Touchmath:

An Intervention that Works

Submitted in Fulfillment for Master's Degree in Education

From Asbury College

Debbie Mays

April 17, 2008

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Introduction

The National Research Council reports that the math skill of students falls short of necessary levels for work performance (Bottge, 2001). According to The Nation's Report Card (2005), about 30% of students perform at or above proficient levels and about 72% perform at or above basic level. Research reports 10% to 13% of students possess a math disability.

Students with significant math deficits comprise approximately 6% of students with learning disabilities. Math deficits are as widely reported as reading deficits independent of and coexisting with each other. Research, though not conclusive, reports the possibility of different types of math difficulties. A solution for math disabilities requires different methods, emphasis, and variation of teaching presentation (Garnett, 1998).

Math skills in our country fall below the levels deemed necessary for successful living. In addition, a significant number of students struggle with disabilities that affect performance in mathematical competency tasks. The students that struggle in these areas suffer from low self-esteem and the end result impacts jobs and everyday lives.

Purpose

The purpose of this study determines if the use of Touchmath improves math computation skills using single digit addition with second grade students.

Justification

In the vast area of math skills, most students find strategies that work for them and utilize these strategies to solve mathematical problems. Students with learning disabilities, whether the disability occurs in math or in another area that affects math performance, need explicit instruction in strategies that work. Researchers suggest that students with learning disability, particularly in math, require engagement in learning with application, plenty of feedback, and teaching that correlates with personal learning style (Bedard, 2002). Touchmath provides these strategies to these students with engagement, feedback, and multi sensory methods (Scott, 1993). Touchmath modifies for individuals or for large groups.

Research Questions

This project addresses the use of Touchmath as a computation strategy and the project investigation addresses these questions.

1. Will the use of Touchmath improve math computation skills with single digit addition in second grade students?
2. Do students continue to use Touchmath for math calculation during removal of auditory prompts?

Definitions of Terms

In this study, particular terms describe certain components. Following are definitions used in this study.

1. Touchmath- "Touchmath is a multi-sensory, paper-and-pencil approach to basic computation. It emphasizes the sense of touch to clarify and simplify the four basic computation processes. Students touch numbers in the consistent Touchmath Touchpoint pattern. The visual prompts of Touchmath consist of posters and desk strips that display the touchpoints

on the numbers. Simultaneously, they count aloud to accelerate learning by involving sound. They decipher math problems quicker because Touchmath is truly multi-sensory -- it provides success through seeing, saying, hearing and touching (Touchmath.com, 2007).

Figure 1- Touchmath Number Touchpoints

2. Collaborative class- A regular education teacher and a special education teacher work together in a classroom environment to meet the needs of the students.
3. Single digit addition- Addition of a pair of numbers chosen from the digits of zero through nine, and having a sum of no more than 18.

Literature Review

Population

This research occurs at Hattie C. Warner Elementary School in two collaborative second grade classrooms. The students in these classrooms range in age from seven through nine. These two classrooms contain the students with identified special needs in the 2nd grade, to allow one special education teacher to float between both classes as needed. The students with special needs are low functioning students, but the classes also contain students scoring average and gifted on achievement tests. One classroom teacher teaches math to both groups and the other teaches science and social studies.

Disability

The American Heritage Stedman Medical Dictionary gives the definition of a disability as "a disadvantage or deficiency, especially a physical or mental impairment that interferes with or prevents normal achievement in a particular area" (2004).

Learning Disability. This study focused on certain types of learning disabilities. The broad term of learning disability includes disabilities that evidence themselves in the areas of reading, math, and writing. Discrepancies of performance and achievement in specific assessments support identification of learning disabilities. For school purposes, the Individuals with Disabilities Education Act (IDEA) defines learning disability in these ways:

"The term means a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, that may manifest itself in an imperfect ability to listen, think, speak, read,

write, spell, or to do mathematical calculations, including conditions such as perceptual disabilities, brain injury, minimal brain dysfunction, dyslexia, and developmental aphasia." (Federal Register, 1977, p.65083)

Math Disabilities. At this time, research presents two main conditions that contribute to underachievement in math among those with learning disabilities. The first condition of math learning disabilities identified as dyscalculia consists of difficulties in understanding, remembering, and manipulating numbers or number facts. According to The American Heritage Stedman Medical Dictionary, the definition of dyscalculia appears as "Impairment of the ability to solve mathematical problems, usually resulting from brain dysfunction" (2004). This disability occurs with school age children, and in all other age groups.

Three methods for diagnosis of dyscalculia exist. The first includes administration of standardized assessment. Through testing, the student demonstrates inconsistencies between intellectual ability and performance or a discrepancy of two years between the grade level and performance. The second includes observation of inclinations that indicate the possibility of dyscalculia. These inclinations include emergent problem solving strategies, poor working memory, long term recall deficiencies, slow processing rates of math skills, lack of recognition of the commutative property in computation, high rates of hasty errors, or visual and spatial functioning difficulties. The last method entails the use of the Dyscalculia Screener measuring a level of numeracy through a computer based assessment (Michaelson, 2007).

The second disability, under the broad title of learning disability, occurs in an area such as reading, but the effects appear in math as well. The National Institute of

Health and the Education Department currently funds an initiative to research and validate theory in math, learning, and math learning disability. One component of this research identifies core deficits of math learning disability (MLD) or finds subtypes that exist so that efficient implementation of interventions occurs (Augustyniak, Murphy, & Phillips, 2005).

Math learning disabilities result in students withdrawing, having low self esteem, and avoiding difficult tasks (Garnett, 1998). These struggles cause difficulty in everyday life, including jobs and careers. The area of math learning difficulties lacks an abundance of math instruction research. This research addresses that lack. Our instruction provides learners strategies to perform challenging tasks. This enables perseverance and strategy utilization toward goals (Vinson, 2004).

Mathematics

According to Mastropieri & Scruggs (2007), "Mathematics is the academic discipline concerned with the solution of problems that involve quantity or number. Mathematics includes such branches as arithmetic, algebra, geometry, trigonometry, and calculus." These ideas connect with each other within facts, procedures, and concepts.

Math Achievement. In the past, math education emphasized memorization of facts or procedures. Recently, The NCTM laid out ten principles that are to help improve math curricula called the *Principles and Standards for School Mathematics.* These principles provide the groundwork for school mathematics programs considering "equity, curriculum, teaching, learning, assessment, and technology" *(NCTM, 2000)*. "The NCTM standards identify five goals for students. Students need to (1) learn to value mathematics, (2) become confident in personal mathematical

abilities, (3) become problem solvers, (4) learn to reason mathematically, and (5) learn to communicate mathematically." (Fleishner & Manheimer, 1997). Students knowing how numbers work and applying that knowledge in a variety of ways achieves these goals. This contrasts with the old school emphasis on rote memorization and rote application.

The specific areas of math skills include skills counting all the way to reasoning. This complex set of skills, more complex that reading skills, predicts math performance. Skills such as counting knowledge, one to one correspondence, number comprehension, fact ability, procedural knowledge, and problem solving ability are required at a very early level of math ability. Children utilize strategies in math problem solving before beginning school and these strategies become more symbolic and abstract as children develop (Augustyniak, Murphy, & Phillips, 2005). The uses of these strategies are beneficial and well developed for some children, while others tend to overuse or use these strategies inconsistently.

Math Understanding. According to research, several factors affect math understanding of all populations. First, the knowledge of the teacher affects math learning. A teacher needs full understanding of the content, and, in addition, ability to explain, prompt, and assess student mistakes. Second, the effective teacher provides a variety of instructional formats, quick instructional pace, and varied grouping arrangements. Third, the effective teacher adequately provides motivational statements that communicate high expectations (Fuchs & Fuchs, 2001). Teacher expectations affect the performance of students, across all diversities (Bottge, 2001). A case study by Phillips, Fuchs, Fuchs, and Hamlett (1996), an effective teacher, utilizing these strategies, led ALL students in the classroom to high achievement and

math understanding (Fuchs and Fuchs, 2001). Fuchs and Fuchs (2001) also suggest four principles for instructional methods: "(1) quick pace with varied instructional activities and high levels of engagement, (2) challenging standards for achievement, (3) self verbalization methods, and (4) physical and visual representations of number concepts or problem solving situations".

Math Learning. The conceptual math research advocates “authentic” math problems. Real world experiences are necessary. These types of experiences increase interest and motivation that, in turn, increases skills and test scores. The use of these experiences promotes transitions to more advanced skills and adult mathematical situations. These experiences, however, require adequate measurement and feedback. Students who receive feedback and track progress are more motivated to continue.

Research also indicates that learning requires a variety of ways to address the different learning styles of students (Scott, 1993). Children possess different learning styles, and sometimes the learning styles are a combination of modes. The most effective teaching strategies combine these styles so that each child utilizes personal approaches and benefits from the combination.

Low achieving students need specific instruction in situation and application. This instruction engages intentionally and aids in the process of transference and cultural awareness. Research shows that explicit instruction in math skills improves computation skills of low performing students. Mathematics education research finds the tools, methods and approaches that allow for effective teaching and study.

Math Fluency. According to NCTM requirements students "will develop fluency in adding, subtracting multiplying, and diving whole numbers" (2000). National policy documents support automaticity is a base requirement for success in

higher mathematics. It lightens the complex tasks and focuses the student on the necessary procedures that allow for accuracy of problem solving (Woodward, 2006).

Mathematical fluency requires not just rote memory, but understanding and manipulation of mathematical concepts. Rote memory lacks research support due to the time and effort required, and the lack of improvement in quantitative thinking or understanding of the workings of numbers. Most educators believe that drill and practice produces automatic recall, however, in the 1930's researchers disputed this belief and, instead, encouraged strategy instruction (Caron, 2007). Cumming and Elkins' research suggests that automaticity results from strategy integration with timed practice (Woodward, 2006). Results from Woodward's own study indicate that a combined approach of strategy instruction and time drills aids students in development of automaticity of basic facts (2006).

Instructional Strategies

Instructional strategies provide a vehicle for student learning. Positive strategies engage, provide explicit instruction, provide different sources of motivation, and engage the student in activities that promote skill transference. In addition, positive strategies provide the techniques that enhance mathematical manipulation through authentic purposes. As Bafumo states in her article on Best Practices (2006), “Math uses patterns to create order and meaning….The task of those who teach math is to convey this language of pattern and order in ways that show its relevance to everyday life”.

The memorization of facts for quick recall results in mixed performance. Some students need strategies that enable faster solutions and, therefore, afford the

student a more positive self image. Utilization of research based practices provides student success.

Supermath. Supermath (2004) increases base skills, scores, and interest in math. Within Supermath, technology provides settings in which the students resolve dilemmas by application of mathematical strategies. Research shows that Supermath improves retention, test performance, and math interest (Pogrow, 2004). Mathematics becomes a game that allows students to discover and apply skills to problems that interest them. The adult concepts of math present themselves in a kid friendly way. This approach augments the current curriculum and allows for authentic discovery.

Peer Assisted Learning Strategies. This intervention supplements current curriculums and claims a wide base of research. Each session of PALS (Peer Assisted Learning Strategies), includes coaching and independent practice (Baker, Gersten, Dimino, & Griffiths, 2004). Curriculum based measurement tracks student progress, matches students, and provides direct feedback. This feedback motivates students and practice with peer interaction benefits them in social development.

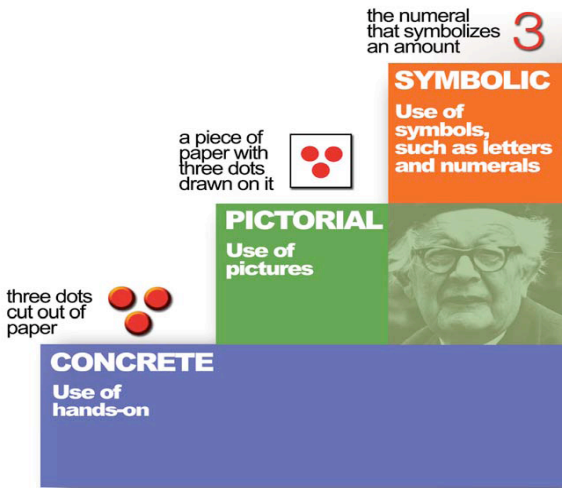
Touchmath. Multisensory methods of instruction improve math achievement (Dev, Doyle, & Valente, 2002). Touchmath, a touch point system, promotes logical thinking in place of rote memorization. Employment of visual, kinesthetic, and tactile learning emphasizes a conceptual understanding of mathematics and reaches a variety of learning styles. Touchmath involves numbers with touch points related to its quantity (see Figure 1). The students follow rules and touch the points on the numbers to solve equations. The student counts aloud and touches during solving, enabling them to learn in multisensory ways. This method engages the student by requiring multiple responses and teaching an easily used and generalized strategy. The student

receives immediate feedback from the teacher as the student models aloud the rules and the thought processes.

