5th Grade Students Who Received an Additional Ten Minutes of Multiplication Flash Card Drill Intervention Daily For Eight Weeks Will Have a Higher Post Assessment Score

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A Special Project

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FACULTY APPROVAL

5th Grade Students Who Received an Additional Ten Minutes of Multiplication Flash Card Drill Intervention Daily For Eight Weeks Will Have a Higher Post Assessment Score

Approved for the Faculty

_____, Faculty Advisor

_____, Date

ABSTRACT

The purpose of the project was to prove that 5th grade students who received an additional ten minutes of multiplication fact drill for eight weeks scored higher on their post assessment test. There were a total of sixty-five 5th grade students who took a multiplication fact pre-test that had 100 problems with facts that ranged from zero to twelve within ten minutes. Based upon the multiplication fact pre-test scores, sixteen (seven females and nine males) fifth grade students who scored below 80% were in the treatment group. The treatment group received multiplication fact intervention for eight consecutive weeks. The researcher then collected data from groups, treatment group (received an additional ten minutes of multiplication flashcard drill intervention outside the math block) and control group (did not receive an additional ten minutes of multiplication flashcard drill intervention daily). The result of the study was reliant upon the dependent variable because of the change or difference of the groups that occurred due to the independent variable. It was concluded that the treatment group scored significantly higher on their post-test compared to their pre-test within an eight week span of ten minutes of multiplication flashcard intervention. Furthermore, students' confident level also increased after the eight-week intervention.

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CHAPTER 1

Introduction

Background for the Project

The No Child Left Behind (NCLB) Act required students to meet a number of academic targets and schools to meet up to 37 requirements each year to achieve Annual Yearly Progress (AYP). The belief was that setting high standards and establishing measurable goals would improve individual outcome in education. The number of Washington schools on the federal needs improvement list nearly doubled growing from 618 in 2008 to 1,073 in 2009. Math and Science Washington Assessment of Student Learning (WASL) scores continued to be areas of serious concerns.

For the past five years, Highline School District's (HSD) main academic concern was in reading; however, the pendulum has swung over to math due to schools not meeting AYP. In fact, six Highline schools faced sanctions under the federal NCLB law as a result of their 2009 WASL scores. If the school did not show improvement, the school faced increasing sanctions that included replacement of the principal and teachers. Fortunately, White Center Heights (WCH) elementary school was not on the list of schools that faced sanctions, but has struggled with meeting AYP for the past two years—specifically in math. In 2009,

WCH students from third to sixth grade scored well below the state average (SA) on the WASL test. According to the Office of Superintendent Office (OSPI), third grade had 33% passing (SA: 66%), fourth grade 26% (SA: 52%), fifth grade 32% (SA: 62%), and sixth grade 29% (SA: 51%).

Since WCH had not met AYP for the past two years, under the federal NCLB law, students attended a Title I school designated as in need of improvement had the right to attend a higher performing school in the district. In response to the federal law, Highline School District decided to take action by re-evaluating and reassessing the current math curriculum to meet state standards. Highline finally realized that the current math curriculum Investigations for grades Kindergarten through fifth grade and Connected Math Program (CMP) for grades sixth through twelve was not meeting state math standards due to a lack of a huge component, which was number sense. As a result, new math curricula (Do the Math, Origo, Bridges) was adopted and each school was required to complete a school improvement plan (SIP).

Statement of the Problem

Highline School District current math curriculum Investigations (K-5th) and CMP (6th -12th) provided students with enough number sense skills and practice to progress to the next grade level. Investigations required students to solve math problems in a creative, non-algorithmic

way, but not all students performed and thought in that manner. The lack of automaticity and basic fluency in multiplication facts impacted students' abilities to compute answers to situations involving whole numbers including fractions and decimals. Due to students who performed below grade level, it was reasonable to assume that teachers' responsibilities were to prepare and design a curriculum that supported low ability students; however, teachers were unaware of which interventions were appropriate for students who struggled with number sense.

In order to meet state standards and AYP, a well-developed math curriculum needed to be chosen with adequately trained teachers, but how did a school district choose the best one? School districts were offered math programs to adopt, but most programs lacked vital components such as traditional mathematic instructions. Investigations and CMP did not prove to be the best math curriculum that emphasized and promoted best practices for number sense.

White Center Heights (WCH) had a high population of diversity, poverty, and low-income students. White Center Heights did not have a Parent-Teacher-Association (PTA), but had a Parent-Teacher-Organization (PTO). The PTO was formed because there were only three to five parents who participated due to language and cultural barriers, and

socio-economic issues. Ten to eleven year old fifth graders tended to struggle not just academically, but also emotionally and mentally. Students' educations were impacted by invisible factors such as their home environment and lack of resources.

Purpose of the Project

The purpose of the study was to determine the effectiveness of the experimental study with a group of 5th graders who received additional multiplication flash card drill intervention for eight weeks. In order to improve 5th grade students' computational fluency in multiplication (and ultimately their performance on standardized assessments), the researcher implemented the multiplication flash cards strategy. This strategy taught a group of 5th grade students to use auditory and visual cues for ten minutes of multiplication drill practice daily. Sixteen students who scored below 80% on their multiplication pre-assessment test were introduced to and utilized the multiplication flash cards on a daily basis over an eight-week period. The students' multiplication progress was measured before, during, and after the intervention using a computer generated multiplication fact drill worksheet from facts zero to twelve. As a result of multiplication flash card strategy, fifth grade students who scored below 80% on their pre-assessment were expected to increase their computational fluency in multiplication scores on their post-test.

