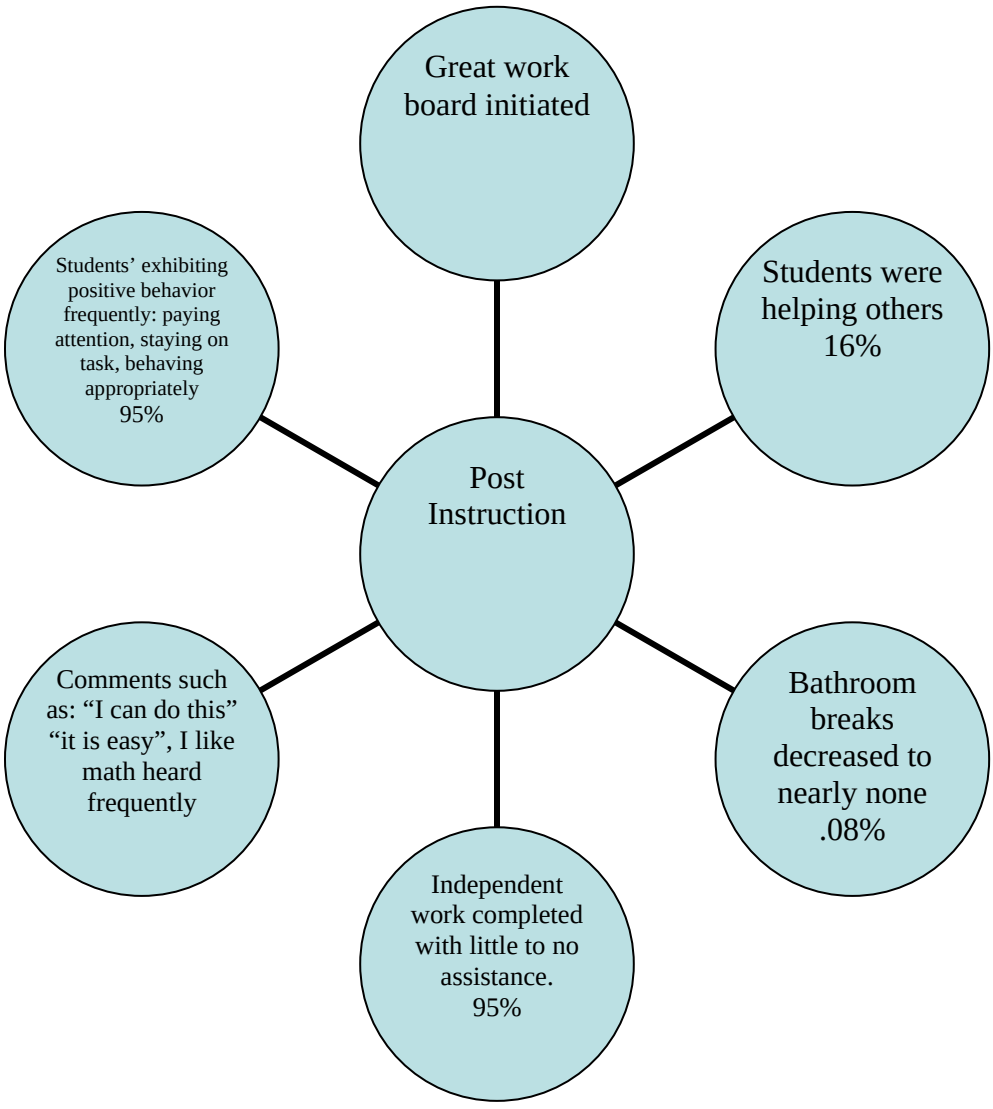
Table 4

During instruction observation



As instruction commenced observations were completed. It was observed that students were beginning to help each other when one was having trouble. Students also initiated a "Great Work" board outside the classroom in the hallway. On this board they wanted to place all the great work they completed: tests, homework, and class work all with exceptional grades. Students' use of the bathroom decreased to almost none. Negative behavior was limited to every once in a while, and students were never observed saying they hated math or could not do it.