Theory Behind Touchmath

This body of research focuses on the Touchmath program. Touchmath bases its foundation on the work of Piaget, Vygotsky and Bruner. According to Bruner, mental development occurs in three stages: concrete, pictorial, and symbolic. Piaget's sensorimotor stage relates closely to Bruner's concrete stage. In this stage, children learn through concrete application (Vinson, 2005). Touchmath matches Piaget and Bruner's research by bridging the gap between the stages. It aligns touchpoints on the symbolic number to show the pictorial quantity. The actual touching of the touchpoints signals the concrete stage and through these measures accounts for all three stages at once. (Figure 2) The ability to bridge all these stages for students allows supports in student transition though these stages. According to Vinson (2005), *"Touchmath is the best method available for making mathematical symbols more computable. It bridges the gap between the hands on and pictorial levels to the symbolic).*

Figure 2- Bruner's stages of learning



Bruner's research also advocated a "spiral curriculum" in which concepts are addressed at a higher and higher level each time. Touchmath incorporates a spiral curriculum as new aspects of the method apply with student progress. Sequential learning and individualized instruction meets the needs of students as they progress to more advanced levels of symbolism and generality.

Vygotsky's work also applies to this study. His theory of scaffolding allows for supports for student learning (Vinson, 2005). Touchmath contains scaffolding in the arrows, touchpoints, and other such cues, but as the student progresses, elimination of cues occurs. Vygotsky's research also outlines the "zone of proximal development" which Vinson (2005) defines as "*the level at which a student can learn with scaffolds or assistance*." Touchmath readily lends itself to utilizing cues and supports as needed with student progression. Touchmath bases its support on the most foundational of research in the area of learning.

Current Research

According to a survey completed by Grattino (2004), of 3500 teachers surveyed from a clientele of Touchmath catalog readers, 99.8% state that Touchmath effectively supplements math curriculum. Additionally, these educators reported students evidence better computational skills, more confidence, and improved comprehension of number/quantity relationships.

Current research finds that students using the Touchmath program improve in accuracy, fluency, and confidence. A study by Dulgarian (2004) compared the results of Touchmath and a traditional approach on a group of 4^{th} and 5^{th} grade special education students with math deficiencies. At the conclusion, the Touchmath group solved problems faster and more accurately than the others. Another study by Scott (1993) outlines research with three elementary students with mild disabilities. After learning the Touchmath technique, the results showed significant gains in computation skills and generalized the knowledge.

A comparative study of six inclusive first grade classrooms introduced Touchmath to three classrooms of children and the traditional approach to the other three classrooms (Bedard, 2002). The results found that scores significantly improved in the Touchmath group's computation.

Another comparative study completed by Strand (no date), Instructed two groups in Touchmath from two different schools and instructed two additional classes with traditional approaches from two different schools. The results of this study expand further than the previous study. However, comparative results occurred. The Touchmath group responded with 80% accuracy after intervention on computation tasks, where as the control group performed at 44%.

This respectable research suggests that a multimodal approach to mathematics contributes positively to the mathematical development of children. Touchmath shows its efficacy in research and the classroom. Based on the previously stated research, the researcher expects to find that Touchmath instruction positively influences math computation skills of the second grade students in this study.

Design and Procedures

The students in the study complete instruction in the Touchmath addition strategy. These lessons occur daily during a one hour math block, four days a week, during a six week period. Assessment of math achievement occurs before and after the intervention on computation skills in single digit addition with sums to 18.

Research Design

Applied behavior analysis attempts to improve specific behaviors by specifically applying an intervention and evaluating the results. These targeted behaviors contain social significance. The study requires that applied behavior analysis be "applied, behavioral, analytic, technological, conceptually systematic, effective, and display some generality (Baer, Wolfe, & Risley, 1968.). Applied behavior analysis clarifies the social importance of the behavior change, summarizes the distinctiveness, outlines the necessary procedures, confirms the reliability, and endorses the validity.

This research design employs a multiple baseline across subjects (two classrooms) design with the notation of $A_1B_1C_1$ with Class A; $A_2B_2C_2$ with Class B pattern. After establishing a baseline over time (A_1A_2), introduction of the Touchmath strategy occurs and the results measured to evaluate the response to the strategy (B_1B_2). Finally, removal of the auditory prompts associated with the Touchmath strategy occurred, and the results of assessment measured (C_1C_2). The researcher established a goal of 100% improvement of average class performance on computation tasks from baseline to end of intervention phase.

Research Variables

This study addresses research variables to ensure a functional relationship.

Independent Variable. The independent variable in this study employs a multisensory approach of Touchmath that integrates visual, kinesthetic and tactile modalities. Sequential instruction in the Touchmath program occurs during the intervention phase. After the intervention phase, the removal of visual prompts occurs.

Dependent Variable. The dependent variables of this study are (1) the percent correct of a sample of one digit addition problems and (2) the independent use of the Touchmath strategy. The investigators collect data on the percent correct of a computation task to determine the effectiveness of the intervention along with data on the observation of the student's obvious utilization of the strategy by the touching of the numerals with a pencil.

Subjects

This study contains two second grade inclusive classrooms. The staff consists of a regular classroom teacher, a part time classroom assistant, an additional special education assistant for a limited time per day, and a special education teacher.

Class A. The class consists of 24 children. 19 students are in the classroom full time. Three students receive supplemental services out of the classroom for 30 minutes a day. Two other students receive supplemental services out of the classroom for one hour a day. This classroom includes five children with IEP's at this time (one autistic, two DD, one MMD, and one LD). There are thirteen girls and eleven boys. The nationalities in the room include three African American and the others qualify as Caucasian. The ages in the room range from seven through nine. According to

Grade testing in the fall, three students score above grade level, six are below grade level, and 13 are on or around grade level.

The four children with IEPs in the class require vastly different experiences. Child A qualifies as autistic and struggles with all subjects. He needs direct instruction of concepts and strategies that target the necessary skills. He receives phonics instruction, sight word instruction, fluency and comprehension building activities, additional Touchmath practice, and speech and language services. He receives practice daily in these skills and needs constant reminders and repetition. Child B qualifies as mild mental disability. This disability affects her in all subjects and in on task behavior. She receives phonics instruction, sight word instruction, and additional Touchmath practice. Child C qualifies with specific learning disabilities in reading, writing and math. Her perceptual organization impacts her performance in all subjects, but her willingness to try and work makes her successful. She receives phonics instruction, sight word instruction, fluency and comprehension building activities, and additional Touchmath practice. Child D qualifies in the area of Developmental Delay because of his age. He presents with severe speech and language needs. In addition, absentee issues occur that cause academic deficits according to the ARC committee. He receives targeted intervention in the areas of speech and language, motor, self-help, reading, writing, and math. Finally, Child E shows absentee issues also, and qualifies with a Developmental Delay. He receives services that target on task behavior, visual perception and visual motor skills, reading, writing, and math. He receives daily practice in phonics, sight words, and Touchmath.

Class B. The class consists of 18 Caucasian, three Hispanic, and one African American child. Nine female students and 13 male students range from the ages of 7 to 8. Four children identify as having disabilities. The class contains all English speaking students. According to Grade testing in the fall, none perform above grade level, 12 on or around grade level, and six below grade level.

The IEP students in the room range widely in ability levels. Child A qualifies as Developmental Delay and the goals relate to math, reading and writing. He also receives speech services. His reading, math, and writing skills improved greatly in one quarter at school. The possibility of this child no longer needing services after the next meeting is great. Child B qualifies as OHI and receives services in the areas of speech, language and math. Diagnoses also relate to his behavior, but responds well to medication and evidence is lacking of behavior problems at this time. He needs repetition and instruction in a variety of ways. He no longer leaves the room for strategy instruction, but receives targeted practice in the classroom with the assistant teacher and the special education teacher. Child C qualifies with a learning disability. His services relate to the areas of speech and language and reading comprehension. He receives daily practice in phonics, sight words, fluency, and comprehension. He struggles with application of phonics rules during writing activities, but reads sufficiently. Child D qualifies as Developmental Delay. His goals target speech and language, math, basic reading, reading comprehension, and writing. He presents with avoidance behaviors and requires prompting to try or to attend to instruction. He receives daily instruction in phonics, sight words, fluency, comprehension, and additional Touchmath practice.

Setting

The participants for this study attend a rural school in Jessamine County, Kentucky. H.C. Warner Elementary School, one of five elementary schools in the district, contains grades one through five with an enrollment of about 575 students. Approximately 98.6% of the population in the school identifies as Caucasian, .6% as African American, .2% as Hispanic, .2% as Asian or Pacific Islander, and the remainder a mix of other ethnic backgrounds. This school met No Child Left Behind (NCLB) requirements of Adequate Yearly Progress (AYP) for the 2006-2007 school year. This school's special needs enrollment consists of 33% economically disadvantaged, .7% English language learners, and 11.8% students with disabilities.

The collaborative setting of the classes determined the participants for this study. The two classrooms in this study include second grade special education students. A panel of teachers considered student personality, teacher personality, and other classmate's compatibility placed the remainder of the class so that the entire class becomes a well rounded balance. These two classes switch classrooms for math and science; hence, one teacher instructs both classes in math.

Within Classroom 1, every child shares a large table with other students. The room contains three computers in the room, all three of which includes software for the needs of the individuals in the class. The room contains a meeting place for calendar time and a separate workplace with a table for small groups and individual work. The students receive chair packs in which to place books and tables share caddies for crayons and scissors. The classroom shares a smart board and an Elmo with another 2nd grade class. This class goes to another 2nd grade classroom for math.

The students use tables within Classroom 2. The room contains one computer in the classroom with software installed for use of the students, one table used for small groups and supplemental work, and a reading area.

Data Collection Instruments

The primary researcher created recording sheets and forms to organize the collecting of data. This compiles the data in one place and allows for reliability. The descriptions of these forms follow.

Individual Data Recording Sheet. Data collection occurred in the form of computation skill assessment percentage charts (Appendix A) for each child to record the computation tasks throughout the implementation. A computation assessment chart exists for each student and documents all of their scores individually.

Class Data Recording Sheet. For this research project, the researcher computes and records class averages to address the research questions. The Class Data Recording Sheet combines the individual data into the class average each day of the study (Appendix A). These averages appear in the results graph.

Independent Variable Reliability Sheet. Daily, both teachers utilize an independent variable reliability sheet to reflect the interrater reliability of the project (Appendix A). This sheet ensures the instruction of the intervention to follow procedures and allows the research reliability and duplication.

Dependent Variable Reliability Sheet. Both teachers also complete a two dependent variable reliability sheets (Appendix A) to reflect the procedural reliability of this study. A teacher scores each student's quiz then another teacher scores a random sample of four sets of quizzes and records the individual results on dependent variable reliability sheet #1. This allows for accurate scoring and reliability of scores.

During the maintenance phase, two teachers observe the targeted student for evident use of the Touchmath strategy and record their observations. They record these observations on data sheet E.

Parent/Guardian Informed Consent Form. Parents receive a letter (Appendix B) outlining the intent of this research. This study requires the parent's signature to give permission for the student to participate. The parent holds the right to deny or allow their child's participation.

Computation Assessments. A collection of ten quizzes consisting of 20 computation tasks up to a sum of 18 assessed student skills (Appendix B). The assessment rotation prevents memorization and the set order of the quizzes eliminates the risk of inadvertent disproportionate use of a particular quiz. These quizzes are compatible with current math computation quizzes and the second grade standard for fluency. The students demonstrate knowledge of the concepts by increasing their scores. The rotation of these assessments appeared as follows:

Baseline-	Week 1- #5
Intervention-	Week 2- #'s 6,9,10, 3
	Week 3- #'s 2,4,8,1
	Week 4- #'s 7,5,3,9
	Week 5- #'s 2, 10, 6, 4
Maintenance-	Week 6- #'s 3,1,7,8

Procedures

In this section, the researcher describes the procedures and elements of implementation for this study.

General Procedures. This study occurs at school during school hours over a period of six weeks. Before implementation of this research, the researcher obtains permission from the institutional review board, the school district, and the parents of the students involved. The results of these procedures appear in graph form (Figure 3). During regular math time, the whole class receives instruction in Touchmath strategy daily. This instruction supplements the regular curriculum. The regular education teacher refrains from instruction in alternate addition strategies during this period of intervention. Data collection consists of 20 question computation assessments of single digit addition administered with a time limit of 1 minute. Data collection occurs on an individual basis, and then combined for class wide data. A data collection sheet exists on the progress of each student. The classroom teacher and special education teacher both score each assessment to ensure reliability. The results of this reliability assessment appear on the Interrater Recording Reliability Sheet (Appendix A). The regular education teacher kept record of validity on the Independent Variable Reliability Sheet A daily (Appendix A). The maintenance phase monitoring consists of dual teacher observation and recording of observed behaviors. The Independent Variable Reliability Sheet B (Appendix A) records teacher observations and the teacher agreement percentages.

Baseline. The initial data appears as a 20 problem computation assignment. All baseline data (A_1, A_2) occurred with a single probe. The probe assessment occurs within the two classes on the same day during week one.

Intervention. The intervention (B_1, B_2) begins during week two with direct instruction covering the Touchmath addition rule along with numbers one through nine touchpoints. Single touch points receive one touch and one count, and double touch points receive two touches and one count (Appendix C). Each student receives an individual touchline to reference as a visual cue. Large posters of the touchpoints display prominently in the room. The data results from the four computation quizzes given during four days in that week. The instruction continues with practice. The computation quizzes gather the data during four separate occasions of week three. Instruction ends during week four and computation quizzes gather data during the four separate occasions. Finally, during week five, the class reviews and practices all numbers and rules, then takes the final intervention computation quizzes during four separate occasions.

Introduction of each number's touch point consists of giving each student a poster of the new number. The number touch point instruction follows with pointing to visual cue of the new number, teacher modeling of the correct count sequence of the points, and student participation. The students look, touch, and speak the counting sequence by following along and placing manipulatives on the individual touch point cues then counting along. Students use dry erase markers and erasers to follow in guided practice of counting the touch points and computing addition problems by writing on their desks and solving. Students participate in class games and practice that allows for teacher observation of the correct use of the touchpoints and the strategy. In the third week of intervention, the Touchmath addition rule instruction occurs, "Touch the largest number, say its name, and continue counting". (Appendix C) This review includes referencing of the poster and repeating the rule as a class and

utilizing this rule to solve questions more fluently. Assessments consist of 20 question computation tasks with a time limit of 1 minute (Appendix B). The total assessments within the intervention phase consist of 16 assignments of 20 addition problems for 16 separate occasions.

Maintenance. The maintenance phase (C_1C_2) occurs with the removal of auditory prompts. The instructors refrain from mentioning Touchmath and the students then perform 20 problem computation assignments with a time limit of 1 minute during four separate days of week six to determine if the students independently sustain the benefit of the intervention.

Reliability

The conditions of this research contain reliability measures to establish consistency of the expected design. This research analyzes the data and trends to monitor the reliability and validity of this study.

Independent Variable Reliability. An independent variable reliability sheet records the independent variable of the Touchmath strategy (Appendix B). The regular education teacher completes the interobserver reliability form. The formula of $\frac{T}{TT}$ X 100% dictates the percentage of reliability. Researchers accept inter observer reliability percentages of 90% as providing variable reliability.

Chart 1 - Administration procedures for the independent variable

	Permission from institutional review board	
	Permission from school district	
	Permission from parents	
Week One		**Baseline**
	Tuesday	Assessment #5- Baseline probe

Week Two		**Intervention Phase 1**
	Monday	-Teach touchpoints 1-3- Show number posters - post in room. -Discuss -Practice placing counters on the touchpoints and practice counting touchpoints as a class -Demonstrate addition with the touchpoints as a class -Have the students say the addition problem and count and answer it aloud Assessment #' 6
	Tuesday	-Teach touchpoints 4-5- Show number posters, have kids touch touchpoints by skywriting as a class- and post in room. -Draw the numbers with touch points with dry erase on desk and practice counting touchpoints as a class -Demonstrate addition with the touchpoints as a class -Students practice addition with touchpoints by writing on desk and answering as a class Assessment #'9
	Wednesday	-Teach touchpoints 6-7- Show number posters, have kids touch touchpoints by skywriting as a class- and post in room. -Use reversible flashcards by showing the side of the card with touchpoints, asking for them to count and give a verbal answer, and flipping the card over and repeating answer. Give a few minutes for the students to work in partners and practice adding the numbers. Assessment #'10
	Thursday	-Teach touchpoints 8-9- Show number posters, have kids touch touchpoints by skywriting as a class- and post in room. -Use reversible flashcards by showing the side of the card with touchpoints, asking for a verbal answer, and flipping the card over and asking for the answer again. Have the students say the problem and answer it aloud. Give a few minutes for the students to work in partners and practice adding the numbers. -Assessment #'3
	Friday	-Students practice addition flashcards with touchpoints as a center activity
Week Three		**Intervention Phase 2**
	Monday	-Review Touch Points- show and practice counting with strips on desk -Teach Addition Rule- tell students the rule and demonstrate that they do not have to count the highest number - Students practice addition with touchpoints using the rule. The students all have a chance to demonstrate and answer a problem aloud. Assessment #'2

	Tuesday	-Review Addition Rule- tell students the rule and demonstrate that they do not have to count the highest number Students practice addition with touchpoints using the rule. The students all have a chance to demonstrate and answer a problem aloud. Assessment #'4
	Wednesday	-Review Addition Rule- students repeat the rule and teacher demonstrates an addition problem again. - Students practice addition with touchpoints with a partner using the rule Have the students say the problem and answer it aloud Assessment #'8
	Thursday	-Review Touch Points- have the students place the dots on the number on board or Smartboard. -Review Addition Rule- restate the rule - Students practice addition with touchpoints with a partner using the rule Have the students say the problem and answer it aloud Assessment #'1
	Friday	-Students practice addition flashcards with touchpoints as a center activity
Week Four		**Intervention Phase 3**
	Monday	- Play around the world. Assessment # 7
	Tuesday	- Students practice addition with regular flashcards with a partner -Assessment #5
	Wednesday	- Play around the world. -Assessment #3
	Thursday	- Play a timed addition game on the Smartboard/computer -Assessment #9
	Friday	-Students practice addition flashcards as a center activity
Week Five		**Intervention Phase 4**
	Monday	Assessment # 2
	Tuesday	Assessment #10
	Wednesday	Assessment #6
	Thursday	

		Assessment #4
	Friday	-Students practice addition flashcards with touchpoints as a center activity
Week Six		**Maintenance**
	Monday	Assessment #1
	Tuesday	Assessment #7
	Wednesday	Assessment #8
	Thursday	Assessment #3
	Friday	Finished.

Dependent Variable Reliability. A dependent variable procedure sheet records the students' performance on the computation tasks. The formula for this method appears as the percentage of $\frac{A}{A+B}$ X 100%. Dependent variable reliability percentage of 90% provides reliability of the permanent products. Both teachers complete scoring of the computation quizzes independently. The results transfer onto the independent variable reliability sheet. (Appendix C)

Validity

Validity provides assurance that the research measures what it claims to measure. The author of this study considers the threats to internal validity and applies controls to assure validity.

Instrumental Validity. The instruments in this study relate appropriately in format and grade level for these students and for the nature of the study. Second grade

curriculum places addition of numbers up to an addend of 18 in the first quarter of the year. The tests reflect the "mad minute" drills utilized by the second grade teachers to encourage automaticity. Any modifications made to the test to address specific student needs did not invalidate the test, but allow for use of the strategy at the students level. The random compilation of these instruments reduces memorization of the test and reflects true knowledge of the addition facts. The time limit and number of assignments reflects the typical expectation of the second grade teachers. The results of the time tests denote the student's addition knowledge and automaticity, showing improvement over the course of the study. A student's score improvement shows growth since the time limit stays the same. A student's non improvement indicates a lack of automaticity and non effect of this strategy.

External Validity. The researcher maintains confidence in the ability to replicate this study. The Touchmath intervention produces results intrasubject, intersubject, and systematically. The intervention benefits a wide audience and produces adequate data. Touchmath produces similar results in a variety of settings and subjects. Application of this intervention benefits all students. This study contributes to other similar research in the field. Previous research validates use of Touchmath with learning disabled students (Scott, 2002); this study validates use of Touchmath in classrooms as a strategy for all students.

Internal Validity. Control of variables in a study demonstrates a functional relationship between the treatment and the skill. The two classes in the study include a wide range of abilities and both include special education students. The same math teacher and the same room contribute to the consistency of this study. To maintain evidence of a functional relationship the regular education teacher refrains from

teaching any conflicting strategies during the weeks of study. Specific procedures to follow negate treatment drift. The same procedures occur for both classes; however, the classes occur at different points during the day. The researcher ensures the validity of assessments by rotating computation quizzes that contain sums up to 18 to certify no memorization of the answers. To negate the threat of regression, the researcher utilizes the pretest another time during intervention and gains the ability to compare scores. The researcher employs a short yet adequate time span for the study so that less interference occurs with history, maturation, and attrition.

Social Validity. Math skills in this country fall below the levels deemed necessary for successful living. In addition, a significant number of students struggle with disabilities that affect performance in mathematical competency tasks. The students that struggle in these areas suffer from low self esteem and the end result impacts jobs and everyday lives.

Multisensory methods of instruction improve math achievement (Dev, Doyle, & Valente, 2002). Touchmath, a touch point system, promotes logical thinking in place of rote memorization. Employment of visual, kinesthetic, and tactile learning emphasizes a conceptual understanding of mathematics and reaches a variety of learning styles. This strategy addresses the learning curve of students. Touchmath enables automaticity.

Positive strategies engage, provide explicit instruction, provide different sources of motivation, and engage the student in activities that promote skill transference. In addition, positive strategies provide the techniques that enhance mathematical manipulation through authentic purposes.

Math difficulties result in students withdrawing, having low self esteem, and avoiding difficult tasks (Garnett, 1998). These struggles cause difficulty in everyday life, including jobs and careers. Early number concepts have relevance to everyday life in adult mathematical situations. It is time for re-evaluation of the value of memorization of facts and teach number concept strategies that transfer into more advanced skills.

Data Analysis and Findings

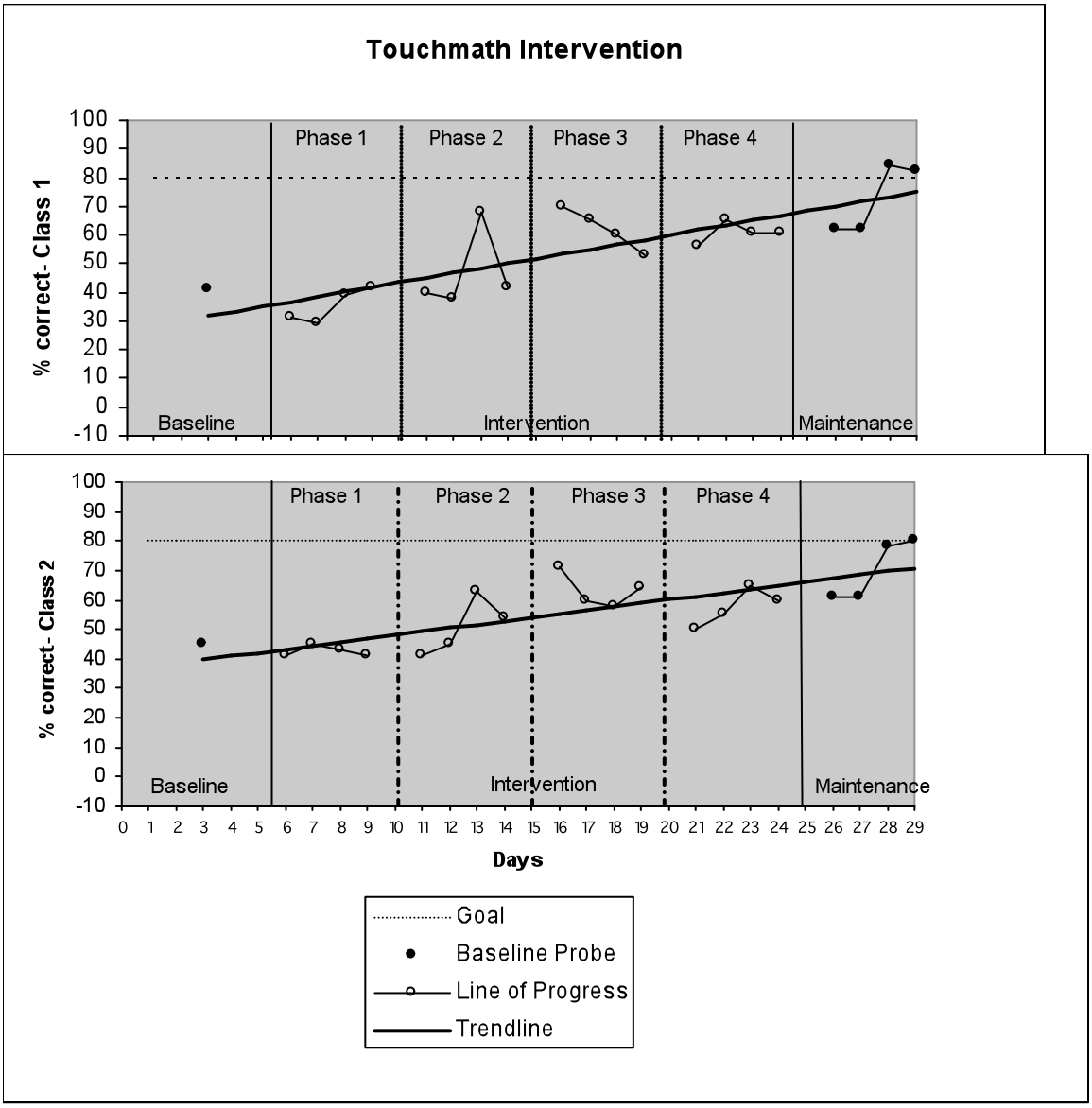
Overall

This study demonstrates a functional relationship between the intervention and student performance. The use of Touchmath strategy increases computation skills and additionally promotes a computation strategy that students use independently. Seventeen of thirty-four students met the goal of 100% improvement on computation tasks. Over the intervention and maintenance conditions, Class A performs overall at a mean of 55.6%, a median of 60%, and a standard deviation score of 15.9. Class B performs overall at a mean of 56.2%, a median of 59%, and a standard deviation score of 11.87. A comparison of baseline scores and the mean score of the intervention and maintenance conditions shows a 35.6% increase of computation scores within Class A and a 25% increase within Class B.