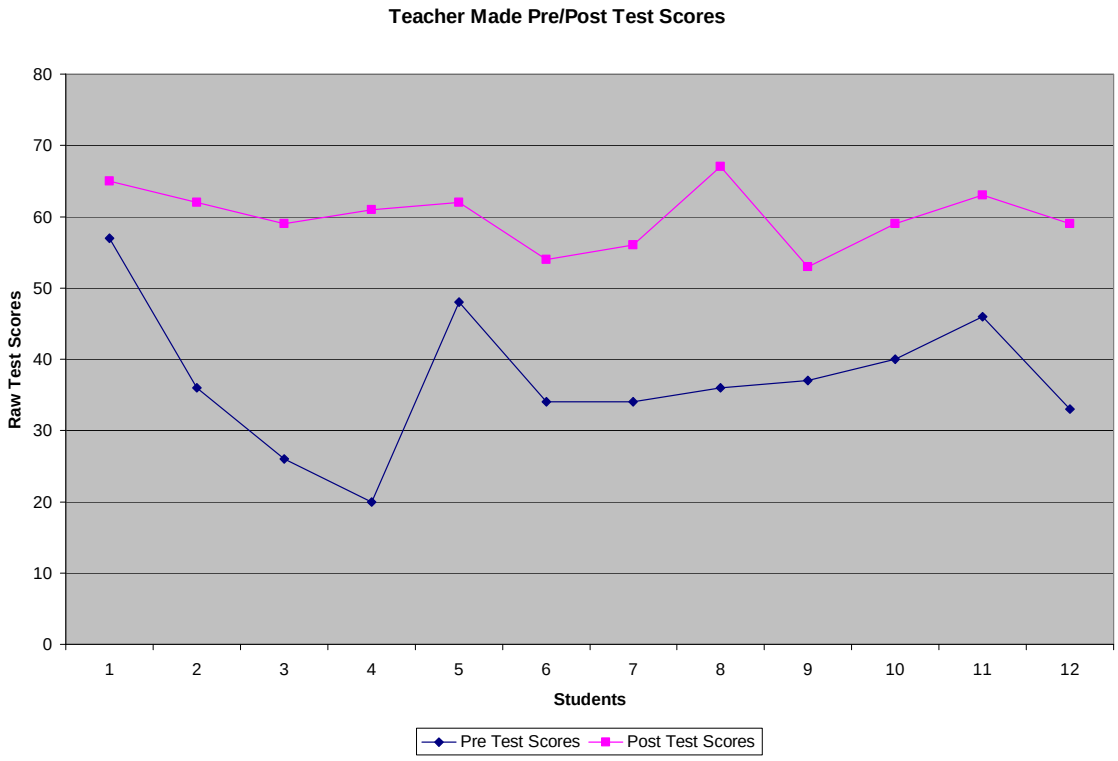
Table 5 Post instruction observation

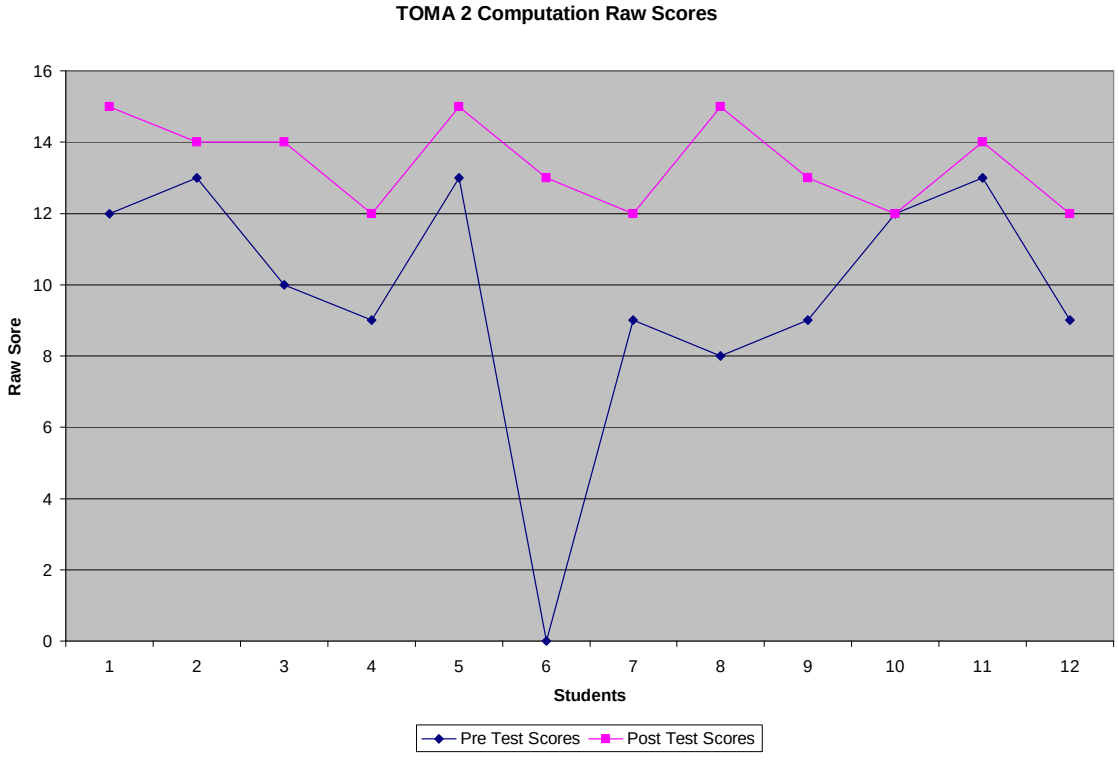


As each set of observations were compared a common theme was found: As the Touch Math strategy was introduced students' behavior and work completion, as well as self concept increased. Therefore the question, when implemented with Special Education Elementary students who are struggling in math, does the Touch Math multi-sensory system used as a supplement to the current Everyday Math program increase students' self concept as a math student?, can be answered yes, it does increase their self concept as a math student.

Discussion

The purpose of this study was to investigate whether or not the Touch Math program used as a supplement to the current Everyday Math program is an effective tool in increasing Special Education students' math achievement. The research conducted found that the Touch Math program did significantly increase students' achievement on both a teacher made test as well as the TOMA-2 computation test. The following line graphs visually represent the collected data:


Teacher Made Pre/Post Test Scores
Raw Test Scores
80
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
8
9
10
11
12
Students
Pre Test Scores
Post Test Scores


TOMA 2 Computation Raw Scores
Raw Sore
16
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
8
9
10
11
12
Students
Pre Test Scores
Post Test Scores

The research also determined that as well as increasing test scores, the Touch Math program also increased students' self concept as a math student. Observations showed that pre instruction students exhibited avoidance behavior when it came to math class but as instruction continued this behavior decreased. Students also began to feel better about them selves as the Touch Math strategy was taught. They went from needing frequent help in completing assignments to being able to complete class work independently. They also began to feel more confident in themselves, as the observation of the "Great Work" board showed. Students were also more willing to help others who needed help, which shows an increase in self concept.

Through the triangulation of data, pre/post test, TOMA-2, and observation, the results of this study show that the Touch Math program is an effective supplement for Special Education Elementary Students. It also shows that using the Touch Math multi-sensory math program can increase students' math achievement.

The Touch Math program is a valuable tool to be used within our Special Education classrooms. This use can be extended beyond that of just Special Education and into our general education classes to increase the math achievement of all students. If the Touch Math program increases the skills of Special Education students the same will be true for our struggling general education students. The Touch Math program can be an effective intervention strategy for all students, not just Special Education students.

Implications