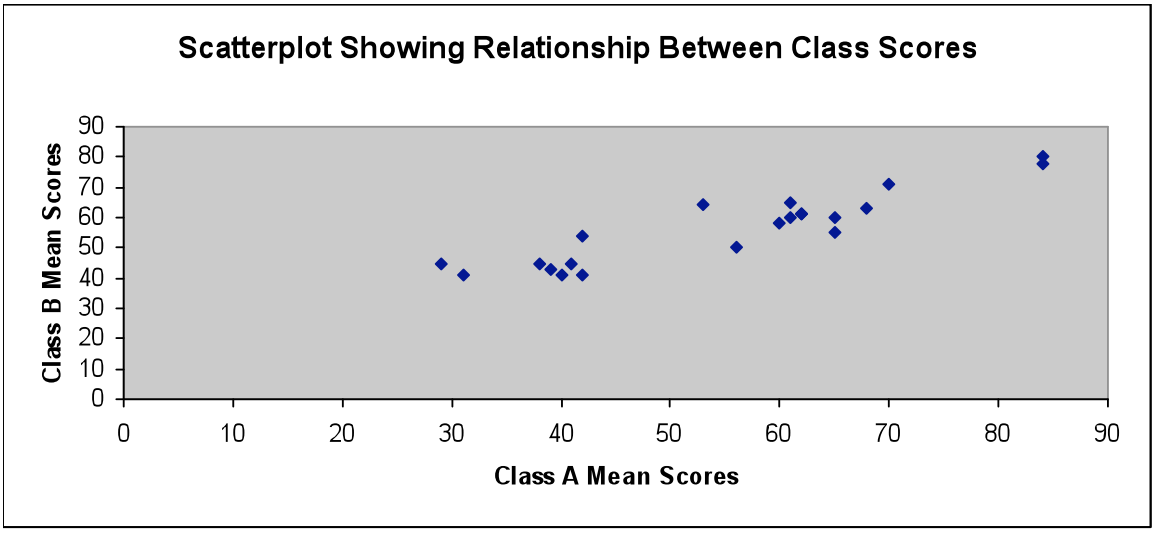
As additional data indicates, errors decrease within attempted problems. A trend line encompassing all phases shows decreasing errors as Touchmath strategy knowledge increases and as students practice. Class A performs overall at an error mean of .68, a median of .73, and a standard deviation score of .73. Class B performs overall at a mean of 1.01 errors, a median of 1, and a standard deviation of .29. A comparison of baseline errors and the mean errors of the intervention and maintenance conditions shows a .03 increase of errors within Class A and a .57 decrease within Class B.

Students utilize the Touchmath strategy. Both classes reflect similar scores and trend lines. (Graphs 2, 3 and 4). Knowledge of touchpoints allows ease of use and faster timed scores. Teacher observation of student use of the Touchmath strategy occurs at 100% per occasion for 8 separate occasions.

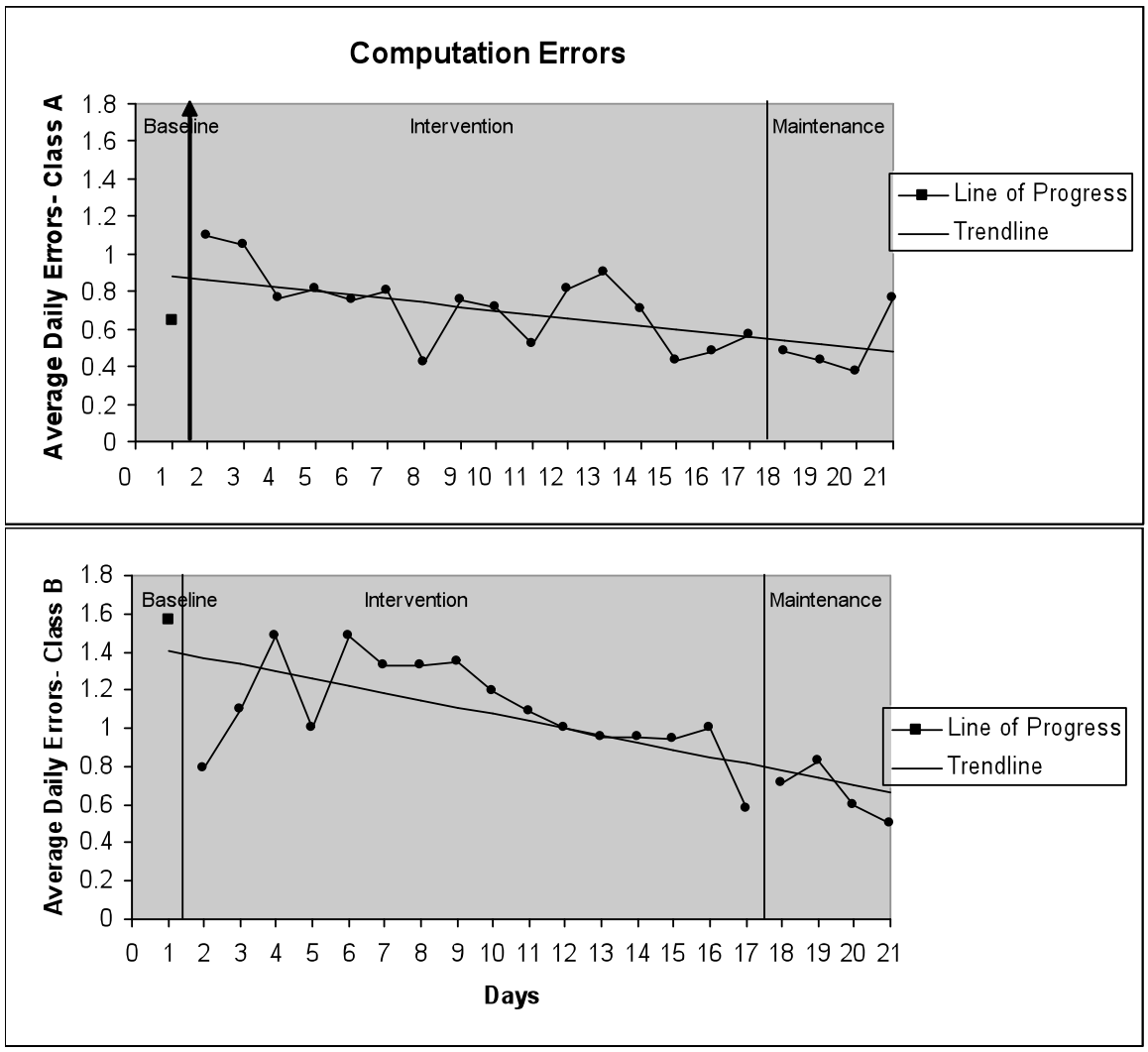
Graph 1- Computation Scores by Class



Graph 2- Scatter Plot Comparison of Classes



Graph 3- Computation Errors with Trend by Class



Within Conditions Analysis

Student performance within the conditions shows significant changes.

Baseline. The Baseline condition (A_1A_2) occurs for a period of one week. During one day of that week, a single probe assessment indicates baseline levels. Class A shows a probe score of 41%. Class B receives a probe score of 45%. The classes demonstrate low computation skills. Class A reflects an average of .65 errors on the probe and Class B reflects an average of 1.57 errors.

Intervention. The intervention condition (B_1B_2) occurs for a period of four weeks. The intervention phase produces an increasing trend that demonstrates the success of the Touchmath strategy.

Class A reveals a mean of 51.3. The individual range of scores places within 0 and 100, which establishes the functional range at 100. The stability score indicates a stability level of 12.5%. Overall, an accelerating trend occurs with a 31% overlap of data. However, when excluding the first week of intervention from this data to allow time for strategy integration a mean score of 56.6 occurs and indicates a stability score of 58%. Class A has a mean of .72 errors and a median of .75 in the intervention phase, which shows a slight increase of errors.

Class B reveals a mean of 54. The range of scores places within 0 and 100, establishing the functional range at 100 and a stability score of 43.8%. If excluding the 1st week of intervention due to student learning of the strategy, the range of scores changes significantly and establishes the functional range at 87. This indicates a stability of 67%. A 25% overlap of data occurs. An accelerating trend appears. Class B obtains a mean of 1.10 and a median of 1.05 within the intervention phase, which is a significant drop in errors as compared to the baseline probe.

Maintenance. The maintenance condition (C_1C_2) occurs for a period of one week following the intervention. The scores demonstrate an increase in computation skill ability and understanding. The students incorporate the strategy and transfer knowledge effectively.

Class A shows a mean of 73 within the maintenance condition. The range of scores place within 29 and 100. The trend accelerates and shows a stability level of 100%. The errors drop to a mean of .51, showing a significant decrease in errors.

Class B shows a mean of 70. The range of scores place within 14 and 100. Using a split middle trend analysis, the scores indicate an accelerating trend. The stability level emerges at 100%. The error mean shows at .66, showing a decrease from the baseline probe of over 100%.

During maintenance, teachers document observations of student use of strategy. Daily, teachers monitor and record a randomly chosen student for obvious use of an addition strategy. The eight individual sessions show 100% reliability between observers and 100% use of the Touchmath strategy.

Table 1- Cross Break Table of Variable 2 Data

	Strategy Use		
Class	**No Strategy Observed**	**Touchmath Strategy Observed**	**Other Strategy Observed**
Class A	0	4	0
Class B	0	4	0
	Interobserver Reliability: 100%		

Data analysis across conditions

This research occurs within a six week period. The baseline probe and first week of intervention means show similarity. During the baseline and first week of intervention, students show significant lack of strategy use and score poorly on single digit addition. The students demonstrate significant computation errors.

Both Class A and B fail to achieve overall stability of computation data with stability range percentage scores of 35% and 50% respectively. However, when excluding the baseline probe score and the 1st week of intervention due to lack of knowledge of the strategy, the data changes significantly. The mean scores increase,

the range varies less, the overlap of data disappears, and the stability of each class reaches a more acceptable 62.5% for each class.

The accelerating trend indicates high achievement. Both classes increase scores by 56% and 64% respectively from baseline to maintenance. Both classes achieve a comparable increase in mean. Both classes score a mean around 53 in the intervention phase and a mean around 72 in the maintenance phase. The data trend increases in each classroom. The increasing trend indicates a productive intervention. The fact that both classes exhibit a similar trend indicates a positive correlation between performance and intervention.

The mean of computation results increase significantly between the baseline and maintenance. The means of both classes compare closely. The maintenance phase means show increased computational skills over the baseline phase, and consistent scores in comparison with the intervention phase. The maintenance condition stability has both classes achieving 100% on the stability range percentages. The data points overlap at 75% and 80% across conditions in Class A and Class B respectively.

The error percentages within both classes drop significantly between the baseline and maintenance phases. The mean and median scores fall and the trend lines show a decrease in errors. Although Class A shows a decrease in errors and a stability score of 40%, Class B's scores show more significant of a drop and a stability score of 100%.

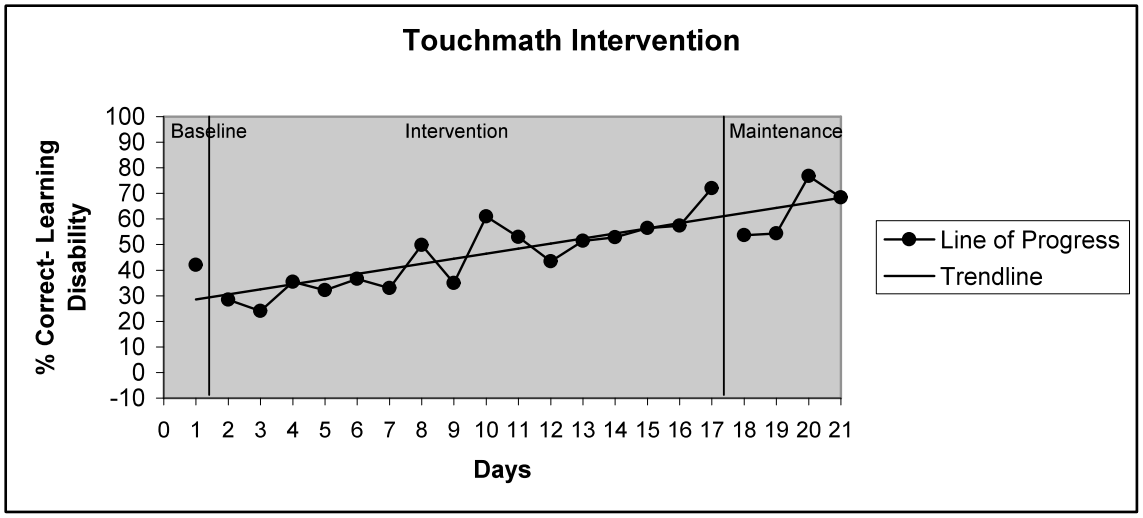
The wide ability levels in the classes benefit from the use of Touchmath. The overall performance of the classes does not isolate individual students, but indicates the application of strategy generally. When the fluency of computation lacks improvement, most students accomplish a reduction of errors per attempt. Because

this research focuses on assessing changes brought about by the use of the Touchmath strategy, assessment of sustained use of the strategy appears in the maintenance phase by documenting the change of performance as compared with the baseline probe. The students' performance indicates continued use of the Touchmath strategy after removal of auditory prompts as seen in documentation of independent teacher observation.