The identified problem within the education setting was the lack of supplemental instruction within the math classrooms and the subsequent low math achievement among

fourth and fifth grade Special Education students. The Touch Math program is an appropriate supplement to the current math series to help students increase their math achievement. The finding from the data showed that the Touch Math program increases students' math achievement on both teacher made tests as well as standardized tests. Therefore, the Touch Math program should be implemented into our classrooms to rectify the aforementioned educational problem.

Although action research occurs in a single setting and the outcome is not usually generalizable this research will be used as a stepping stone to future training within this school community and presented as evidence of the effectiveness of the Touch Math program. Results will be presented to the stakeholders of the school as well as those parties that may be interested: parents, student teachers, ECT. In service learning communities will be developed so that other educators may benefit from the Touch Math program and learn the basic of implementing it in their own classrooms.

Teachers within this school community will be able to use this research to develop their own ways to implement the Touch Math program within their classrooms. The use of the program within centers, as small group lessons or as an intervention for those students who are struggling, are all ways that can incorporate the Touch Math program.

Limitations

The major hindrance of the research findings and to the entire research is the researcher's own bias towards the Touch Math program. The researcher began the research with preconceived notions about how effective the Touch Math program would be. These biases were identified early on and there were attempts to mitigate them.

Although these attempts were made, it needs to be noted that they may have affected the research outcomes unintentionally.

This study looked at the effects the Touch Math program had on a teacher made test and a standardized TOMA-2 test over a short period of time. One of the changes for future research would be to look at the long term effects of the program. Is there an increase in state assessment scores from one year to the next when the Touch Math program is used as a supplement to the current math program?

One of the major limitations of the research is the ability to generalize the findings to all fourth and fifth grade Special Education students. Although the results showed that the Touch Math program was an effective program for this particular school, it can not be generalized that it would be effective in all schools. For example, there are no English as a second language learners in this school. Would the results be the same for Special Education students who fall into this category? The future research should focus on a larger research group across different schools and backgrounds.