Data Analysis of Specific Population

A significant population of Learning Disabled students participates in this study. The data of their progress shows a positive trend and a correlation between Touchmath and their computation scores. The baseline mean shows a 42% with a median score of 36%. The intervention mean shows at 45.1% with a median score of 46.6%, showing an increase in computational scores and fluency. Finally, the maintenance condition shows a mean of 63.3% and a median of 61.4%, which demonstrates a 50% increase of scores. Overall, the mean score shows 48.4% and a median score of 51%. The standard deviation across all phases places at 14.5. This data suggests that Touchmath is a valid intervention for this population of students in a diverse classroom.

Graph 4- Computation Scores of Leaning Disability Students



Reliability Data Analysis

Procedural observations and data collection prove the reliability and integrity of results in research.

Dependent. A functional relationship between the dependent variable and independent variable occurs to validate this study. A score of 95% required to assure procedural reliability. In this study, the procedural reliability sheet reflects a 100% reliability rating, meets set criteria, and demonstrates application of all procedures.

Independent. The mean inter observer reliability for this portion reflects a 100% reliability rating and demonstrated inter observer reliability. The reliability rating for this study exceeds the required percentage of 90%.

Validity Data Analysis

Control of variables in research provides validity. Control of independent, dependent, and extraneous variables allows the research validity. Determination whether the research measures the intended variable depends upon the validity of the research.

Internal Validity. This study shows increasing performance on one digit addition problems. The baseline readings lend credence to the functional relationship

that result from the implementation of the intervention. This study assures internal validity through baseline data that improves due to the intervention. The relationship between the dependent and independent variables shows the Touchmath program effective with the individual and with the class setting. These results identify positive implications for educators who need strategies that increase computation skills. Touchmath facilitates the learning of computational skills by outlining specific strategies for students to utilize. This research promotes that the program not only works for the individual, but for classes. Touchmath allows the teacher the flexibility to utilize this strategy beside another program and individualize for the student's needs. Observation during testing reveals some students learn a valid test taking strategy. These students learn to answer the easy questions on the test first and skip the harder ones. This occurs infrequently enough to for non effect on results. Avoidance of this issue in future studies requires sequential progress on test questions.

External Validity. External validity shows effectiveness when employed in other situations. The results of this study generalize to other groups. The data from Class A was commensurate with the data from Class B, differing in basic scores, but undisputable in trend. The effectiveness of Touchmath in this setting indicates a benefit for including Touchmath in all classrooms and for all students.

Social Validity. The Touchmath program addresses social validity by providing strategies necessary for struggling students. As previously stated, research shows that explicit instruction in math skills improves computation skills of low performing students (Bottge, 2001.). Students with math disabilities especially need direct instruction in strategies across multi sensory styles. Research validates the need

for multi modal strategies to promote achievement (Scott, 1993). Students require knowledge of how numbers work and how to apply that knowledge in a variety of ways.

Summary and Conclusions

Overall

The results for this study represent the true potential of the Touchmath strategy. The students' computation skills increase, errors decrease and a strategy for unknown facts occurs. Strategy use improves computation scores within the later intervention phases and within the maintenance phase. Both classes, and a variety of students, utilize and apply the instructional strategies. The overall results indicate continued use of the Touchmath strategy to the benefit of the computation scores.

Summary

Students with learning disabilities, whether the disability occurs in math or in another area that affects math performance, need explicit instruction in strategies that work. These students require engagement in learning with application, plenty of feedback, and teaching that correlates with personal learning style. The successful study positively supports the research questions. First, the use of Touchmath improves math computation skills with single digit addition in second grade students, and, second, students continue to use Touchmath for math calculation when removal of auditory prompts occurs.

Touchmath provides basic requirements of valuable instruction. First, students who receive feedback and track progress obtain more motivation to continue. These students have the opportunity to practice correct computations and self-correct. Second, the most effective teaching strategies combine styles so that each child utilizes personal approaches and benefits from the combination. Finally, research shows that explicit instruction in math skills improves computation skills of low performing students.

Implications

By using multiple baseline, the strongest of all single subject research designs, this study provides strong implications for the success of Touchmath in general education classrooms.

Meaning

This research relates to student need for purposeful understanding of mathematics concepts. As discussed previously, students benefit from a variety of learning strategies. Some students lack the ability to develop and implement strategies independently. Direct instruction in strategy use allows these students to incorporate math understanding. The math learning challenged students benefit from the use of Touchmath. The multi modal approach promotes understanding and manipulation of math concepts. In addition, other typical students utilize the strategy and some continue use independently. Touchmath is not a strategy limited in use to only students with learning disabilities. This strategy benefits all.

Limitations

Due to validity and reliability, this study targets specific questions. The strategy benefits students, however, the individual results vary. Not all students benefit from the use of this strategy. Overall data reflect group reaction and not individual reaction to Touchmath. Several questions still occur:

1. What kept some students from utilizing the Touchmath strategy?
2. Would further instruction allow beneficial utilization of the strategy?
3. Who (what types of learners/ disabilities) did and did not benefit from the strategy?

Generalizations

Use of math strategies in primary classrooms provides a transition to higher level thinking. Students utilize these strategies as the curriculum increases in difficulty to build connections to the next stage. Students form concepts with these understandings, which provide a solid basis for the development of advanced mathematics learning.

Due to the positive results of this study, continued use of the Touchmath strategy occurs along with utilization of the multi digit addition and subtraction strategies. In addition, incorporation of the Touchmath program benefits many classrooms within the school. Within the 2nd grade, strategy instruction in Touchmath continues and broadens.

Future Research

Due to the beneficial nature of this strategy, continuation of this research into the other areas naturally follows. The researcher suggests:

1. Comparative studies within the Touchmath programs to determine the effects.
2. Studies moving into higher levels of mathematics.
3. Comparative studies to find the types of children who benefit from this strategy.

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Appendices

Appendix A – Data Sheets
Appendix B – Forms
Appendix C – Information
Appendix D- Computation Scores

Appendix A – Data Sheets

Data Sheet A- Individual Data Recording Sheet

Curriculum-Based Assessment Progress-Monitoring Data Recording Sheet

Math Computation

Student Name: ________________ Grade/Classroom: ____________________

- ❑ Single-Skill Worksheet
- ❑ Multiple-Skill Worksheet

Computation Skill(s) Assessed: ________________________________

					Notes/Comments
Date:______	TD:_____	E:_____	CD: _____	%CD:_____	
Date:______	TD:_____	E:_____	CD: _____	%CD:_____	
Date:______	TD:_____	E:_____	CD: _____	%CD:_____	
Date:______	TD:_____	E:_____	CD: _____	%CD:_____	
Date:______	TD:_____	E:_____	CD: _____	%CD:_____	
Date:______	TD:_____	E:_____	CD: _____	%CD:_____	
Date:______	TD:_____	E:_____	CD: _____	%CD:_____	
Date:______	TD:_____	E:_____	CD: _____	%CD:_____	
Date:______	TD:_____	E:_____	CD: _____	%CD:_____	
Date:______	TD:_____	E:_____	CD: _____	%CD:_____	
Date:______	TD:_____	E:_____	CD: _____	%CD:_____	
Date:______	TD:_____	E:_____	CD: _____	%CD:_____	
Date:______	TD:_____	E:_____	CD: _____	%CD:_____	

TRW– Total Digits E–Errors CD–Correct Digits %CD–Percent Accuracy (CD/TD)

Data Sheet B- Independent Variable Sheet

Independent Variable Reliability Sheet

Administration procedures for the independent variable follow:

	Permission from institutional review board	
	Permission from school district	
	Permission from parents	
Week One		**Baseline**
	Tuesday	
	___	Assessment #5- Baseline probe
Week Two		**Intervention**
	Monday	
	___	-Teach touchpoints 1-3- Show number posters - post in room.
	___	-Discuss -Practice placing counters on the touchpoints and practice counting touchpoints as a class
	___	-Demonstrate addition with the touchpoints as a class
	___	-Have the students say the addition problem and count and answer it aloud
	___	Assessment #' 6
	Tuesday	
	___	-Teach touchpoints 4-5- Show number posters, have kids touch touchpoints by skywriting as a class- and post in room.
	___	-Draw the numbers with touch points with dry erase on desk and practice counting touchpoints as a class
	___	-Demonstrate addition with the touchpoints as a class
	___	-Students practice addition with touchpoints by writing on desk and answering as a class
		Assessment #'9
	Wednesday	
	___	-Teach touchpoints 6-7- Show number posters, have kids touch touchpoints by skywriting as a class- and post in room.
	___	-Use reversible flashcards by showing the side of the card with touchpoints, asking for them to count and give a verbal answer, and flipping the card over

	___ ___	and repeating answer. Give a few minutes for the students to work in partners and practice adding the numbers. Assessment #'10
	Thursday __ ___ __	-Teach touchpoints 8-9- Show number posters, have kids touch touchpoints by skywriting as a class- and post in room. -Use reversible flashcards by showing the side of the card with touchpoints, asking for a verbal answer, and flipping the card over and asking for the answer again. Have the students say the problem and answer it aloud. Give a few minutes for the students to work in partners and practice adding the numbers. -Assessment #'3
	Friday ___	-Students practice addition flashcards with touchpoints as a center activity
Week Three		**Intervention**
	Monday ___ ___ ___ ___	-Review Touch Points- show and practice counting with strips on desk -Teach Addition Rule- tell students the rule and demonstrate that they do not have to count the highest number - Students practice addition with touchpoints using the rule. The students all have a chance to demonstrate and answer a problem aloud. Assessment #'2
	Tuesday ___ ___ ___	-Review Addition Rule- tell students the rule and demonstrate that they do not have to count the highest number Students practice addition with touchpoints using the rule. The students all have a chance to demonstrate and answer a problem aloud. Assessment #'4
	Wednesday ___	-Review Addition Rule- students repeat the rule and teacher demonstrates an

	___ ___	addition problem again. - Students practice addition with touchpoints with a partner using the rule Have the students say the problem and answer it aloud Assessment #'8
	Thursday ___ ___ ___ ___	-Review Touch Points- have the students place the dots on the number on board or Smartboard. -Review Addition Rule- restate the rule - Students practice addition with touchpoints with a partner using the rule Have the students say the problem and answer it aloud Assessment #'1
	Friday ___	-Students practice addition flashcards with touchpoints as a center activity
Week Four		**Intervention**
	Monday ___ ___	- Play around the world. Assessment # 7
	Tuesday ___ ___	- Students practice addition with regular flashcards with a partner -Assessment #5
	Wednesday ___ ___	- Play around the world. -Assessment #3
	Thursday ___ ___	- Play a timed addition game on the Smartboard/computer -Assessment #9
	Friday ___	-Students practice addition flashcards as a center activity
Week Five		**Intervention**
	Monday ___	Assessment # 2

	Tuesday ___	Assessment #10
	Wednesday ___	Assessment #6
	Thursday ___	Assessment #4
	Friday ___	-Students practice addition flashcards with touchpoints as a center activity
Week Six		**Maintenance-**
	Monday ___	Assessment #1
	Tuesday ___	Assessment #7
	Wednesday ___	Assessment #8
	Thursday ___	Assessment #3
	Friday _	Finished.

Data Sheet C- **Inter Rater Recording Reliability Sheet**

Name of observers: Johnson, Mays, Egan

Month/Year: September 2007

		Observer 1	Observer 2	% agreement
Set of quizzes	Set 1			
	Set 2			
	Set 3			
	Set 4			
TOTAL INTERRATER RELIABILITY %:				

Data Sheet D- **Class Data Recording Sheet**
Class A

Students	day 1	day 2	day 3	day 4	day 5	day 6	day 7	day 8	day 9	day 10
A										
B										
C										
D										
E										
F										
G										
H										
I										
J										
K										
L										
M										
N										
O										
P										
Class Average										

Class Data Recording Sheet cont'
Class A

Students	day 11	day 12	day 13	day 14	day 15	day 16	day 17	day 18	day 19	day 20	day 21
Q											
R											
S											
T											
U											
V											
W											
X											
Y											
Z											
Class Average											

Class Data Recording Sheet
Class B

Students	day 1	day 2	day 3	day 4	day 5	day 6	day 7	day 8	day 9	day 10
A										
B										
C										
D										
E										
F										
G										
H										
I										
J										
K										
L										
M										
N										
O										
P										
Class Average										

Class Data Recording Sheet cont'
Class B

Students	day 11	day 12	day 13	day 14	day 15	day 16	day 17	day 18	day 19	day 20	day 21
Q											
R											
S											
T											
U											
V											
W											
X											
Y											
Z											
Class Average											

Data Sheet E- **Inter Rater Recording Reliability**

Teacher Observation Sheet

Observer 1

	Students using Touchmath
Day 1- Student 1	
Day 2- Student 2	
Day 3- Student 3	
Day 4- Student 4	

Observer 2

	Students using Touchmath
Day 1- Student 1	
Day 2- Student 2	
Day 3- Student 3	
Day 4- Student 4	

Interobserver agreement

	Observer 1	Observer 2	Interobserver Agreement %
Day 1- Student 1			
Day 2- Student 2			
Day 3- Student 3			
Day 4- Student 4			

Appendix B – Forms

Form A-

Curriculum-Based Assessment Mathematics
Single-Skill Computation Probe 1: Examiner Copy

Item 1: 1 CD/1 CD Total	Item 2: 2 CD/3 CD Total	Item 3: 2 CD/5 CD Total	Item 4: 2 CD/7 CD Total
1 +6 **7**	9 +6 **15**	6 +4 **10**	7 +7 **14**

Item 5: 1 CD/8 CD Total	Item 6: 2 CD/10 CD Total	Item 7: 2 CD/12 CD Total	Item 8: 2 CD/14 CD Total
1 +6 **7**	8 +5 **13**	4 +9 **13**	6 +7 **13**

Item 9: 2 CD/16 CD Total	Item 10: 1 CD/17 CD Total	Item 11: 2 CD/19 CD Total	Item 12: 1 CD/20 CD Total
6 +7 **13**	3 +5 **8**	6 +7 **13**	1 +2 **3**

Item 13: 1 CD/21 CD Total	Item 14: 1 CD/22 CD Total	Item 15: 1 CD/23 CD Total	Item 16: 1 CD/24 CD Total
4 +2 **6**	7 +2 **9**	2 +5 **7**	3 +4 **7**

Item 17: 1 CD/25 CD Total	Item 18: 1 CD/26 CD Total	Item 19: 1 CD/27 CD Total	Item 20: 1 CD/28 CD Total
2 +5 **7**	1 +3 **4**	7 +1 **8**	7 +1 **8**

Curriculum-Based Assessment Mathematics
Single-Skill Computation Probe 1: Student Copy

Student: Date: _____

1 + 6	9 + 6	6 + 4	7 + 7
1 + 6	8 + 5	4 + 9	6 + 7
6 + 7	3 + 5	6 + 7	1 + 2
4 + 2	7 + 2	2 + 5	3 + 4
2 + 5	1 + 3	7 + 1	7 + 1

Curriculum-Based Assessment Mathematics
Single-Skill Computation Probe 2: Examiner Copy

Item 1: 2 CD/2 CD Total	Item 2: 1 CD/3 CD Total	Item 3: 1 CD/4 CD Total	Item 4: 1 CD/5 CD Total
3 +8 **11**	6 +3 **9**	1 +4 **5**	4 +2 **6**

Item 5: 2 CD/7 CD Total	Item 6: 2 CD/9 CD Total	Item 7: 2 CD/11 CD Total	Item 8: 2 CD/13 CD Total
7 +5 **12**	8 +6 **14**	6 +6 **12**	8 +9 **17**

Item 9: 1 CD/14 CD Total	Item 10: 1 CD/15 CD Total	Item 11: 1 CD/16 CD Total	Item 12: 1 CD/17 CD Total
3 +2 **5**	2 +3 **5**	2 +2 **4**	5 +4 **9**

Item 13: 2 CD/19 CD Total	Item 14: 1 CD/20 CD Total	Item 15: 2 CD/22 CD Total	Item 16: 1 CD/23 CD Total
6 +4 **10**	3 +2 **5**	7 +8 **15**	1 +4 **5**

Item 17: 2 CD/25 CD Total	Item 18: 2 CD/27 CD Total	Item 19: 2 CD/29 CD Total	Item 20: 2 CD/31 CD Total
8 +8 **16**	4 +9 **13**	2 +9 **11**	3 +8 **11**

Curriculum-Based Assessment Mathematics
Single-Skill Computation Probe 2: Student Copy

Student: Date: _____

3 + 8	6 + 3	1 + 4	4 + 2
7 + 5	8 + 6	6 + 6	8 + 9
3 + 2	2 + 3	2 + 2	5 + 4
6 + 4	3 + 2	7 + 8	1 + 4
8 + 8	4 + 9	2 + 9	3 + 8

Curriculum-Based Assessment Mathematics
Single-Skill Computation Probe 3: Examiner Copy

Item 1: 1 CD/1 CD Total	Item 2: 1 CD/2 CD Total	Item 3: 1 CD/3 CD Total	Item 4: 2 CD/5 CD Total
3 +2 **5**	5 +1 **6**	3 +6 **9**	4 +7 **11**

Item 5: 2 CD/7 CD Total	Item 6: 1 CD/8 CD Total	Item 7: 1 CD/9 CD Total	Item 8: 1 CD/10 CD Total
7 +5 **12**	6 +3 **9**	1 +3 **4**	2 +7 **9**

Item 9: 1 CD/11 CD Total	Item 10: 1 CD/12 CD Total	Item 11: 2 CD/14 CD Total	Item 12: 2 CD/16 CD Total
1 +4 **5**	3 +1 **4**	7 +9 **16**	4 +6 **10**

Item 13: 2 CD/18 CD Total	Item 14: 1 CD/19 CD Total	Item 15: 2 CD/21 CD Total	Item 16: 1 CD/22 CD Total
4 +6 **10**	3 +5 **8**	7 +6 **13**	6 +2 **8**

Item 17: 1 CD/23 CD Total	Item 18: 2 CD/25 CD Total	Item 19: 1 CD/26 CD Total	Item 20: 2 CD/28 CD Total
1 +2 **3**	6 +9 **15**	6 +1 **7**	6 +4 **10**

Curriculum-Based Assessment Mathematics
Single-Skill Computation Probe 3: Student Copy

Student: Date: _____

3 + 2	5 + 1	3 + 6	4 + 7
7 + 5	6 + 3	1 + 3	2 + 7
1 + 4	3 + 1	7 + 9	4 + 6
4 + 6	3 + 5	7 + 6	6 + 2
1 + 2	6 + 9	6 + 1	6 + 4

Curriculum-Based Assessment Mathematics
Single-Skill Computation Probe 4: Examiner Copy

Item 1: 2 CD/2 CD Total	Item 2: 1 CD/3 CD Total	Item 3: 2 CD/5 CD Total	Item 4: 1 CD/6 CD Total
6 +5 **11**	2 +5 **7**	8 +7 **15**	1 +8 **9**
Item 5: 2 CD/8 CD Total	**Item 6: 2 CD/10 CD Total**	**Item 7: 2 CD/12 CD Total**	**Item 8: 1 CD/13 CD Total**
6 +7 **13**	8 +7 **15**	8 +2 **10**	4 +1 **5**
Item 9: 2 CD/15 CD Total	**Item 10: 1 CD/16 CD Total**	**Item 11: 2 CD/18 CD Total**	**Item 12: 2 CD/20 CD Total**
4 +6 **10**	1 +7 **8**	8 +3 **11**	7 +7 **14**
Item 13: 2 CD/22 CD Total	**Item 14: 1 CD/23 CD Total**	**Item 15: 1 CD/24 CD Total**	**Item 16: 2 CD/26 CD Total**
3 +7 **10**	2 +2 **4**	2 +2 **4**	7 +4 **11**
Item 17: 1 CD/27 CD Total	**Item 18: 1 CD/28 CD Total**	**Item 19: 1 CD/29 CD Total**	**Item 20: 1 CD/30 CD Total**
3 +2 **5**	1 +8 **9**	1 +1 **2**	2 +4 **6**

Curriculum-Based Assessment Mathematics
Single-Skill Computation Probe 4: Student Copy

Student: Date: _____

6 + 5	2 + 5	8 + 7	1 + 8
6 + 7	8 + 7	8 + 2	4 + 1
4 + 6	1 + 7	8 + 3	7 + 7
3 + 7	2 + 2	2 + 2	7 + 4
3 + 2	1 + 8	1 + 1	2 + 4

Curriculum-Based Assessment Mathematics
Single-Skill Computation Probe 5: Examiner Copy

Item 1: 2 CD/2 CD Total	Item 2: 1 CD/3 CD Total	Item 3: 2 CD/5 CD Total	Item 4: 2 CD/7 CD Total
4 +6 **10**	2 +7 **9**	3 +9 **12**	8 +5 **13**

Item 5: 1 CD/8 CD Total	Item 6: 1 CD/9 CD Total	Item 7: 2 CD/11 CD Total	Item 8: 2 CD/13 CD Total
2 +1 **3**	4 +3 **7**	6 +7 **13**	6 +5 **11**

Item 9: 1 CD/14 CD Total	Item 10: 1 CD/15 CD Total	Item 11: 1 CD/16 CD Total	Item 12: 1 CD/17 CD Total
5 +1 **6**	3 +3 **6**	3 +1 **4**	4 +1 **5**

Item 13: 1 CD/18 CD Total	Item 14: 1 CD/19 CD Total	Item 15: 1 CD/20 CD Total	Item 16: 2 CD/22 CD Total
3 +4 **7**	7 +2 **9**	6 +3 **9**	7 +6 **13**

Item 17: 2 CD/24 CD Total	Item 18: 2 CD/26 CD Total	Item 19: 1 CD/27 CD Total	Item 20: 1 CD/28 CD Total
5 +5 **10**	9 +4 **13**	1 +6 **7**	2 +6 **8**

Curriculum-Based Assessment Mathematics
Single-Skill Computation Probe 5: Student Copy

Student: Date: _____

4 + 6	2 + 7	3 + 9	8 + 5
2 + 1	4 + 3	6 + 7	6 + 5
5 + 1	3 + 3	3 + 1	4 + 1
3 + 4	7 + 2	6 + 3	7 + 6
5 + 5	9 + 4	1 + 6	2 + 6

Curriculum-Based Assessment Mathematics
Single-Skill Computation Probe 6: Examiner Copy

Item 1: 1 CD/1 CD Total	Item 2: 1 CD/2 CD Total	Item 3: 1 CD/3 CD Total	Item 4: 1 CD/4 CD Total
4 +3 **7**	1 +2 **3**	2 +7 **9**	1 +4 **5**
Item 5: 1 CD/5 CD Total	Item 6: 2 CD/7 CD Total	Item 7: 1 CD/8 CD Total	Item 8: 2 CD/10 CD Total
3 +2 **5**	7 +6 **13**	7 +2 **9**	9 +6 **15**
Item 9: 1 CD/11 CD Total	Item 10: 2 CD/13 CD Total	Item 11: 2 CD/15 CD Total	Item 12: 2 CD/17 CD Total
2 +4 **6**	5 +7 **12**	9 +8 **17**	6 +7 **13**
Item 13: 2 CD/19 CD Total	Item 14: 2 CD/21 CD Total	Item 15: 1 CD/22 CD Total	Item 16: 2 CD/24 CD Total
5 +5 **10**	7 +7 **14**	2 +1 **3**	2 +8 **10**
Item 17: 2 CD/26 CD Total	Item 18: 1 CD/27 CD Total	Item 19: 1 CD/28 CD Total	Item 20: 1 CD/29 CD Total
8 +4 **12**	1 +6 **7**	4 +1 **5**	2 +1 **3**

Curriculum-Based Assessment Mathematics
Single-Skill Computation Probe 6: Student Copy

Student: Date: _____

4 + 3	1 + 2	2 + 7	1 + 4
3 + 2	7 + 6	7 + 2	9 + 6
2 + 4	5 + 7	9 + 8	6 + 7
5 + 5	7 + 7	2 + 1	2 + 8
8 + 4	1 + 6	4 + 1	2 + 1

Curriculum-Based Assessment Mathematics
Single-Skill Computation Probe 7: Examiner Copy

Item 1: 1 CD/1 CD Total	Item 2: 1 CD/2 CD Total	Item 3: 2 CD/4 CD Total	Item 4: 1 CD/5 CD Total
3 +4 **7**	3 +5 **8**	2 +8 **10**	1 +6 **7**

Item 5: 2 CD/7 CD Total	Item 6: 2 CD/9 CD Total	Item 7: 1 CD/10 CD Total	Item 8: 2 CD/12 CD Total
5 +5 **10**	9 +2 **11**	6 +1 **7**	8 +2 **10**

Item 9: 2 CD/14 CD Total	Item 10: 2 CD/16 CD Total	Item 11: 2 CD/18 CD Total	Item 12: 1 CD/19 CD Total
6 +6 **12**	6 +6 **12**	9 +7 **16**	1 +4 **5**

Item 13: 2 CD/21 CD Total	Item 14: 1 CD/22 CD Total	Item 15: 2 CD/24 CD Total	Item 16: 1 CD/25 CD Total
8 +4 **12**	1 +7 **8**	8 +5 **13**	5 +4 **9**

Item 17: 1 CD/26 CD Total	Item 18: 1 CD/27 CD Total	Item 19: 1 CD/28 CD Total	Item 20: 1 CD/29 CD Total
4 +5 **9**	2 +7 **9**	4 +1 **5**	1 +4 **5**