Self Critique

I found my path to attaining my Masters Degree a very rewarding and enlightening experience. The skills I have attained will help me in the future in many ways. As a current Special Education teacher and member of the intervention committee I am able to provide research backed supports to fellow colleagues in need of specialized intervention for students within their classroom. When I am unable to develop an intervention myself I now have the skills to complete the necessary review of the

literature to help me learn the work of others in the field to come up with new strategies to help the students in my school.

My skills at creating rewarding and challenging curriculum for my students have increased greatly as a result of my work with in the instructional design domain. I now hold the necessary skills to create lessons that incorporate a variety of strategies utilizing Bloom's taxonomy and Gardner's multiple intelligences. I have also developed the confidence to look outside the box and develop lessons that are more creative and rewarding.

Overall, this experience to gain my Masters Degree has been one that will stay with me throughout my teaching career. I now hold the knowledge to thoughtfully reflect on lessons and research based strategies that will enhance my teaching ability for years to come.

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Appendix A

Do you like Math?

Yes No

Do you want to get good math grades?

Yes No

Do you think Math is hard?

Yes No

Place an X next to each math subject you think you need help in.

_____ Addition

_____ Subtraction

_____ Multiplication

_____Division

_____Counting

Who helps you with your math homework?

Mom & Dad	Mom	No one
Dad	Grandparent	Other

Appendix B

Pre/Post Test

Name:_____ Date_____

Circle the number that is in the ones place on each number

345 456 983 298 927

Circle the number that is in the tens place on each number

345 456 983 298 927

Circle the number that is in the hundreds place on each number

345 456 983 298 927

Solve each addition problem
Use scratch paper if needed

4 + 7 = 8 + 3 = 5 + 9 =

34 + 98 = 47 + 76 = 76 + 67 =

345 + 897 = 234 + 511 = 456 + 231 =

Solve each subtraction problem
Use scratch paper if needed

8 – 5 = 12 – 7 = 4 – 2 =

32 – 11 = 45 – 23 = 29 – 13 =

45 – 19 = 98 – 39 = 76 – 48 =

Solve each subtraction problem

Use scratch paper if needed

452 – 239 = **398 – 290 =** **121 – 111 =**

563 – 222 = **764- 456 =** **198 – 110 =**

Skip Count by each number

2 ___ ___ ___ ___ ___ ___ ___ ___

3 ___ ___ ___ ___ ___ ___ ___ ___

4 ___ ___ ___ ___ ___ ___ ___ ___

5 ___ ___ ___ ___ ___ ___ ___ ___

6 ___ ___ ___ ___ ___ ___ ___ ___

7 ___ ___ ___ ___ ___ ___ ___ ___

8 ___ ___ ___ ___ ___ ___ ___ ___

9 ___ ___ ___ ___ ___ ___ ___ ___

Solve each multiplication problem
Use scratch paper if needed

4 x 6 = **8 x 3 =** **2 x 9 =** **5 x 7 =**

6 x 3 = **34 x 3 =** **96 x 5 =** **12 x 3 =**

56 x 3 = **84 x 9 =** **26 x 5 =** **11 x 9 =**

Divide each problem
Use scratch paper if needed

56 ÷ 8 = **45 ÷ 5 =** **24 ÷ 4 =** **12 ÷ 3 =**

16 ÷ 2 = **18 ÷ 6 =** **81 ÷ 9 =** **49 ÷ 7 =**

Appendix C

Student Anecdotal Record Form

Name:_____ Date:_____

Grade:_____

Behavior Observations	Frustration Level Observations

Appendix D
Western Governors University

Master of Science in Special Education
Effectiveness of Touch Math
Nora Green

Introduction This year I will be conducting a research study measuring how effective the Touch Math program is as a supplement to the current Every Day math program. All students will be instructed using the Touch Math program daily as part of the regular school day.

Description of the project:

- The purpose of this study is to see if the Touch Math program is an effective supplement to the current Everyday Math program.
- Students will be instructed using the Touch Math program as well as the Every Day math program
- The research will be conducted during the regular class time with no disruption to the school day
- Participants will be expected to attend class as usual with no significant changes.

Benefits and Risks of this study: The benefits to the participants are a new and effective way to solve math computation problems. There are no risks to this study.

Confidentiality: All participant's identities will remain anonymous.

Voluntary participation and withdrawal: All activities are part of the normal class day, therefore participation is expected.

Questions, Rights and Complaints: Any questions please fell free to contact Mrs. Nora Green at the Joseph T Donahue School
609-698-2462
ngreen@mail.bts.k12.nj.us

Please contact Nora Green at the Donahue School if you are interested in the results of this study.

Consent statement: I agree to let my child participate in the research study, The Effectiveness of Touch Math, conducted by Mrs. Nora Green.