Curriculum-Based Assessment Mathematics
Single-Skill Computation Probe 7: Student Copy

Student: Date: _____

3 + 4	3 + 5	2 + 8	1 + 6
5 + 5	9 + 2	6 + 1	8 + 2
6 + 6	6 + 6	9 + 7	1 + 4
8 + 4	1 + 7	8 + 5	5 + 4
4 + 5	2 + 7	4 + 1	1 + 4

Curriculum-Based Assessment Mathematics
Single-Skill Computation Probe 8: Examiner Copy

Item 1: 1 CD/1 CD Total	Item 2: 2 CD/3 CD Total	Item 3: 1 CD/4 CD Total	Item 4: 2 CD/6 CD Total
4 +1 **5**	3 +8 **11**	4 +2 **6**	8 +2 **10**
Item 5: 2 CD/8 CD Total	Item 6: 1 CD/9 CD Total	Item 7: 2 CD/11 CD Total	Item 8: 1 CD/12 CD Total
2 +8 **10**	3 +2 **5**	4 +8 **12**	4 +3 **7**
Item 9: 1 CD/13 CD Total	Item 10: 1 CD/14 CD Total	Item 11: 2 CD/16 CD Total	Item 12: 2 CD/18 CD Total
3 +3 **6**	3 +3 **6**	8 +2 **10**	7 +3 **10**
Item 13: 2 CD/20 CD Total	Item 14: 2 CD/22 CD Total	Item 15: 1 CD/23 CD Total	Item 16: 2 CD/25 CD Total
2 +8 **10**	2 +8 **10**	4 +3 **7**	3 +7 **10**
Item 17: 1 CD/26 CD Total	Item 18: 2 CD/28 CD Total	Item 19: 1 CD/29 CD Total	Item 20: 2 CD/31 CD Total
1 +6 **7**	2 +8 **10**	5 +4 **9**	7 +7 **14**

Curriculum-Based Assessment Mathematics
Single-Skill Computation Probe 8: Student Copy

Student: Date: _____

4 + 1	3 + 8	4 + 2	8 + 2
2 + 8	3 + 2	4 + 8	4 + 3
3 + 3	3 + 3	8 + 2	7 + 3
2 + 8	2 + 8	4 + 3	3 + 7
1 + 6	2 + 8	5 + 4	7 + 7

Curriculum-Based Assessment Mathematics
Single-Skill Computation Probe 9: Examiner Copy

Item 1: 1 CD/1 CD Total	Item 2: 1 CD/2 CD Total	Item 3: 1 CD/3 CD Total	Item 4: 2 CD/5 CD Total
6 +1 **7**	5 +4 **9**	1 +5 **6**	8 +5 **13**

Item 5: 2 CD/7 CD Total	Item 6: 2 CD/9 CD Total	Item 7: 2 CD/11 CD Total	Item 8: 1 CD/12 CD Total
9 +8 **17**	8 +8 **16**	7 +7 **14**	1 +4 **5**

Item 9: 1 CD/13 CD Total	Item 10: 1 CD/14 CD Total	Item 11: 1 CD/15 CD Total	Item 12: 2 CD/17 CD Total
3 +4 **7**	4 +1 **5**	3 +3 **6**	5 +9 **14**

Item 13: 2 CD/19 CD Total	Item 14: 2 CD/21 CD Total	Item 15: 2 CD/23 CD Total	Item 16: 2 CD/25 CD Total
8 +4 **12**	8 +5 **13**	5 +7 **12**	2 +8 **10**

Item 17: 1 CD/26 CD Total	Item 18: 1 CD/27 CD Total	Item 19: 1 CD/28 CD Total	Item 20: 2 CD/30 CD Total
2 +2 **4**	6 +3 **9**	3 +3 **6**	5 +5 **10**

Curriculum-Based Assessment Mathematics
Single-Skill Computation Probe 9: Student Copy

Student: Date: _____

6 + 1	5 + 4	1 + 5	8 + 5
9 + 8	8 + 8	7 + 7	1 + 4
3 + 4	4 + 1	3 + 3	5 + 9
8 + 4	8 + 5	5 + 7	2 + 8
2 + 2	6 + 3	3 + 3	5 + 5

Curriculum-Based Assessment Mathematics
Single-Skill Computation Probe 10: Examiner Copy

Item 1: 2 CD/2 CD Total	Item 2: 1 CD/3 CD Total	Item 3: 1 CD/4 CD Total	Item 4: 2 CD/6 CD Total
5 +7 **12**	7 +2 **9**	3 +2 **5**	6 +4 **10**

Item 5: 1 CD/7 CD Total	Item 6: 2 CD/9 CD Total	Item 7: 1 CD/10 CD Total	Item 8: 2 CD/12 CD Total
6 +1 **7**	8 +4 **12**	4 +2 **6**	6 +4 **10**

Item 9: 1 CD/13 CD Total	Item 10: 1 CD/14 CD Total	Item 11: 1 CD/15 CD Total	Item 12: 1 CD/16 CD Total
3 +2 **5**	6 +1 **7**	1 +3 **4**	1 +1 **2**

Item 13: 2 CD/18 CD Total	Item 14: 2 CD/20 CD Total	Item 15: 2 CD/22 CD Total	Item 16: 2 CD/24 CD Total
7 +9 **16**	6 +8 **14**	8 +2 **10**	2 +9 **11**

Item 17: 1 CD/25 CD Total	Item 18: 1 CD/26 CD Total	Item 19: 2 CD/28 CD Total	Item 20: 2 CD/30 CD Total
5 +2 **7**	2 +4 **6**	7 +3 **10**	7 +4 **11**

Curriculum-Based Assessment Mathematics
Single-Skill Computation Probe 10: Student Copy

Student: Date: _____

5 + 7	7 + 2	3 + 2	6 + 4
6 + 1	8 + 4	4 + 2	6 + 4
3 + 2	6 + 1	1 + 3	1 + 1
7 + 9	6 + 8	8 + 2	2 + 9
5 + 2	2 + 4	7 + 3	7 + 4

Form B- Parent/Guardian Informed Consent Form

Dear Parents/Guardians,

I am a special education teacher in your child's classroom at Warner. In addition, I am currently a graduate student at Asbury College in Wilmore, Kentucky, working on my Masters of Arts degree in Special Education. I am conducting an educational research study on the Touchmath addition strategy. Touchmath involves numbers with touch points related to its quantity. The students follow rules and touch the points on the numbers to solve equations.

The student counts aloud and touches during solving. This study will teach the Touchmath strategy to your student. They will participate in typical math class and instruction with the added bonus of the Touchmath intervention. During four weeks, the computation quizzes will be graded to see if the Touchmath strategy benefits their addition performance. Finally, the Touchmath posters will be removed during the last week, to see if the strategy is still beneficial. The study will last six weeks.

No participants will be identified by their names. They will be identified as "subject A" or "subject B". Only the subject, the subject's parent/guardian, homeroom teacher, and myself will have access their real identity.

In order for your child to participate in this study, you will need to sign and date the appropriate line at the bottom. If you have any questions please feel free to contact me at

dmays@jessamine.k12.ky.us, or at 859-885-3085

Sincerely,

Deborah Mays
Special Education Teacher
Warner Elementary School

I give my child _____ permission to participate in the study.
(Child's name)

_____ _____
(Child's signature) (Date)

_____ _____
(Parent/Guardians Signature) (Date)

I do not give my child _____ permission to participate in the study.
(Child's name)

_____ _____
(Child's Signature) (Date)

_____ _____
(Parent/Guardian Signature) (Date)

Appendix C – Information

Information A- Touchmath Touchpoint Counting Order

Touchpoints

TOUCHING AND COUNTING

Prerequisites

- ***Counting***
- ***Numeral identification 1-9***

The Teaching Process

When demonstrating the touching/counting process:

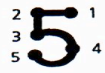
1. The one is touched at the top while counting: "One."

2. The two is touched at the beginning and the end of the numeral while counting: "One, two."

3. The three is touched at the beginning, middle and end of the numeral while counting: "One, two, three."

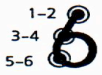
4. The four is touched and counted from top to bottom on the down strokes while counting: "One, two, three, four."

5. The five is touched and counted in the order pictured: "One, two, three, four, five." The fourth Touchpoint may be referred to as the "belly button" to help students remember it.

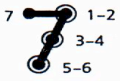


TOUCHING AND COUNTING *(Continued)*

6. The six begins the use of dots with circles. The encircled dots should be touched and counted twice, whenever they appear. Six is touched and counted from top to bottom: "One-two, three-four, five-six."

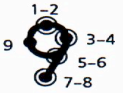


7. The seven is touched and counted from top to bottom: "One-two, three-four, five-six," followed by the single dot: "seven." The single Touchpoint can be thought of as the nose. Teachers sometimes tell young or remedial students to "touch him on the nose" to help them remember the final Touchpoint.

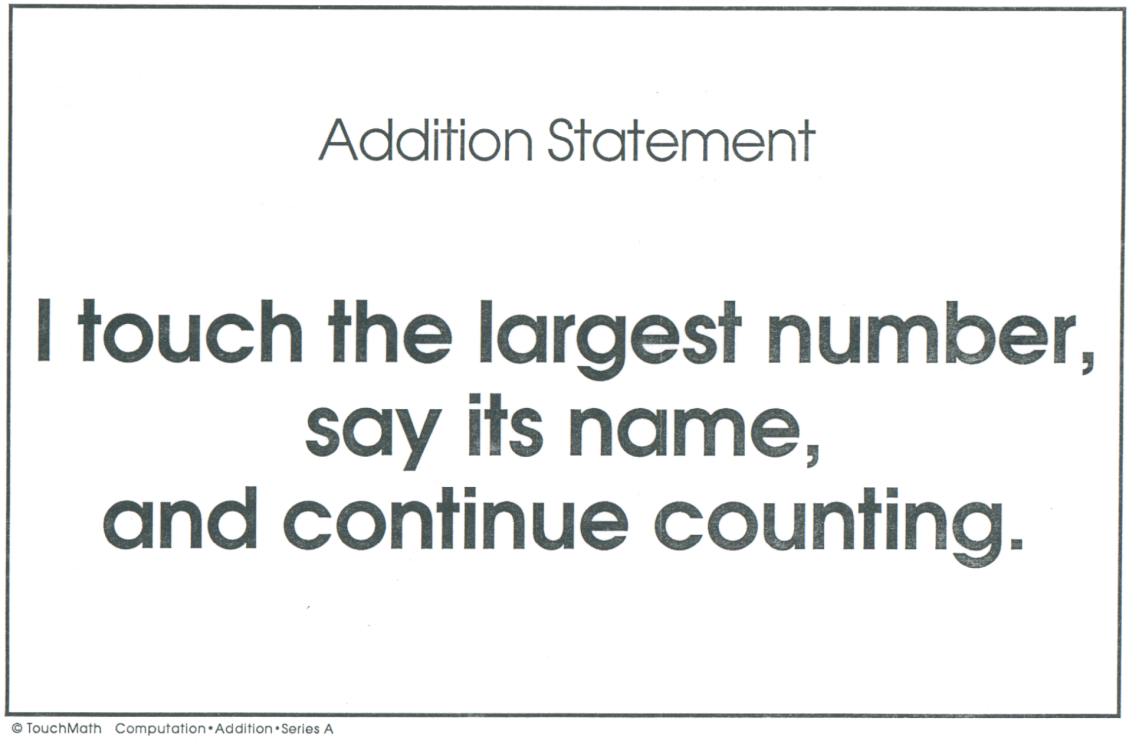


8. The eight is touched and counted from left to right: "One-two, three-four, five-six, seven-eight." Tell the young or remedial students that the eight looks like a robot. Count his head first, and then his body.

9. The nine is touched and counted from top to bottom: "One-two, three-four, five-six, seven-eight," followed by the single dot: "nine." Tell young or remedial students that the nine is the only number with a "hat". They should start counting on the "hat" and count straight down the number. Again, the single Touchpoint can be thought of as the nose.



Information B- Touchmath Addition Rule Statement


Addition Statement
I touch the largest number,
say its name,
and continue counting.
© TouchMath Computation • Addition • Series A

Appendix D – Completed Forms and Scores

Data Sheet B- Independent Variable Sheet

Independent Variable Reliability Sheet

Administration procedures for the independent variable follow:

X	Permission from institutional review board	
X	Permission from school district	
X	Permission from parents	
Week One		**Baseline**
	Tuesday	
	_X_	Assessment #5- Baseline probe
Week Two		**Intervention**
	Monday	
	_X_	-Teach touchpoints 1-3- Show number posters - post in room.
	_X_	-Discuss -Practice placing counters on the touchpoints and practice counting touchpoints as a class
	_X_	-Demonstrate addition with the touchpoints as a class
	_X_	-Have the students say the addition problem and count and answer it aloud
	___X	Assessment #' 6
	Tuesday	
	_**X**_	-Teach touchpoints 4-5- Show number posters, have kids touch touchpoints by skywriting as a class- and post in room.
	_**X**_	-Draw the numbers with touch points with dry erase on desk and practice counting touchpoints as a class
	_**X**_	-Demonstrate addition with the touchpoints as a class
	_**X**_	-Students practice addition with touchpoints by writing on desk and answering as a class
		Assessment #'9
	Wednesday	
	_**X**_	-Teach touchpoints 6-7- Show number posters, have kids touch touchpoints by skywriting as a class- and post in room.
	_**X**_	-Use reversible flashcards by showing the side of the card with touchpoints, asking for them to count and give a verbal answer, and flipping the card over

		and repeating answer.
	__X_	Give a few minutes for the students to work in partners and practice adding the numbers.
	__X_	Assessment #'10
	Thursday	
	__X_	-Teach touchpoints 8-9- Show number posters, have kids touch touchpoints by skywriting as a class- and post in room.
	X	
	___X	-Use reversible flashcards by showing the side of the card with touchpoints, asking for a verbal answer, and flipping the card over and asking for the answer again. Have the students say the problem and answer it aloud.
	_X	
	__X	Give a few minutes for the students to work in partners and practice adding the numbers.
	X	-Assessment #'3
	Friday	
	__X_	-Students practice addition flashcards with touchpoints as a center activity
Week Three		**Intervention**
	Monday	
	_X__	-Review Touch Points- show and practice counting with strips on desk
	_X__	-Teach Addition Rule- tell students the rule and demonstrate that they do not have to count the highest number
	_X__	- Students practice addition with touchpoints using the rule. The students all have a chance to demonstrate and answer a problem aloud.
	_X__	Assessment #'2
	Tuesday	
	__X_	-Review Addition Rule- tell students the rule and demonstrate that they do not have to count the highest number
	__X_	Students practice addition with touchpoints using the rule. The students all have a chance to demonstrate and answer a problem aloud.
	__X_	Assessment #'4
	Wednesday	
	_X__	-Review Addition Rule- students repeat the rule and teacher demonstrates an

		addition problem again.
	_X__	- Students practice addition with touchpoints with a partner using the rule
		Have the students say the problem and answer it aloud
	_X__	Assessment #'8
	Thursday	
	__X_	-Review Touch Points- have the students place the dots on the number on board
		or Smartboard.
	__X_	-Review Addition Rule- restate the rule
	__X_	- Students practice addition with touchpoints with a partner using the rule
		Have the students say the problem and answer it aloud
	__X_	Assessment #'1
	Friday	
	__X_	-Students practice addition flashcards with touchpoints as a center activity
Week Four		**Intervention**
	Monday	
	__X_	- Play around the world.
	__X_	Assessment # 7
	Tuesday	
	_X__	- Students practice addition with regular flashcards with a partner
	_X__	-Assessment #5
	Wednesday	
	_X__	- Play around the world.
	__X_	-Assessment #3
	Thursday	
	__X_	- Play a timed addition game on the Smartboard/computer
	__X_	-Assessment #9
	Friday	
	__X_	-Students practice addition flashcards as a center activity
Week Five		**Intervention**
	Monday	
	_X__	Assessment # 2

	Tuesday **_X__**	Assessment #10
	Wednesday **_X__**	Assessment #6
	Thursday **__X_**	Assessment #4
	Friday **__X_**	-Students practice addition flashcards with touchpoints as a center activity
Week Six		**Maintenance-**
	Monday **_X__**	Assessment #1
	Tuesday **__X_**	Assessment #7
	Wednesday **_X__**	Assessment #8
	Thursday **_X__**	Assessment #3
	Friday **_X__**	Finished.

Data Sheet C- **Inter Rater Recording Reliability Sheet**

Name of observers: Johnson, Mays, Egan

Month/Year: September 2007

		Observer 1	Observer 2	% agreement
Set of quizzes	Set 1	100%	95%	95%
	Set 2	100%	100%	100%
	Set 3	100%	97%	97%
	Set 4	100%	100%	100%
TOTAL INTERRATER RELIABILITY %: **100%**				

Data Sheet D- **Class Data Recording Sheet**
Class A

Students	day 1	day 2	day 3	day 4	day 5	day 6	day 7	day 8	day 9	day 10
A	30	28	27	47	43	35	20	71	4	90
B	29	34	27	30	25	29	40	42	36	55
C	36	24	27	20	29	35	30	68	36	69
D	39	14	30	13	43			58	32	62
E	71	72	43	87	89	67	40	100	89	86
F	64	24	50	53	43	54	60			76
G	0	10	30	23	36	29	17	13	18	24
H	39	62	38	53	46	35	37	71	50	76
I	32	17	13	37	21	35	27	39	7	55
J	50	52	57	67	79	61	80	87	79	86
K	18	28	17	23	11	25	20	65	57	76
L	61	28	23	23	24	35	60	84	75	83
M	25	24	10	27	14	32	37	71	21	79
N	64	28	17	23	39	51	37	74	39	72
O	46	31	17	40	46	29	43	52	36	66
P	39	38	50	30	57	48	37	100	43	76
Q	29	14	6	20	43	22	20	68	50	55
R	71		43	77	61	65	43	94	50	66
Class Average	41	31	29	39	42	40	38	68	42	70

Class Data Recording Sheet cont'
Class A

Students	day 11	day 12	day 13	day 14	day 15	day 16	day 17	day 18	day 19	day 20	day 21
A	68	50	63	55	73	41	53	64	50	97	90
B	61	46	53	58	70	69	67	68	54	83	71
C	50	50	50	55	60	48	47	54	57	93	90
D	64	68	40	55	87	69	53	57	57	83	94
E	100	96	50	65	66	55	66	64	68	100	100
F	93	79	87	71	93	97	100	79	75	100	100
G	18	21	17	13	17	21	13	25	25	21	29
H	100	75	50	65	53	62	93	86	86	97	94
I	39	50	37	61	60	52	43	64	50	90	77
J	68	54	60	65	93	83	70	68	82		94
K	61	61	37	55	60	66	63	50	71	90	48
L	71	71	63	61	73	66	70	75	64	76	84
M	50	71	60		47	52	60	46	46	90	90
N	61	71	53	55	80	86	60	64	75	86	
O	61	46	47	55	53	52	50	50	61	83	74
P	64	68	67	61	73	72	77	82	61	100	100
Q	57	46	60	26	47	31	30	50	39	59	71
R	75	57	57	77	67	83	87	64	100		94
Class Average	65	60	53	56	65	61	61	62	62	84	82

Class Data Recording Sheet
Class B

Students	day 1	day 2	day 3	day 4	day 5	day 6	day 7	day 8	day 9	day 10
A	25	14	10	10	14	19	0	35	21	34
B	29	48	53	50	29	42	53	94	54	87
C	57	66	77	30	75	68	97	100	79	100
D	25	17	13	23		42	43	32	29	66
E	61	100	100	97	100	100	93	100	100	100
F	43	48	53	33	36	48	30	68	50	66
G	86	55	53	87	64	45	80	100	71	97
H	18	24	17	10	25	32	23	35		55
I	54	24	47	77	32	42	53	48	50	55
J	89	66	63	30	29	35	43	77	82	86
K	36	24	50	40	43	35	43	58	57	90
L	43	38	23	40	11	29	33	52	54	79
M	7	17	3	3	11	6	6	19	11	14
N	39	24	20	40	43	16	17	38	36	59
O	57	45	63	40	46	45	73	100	29	97
P	57	45	46	40	21	35	27	52	39	55
Q	54			77	75	65	77	84	71	100
Class Average	45	41	45	43	41	41	45	63	54	71

Class Data Recording Sheet cont'
Class B

Students	day 11	day 12	day 13	day 14	day 15	day 16	day 17	day 18	day 19	day 20	day 21
A	36	21	50	45	52	52		61	11	76	45
B	64	46	80	45	47	76	73	39	57	72	81
C	96	100	97	74	100	100	100	96	96	100	100
D	43	25	43	45	60	45	60	50	54	66	58
E	96	100	100	100	100	100	83	96	100	100	100
F	50	54	67	42	47	48	47	43	61	66	81
G	86	85	100	61		97	87	100	75	100	100
H	46	46	60	35	43	28	20	50	50	59	71
I	55	43	53	42	67	62	73			79	87
J	100	82	83	55	60	83	73	79	79	97	100
K	46	54	53	52	60	69	53	50	54	83	97
L	54	54	50	26	47	41	67			52	65
M	18	7	17	13	20	34	17	14	14	38	35
N	36	50	40	52	53	83	30	43	50	86	
O	46	64	47	39	43	31	37	39	46	76	
P	89	93	90	77	73	97	87	100	100	100	100
Q											
R											
Class Average	60	58	64	50	55	65	60	61	61	78	80

Data Sheet E- **Inter Rater Recording Reliability**

Teacher Observation Sheet

Observer 1

	Students using Touchmath
Day 1- Student 1	Yes
Day 2- Student 2	Yes
Day 3- Student 3	Yes
Day 4- Student 4	Yes

Observer 2

	Students using Touchmath
Day 1- Student 1	Yes
Day 2- Student 2	Yes
Day 3- Student 3	Yes
Day 4- Student 4	Yes

Interobserver agreement

	Observer 1	Observer 2	Interobserver Agreement %
Day 1- Student 1	Yes	Yes	100%
Day 2- Student 2	Yes	Yes	100%
Day 3- Student 3	Yes	Yes	100%
Day 4- Student 4	Yes	Yes	100%

Data Chart A-Class A Average Computation Scores

Days	Goal	Baseline- A	Intervention-	Maintenance	Trendline- A
0					
1	80				
2	80				
3	80	41			31.8025651
4	80				33.465138
5	80				35.1277108
6	80		31		36.7902837
7	80		29		38.4528566
8	80		39		40.1154295
9	80		42		41.7780023
10	80				43.4405752
11	80		40		45.1031481
12	80		38		46.7657209
13	80		68		48.4282938
14	80		42		50.0908667
15	80				51.7534396
16	80		70		53.4160124
17	80		65		55.0785853
18	80		60		56.7411582
19	80		53		58.4037311
20	80				60.0663039
21	80		56		61.7288768
22	80		65		63.3914497
23	80		61		65.0540225
24	80		61		66.7165954
25	80				68.3791683
26	80			62	70.0417412
27	80			62	71.704314
28	80			84	73.3668869
29	80			82	75.0294598

Data Chart B- Class B Average Computation Scores

Days	Goal	Baseline- A	Intervention-	Maintenance	Trendline- A
0					
1	80				
2	80				
3	80	45			39.6591527
4	80				40.8596969
5	80				42.060241
6	80		41		43.2607851
7	80		45		44.4613292
8	80		43		45.6618733
9	80		41		46.8624174
10	80				48.0629615
11	80		41		49.2635056
12	80		45		50.4640497
13	80		63		51.6645939
14	80		54		52.865138
15	80				54.0656821
16	80		71		55.2662262
17	80		60		56.4667703
18	80		58		57.6673144
19	80		64		58.8678585
20	80				60.0684026
21	80		50		61.2689468
22	80		55		62.4694909
23	80		65		63.670035
24	80		60		64.8705791
25	80				66.0711232
26	80			61	67.2716673
27	80			61	68.4722114
28	80			78	69.6727555
29	80			80	70.8732997

Data Chart C- Class A Average Error Scores

Days	Baseline	Interventio	Maintenan	Trendline
0				
1	0.65			0.878831
2		1.1		0.858805
3		1.05		0.838779
4		0.76		0.818753
5		0.81		0.798727
6		0.75		0.778701
7		0.8		0.758675
8		0.42		0.738649
9		0.75		0.718623
10		0.71		0.698597
11		0.52		0.678571
12		0.81		0.658545
13		0.9		0.638519
14		0.7		0.618494
15		0.43		0.598468
16		0.48		0.578442
17		0.57		0.558416
18			0.48	0.53839
19			0.43	0.518364
20			0.37	0.498338
21			0.76	0.478312

Data Chart D- Class B Average Error Scores

Days	Baseline	Interventio	Maintenan	Trendline
0				
1	1.57			1.407706
2		0.79		1.370602
3		1.1		1.333498
4		1.48		1.296394
5		1		1.25929
6		1.48		1.222186
7		1.33		1.185082
8		1.33		1.147978
9		1.35		1.110874
10		1.19		1.073771
11		1.09		1.036667
12		1		0.999563
13		0.95		0.962459
14		0.95		0.925355
15		0.94		0.888251
16		1		0.851147
17		0.58		0.814043
18			0.71	0.776939
19			0.83	0.739835
20			0.6	0.702732
21			0.5	0.665628

Data Chart E- Learning Disability Average Computation Scores

Days	Baseline	Interventior	Maintenan	Trendline
0				
1	42			28.56797
2		28.5		30.55426
3		24		32.54056
4		35.4		34.52686
5		32.2		36.51316
6		36.6		38.49946
7		33		40.48576
8		49.8		42.47206
9		35		44.45835
10		61		46.44465
11		53		48.43095
12		43.4		50.41725
13		51.4		52.40355
14		52.8		54.38985
15		56.4		56.37615
16		57.4		58.36245
17		72		60.34874
18			53.6	62.33504
19			54.4	64.32134
20			76.75	66.30764
21			68.4	68.29394