_____	_____
Signature of Participant	Signature of Legal Guardian
_____	_____
Typed/printed Name	Typed/printed Name
_____	_____

Date Date

Appendix E

Western Governors University
Institutional Review Board
Application for Approval of Research Project

Directions to the candidate: Please complete each portion of this application, attach necessary documentation, and click submit.

Name: Nora Green **Student ID Number:** 000171092

Title of prospectus: How Effective is Touch Math as a Supplemental Math Program for Special Education students?

Capstone committee chairperson: Melanie Shafaat **Degree/Discipline** M.S.Sp. ED.

WGU E-mail address: ndgreen@my.wgu.edu

1. Describe the research method(s) to be utilized in this study. Include research question(s) as well as an explanation of the need for human subject participants.

Does the Touch Math system increase the formal assessment math scores of Special Education Elementary School students in the fourth and fifth grade?

Is the Touch Math system an appropriate supplemental math program for special education Elementary School students?

When implemented with special education Elementary students who are struggling in math, does the Touch Math multi-sensory system used as a supplement to the current Everyday Math program increase students' self concept as a math student?

Human subjects, more specifically special education students, are needed so that the effectiveness of the program can be measured and the program can be taught.

2. Describe the research procedure(s) to be employed in this study. Research procedures must include methods used to collect and analyze data.

*** Instruction using the Touch Math program.**
*** Pre/Post teacher made test, Pre/Post Test of Mathematical Ability, Teacher observation**
*** Analysis. Using t-test for non independent samples.**

3. Describe the use of any data collection tool(s) your study will employ. Attach any applicable documents to this application.

Observation (see attached)

Pre/post test (see attached)

Test of Mathematical Ability 2nd edition

4. Describe the human subject participant population. Include the following demographic information: age, gender, physical or developmental disabilities, and any relationship to the researcher.

The participants in this study consist of four fourth graders; two boys and two girls and seven fifth graders; two girls and five boys. Of the four girls, two are African American, one is Hispanic and one is Caucasian. All four girls come from homes considered to be within the low socio-economic economic range; receiving free/reduced lunch. Of the seven males represented, two are African American, one is Hispanic, and four are Caucasian. Three of the males come from low socio-economic homes. All students are receiving Special Education services and are classified under the Specific Learning Disability or Other Health Impaired category.

Pre-formed groups with in the Joseph T. Donahue Elementary School in Barnegat Township, NJ will be used in this research; a fourth grade Special Education math class as well as a fifth grade Special Education math class. The researcher is the current special education provider for these students.

5. Will your population include any members of vulnerable or protected populations such as: pregnant women, children, prisoners, residents of a facility such as a nursing home or group home, individuals with mental or emotional disabilities, non-English speakers, individuals at or above the age of 65, traumatized individuals, economically disadvantaged individuals, employees of the researcher, or students of the researcher? If so, provide justification for the inclusion of this population in this study and describe how you will mitigate any potential conflicts of interest as well as provide for full informed consent of such participants.

The study focuses on how effective the Touch Math program is for increasing math achievement of special education students, therefore students must be included in the research.

Consent will be obtained from parents at conference night.

6. If your population includes children under the age of 18, identify whether your study poses only minimal risk, greater than minimal risk but with a benefit to participants, or greater than minimal risk but with no benefit to participants.

This study poses no risk. The instruction is a benefit to all involved.

7. Describe the steps you will take to minimize any risk to participants in your study.

There is no risk.

8. Describe the steps you will take to ensure anonymity and/or confidentiality of research participants and collected data. If participants will not partake in the study in an anonymous and/or confidential manner, discuss why this type research design is necessary.

Only first names will be used on all documentation forms.

9. Discuss the procedures you will employ to gain informed consent of participants in your study. Informed consent typically consists of a form signed by participants. Such documentation informs potential participants of the following:

- Description of the nature of the research study in lay terms;
- The identity of the researcher;
- Expected nature and duration of the participant's involvement in the study;
- Statement that participation is voluntary and can be terminated by the participant at any time without penalty;
- Description of reasonably foreseeable risks and benefits;
- Description of confidentiality procedures;
- Disclosure of potential conflicts of interest; and
- Parental consent (i.e. informed assent) for participants who are under 18 years of age.

Attach a copy of informed consent documentation you will utilize. You may submit the same document you utilized in your capstone prospectus.

Consent will be obtained at parent teacher conferences.

10. If your research study requires access to members of organizations, agencies, school districts, etc., please attach an official letter of permission from the institution(s) where you will be conducting your research.

I am already employed in the school district as a special education teacher, therefore I already have permitted access to the students. Permission to conduct the research has also been obtained from the school principal, Mr. George Chidiac.