Delimitations

The test used to measure the students' computational fluency in multiplication was computer generated worksheet from a website (www.math-drill.com). The scores from the test indicated whether the student did not have computational fluency in multiplication if their score was below 80%. The data were collected from all 66 5th grade students on January 1, 2010 to February 26, 2010. The group of sixteen 5th grade students was divided into two groups of eight students. Student who were part of the experimental study were from two other 5th grade classrooms. The intervention of the first group took place in an open area in the pod and at 1:40pm. The second group received intervention in the same place, but at 2:00pm. After the first three weeks, one student dropped out of the intervention and another student went to Iraq for three weeks. The white boards that the students used to write their answer could be seen by others who may have copied their peer's answer and then reported that they scored 100%.

Assumptions

The benefits of the experimental study were that the intervention had a positive emotional, social, and academic impact on the students in the study group. Students in the treatment group arrived with a positive attitude and tried their best to reach their goal. Students were eager to

attend and were not frustrated that they missed class or recess time to be a part of the study. The fifth graders were ready to learn. The flash card intervention that the researcher used was age appropriate for 5th grade students. Students in the treatment group showed significant gains on their post-assessment scores.

Hypothesis or Research Question

Fifth grade students who received an additional ten minutes of multiplication flash card drill intervention daily for eight weeks had a significantly higher post assessment score. As students progressed through each grade level, math facts were critical in order to perform higher-level math skills.

Null Hypothesis

Fifth grade students who receive ten minutes of multiplication flash card drill intervention daily for eight weeks showed no significant difference on their post assessment scores. The significance was determined by $p \geq .05, .01, .001$.

Significance of the Project

The WASL results from 2009 indicated that students in grades three to six scored well below the state average. The current math curricula, Investigation and Connected Math Program, had not met the needs of struggling students. The math curricula had more of a

constructivist model, which was to solve math problems in a creative, non-algorithmic way, but not all students performed and thought in that manner—especially English Language Learners (ELL).

In order for students to progress into the next grade level, students needed to have a solid foundation for number sense, specifically multiplication facts. The deficit of automaticity and basic fluency in multiplication facts impacted students' abilities to compute answers to situations involving whole numbers including fractions and decimals. As a result, back-to-basics needed to be integrated and implemented for students' success.

Procedure

One week prior to Christmas break; the researcher scheduled a meeting with the principal, Dave Darling, to ask permission for conducting the experimental study on 5th grade students in the following classes: Karen Lai, SeAnn Sivly, and Tien Vo's classes. Once the permission was granted, the researcher scheduled another meeting with the other two fifth grade teachers who also granted permission to do the experimental study on their fifth grade students. The researcher used technology to generate a multiplication fact worksheet that had multiplication facts from zero to twelve. A pre-test was given on January 1, 2010 to all 66 fifth graders in Sivly, Vo, and Lai's classes. Based upon the data from the pre-test, sixteen

students who scored below 80% were selected for the treatment group who will receive an additional ten minutes of multiplication flash card drill intervention. The remaining fifty students, who did not receive an additional ten minutes of multiplication flash card drill intervention, were in the control group. The sixteen students, who were selected for the treatment group, were divided into two groups of eight students. After four weeks of intervention, the researcher administered a mid-test on January 29, 2010 to all 66 fifth grade students. The researcher continued the additional ten minutes of multiplication flash card drill intervention for another four weeks. In total, the treatment group received an additional ten minutes of multiplication flash card drill intervention for a period of eight weeks. After the intervention, the researcher administered the post-test on February 26, 2010 to all 66 fifth grade students to see if the null hypothesis was accepted or rejected and if the hypothesis was supported or not supported.

Definitions of Terms

assessment. Assessment was defined as the act of assessing; appraisal, or evaluation. (dictionary.reference.com)

auditory. Auditory was defined as perceived through or resulting from the sense of hearing. (dictionary.reference.com)

curriculum. Curriculum was defined as the aggregate of courses of

study given in a school, college, university. (dictionary.reference.com)

intervention. Intervention was defined as the act or fact of intervening. (dictionary.reference.com)

number sense. Number sense was defined as a cluster of ideas, such as the meaning of a number, ways of representing numbers, relationships among numbers, the relative magnitude of numbers, and skills in working with them. (dictionary.reference.com)

pod. Pod was defined as a streamlined enclosure, housing, or detachable container of some kind. (dictionary.reference.com)

strategy. Strategy was defined as a plan, method, or series of maneuvers or stratagems for obtaining a specific goal or result. (dictionary.reference.com)

visual. Visual was defined as pertaining to seeing or sight, perceptible by the mind, of the nature of a mental vision. (dictionary.reference.com)

Acronyms

AYP. Annual Yearly Progress

CMP. Connected Math Program

CT. Control Group

ELL. English Language Learner

EM. Everyday Math

HB. Harcourt Brace

HM. Houghton Mifflin

HSD. Highline School District

IEP. Individual Education Program

MAP. Measurement of Academic Progress

NCLB. No Child Left Behind

NCTM. National Council of Teachers of Mathematics

OSPI. Office of Superintendent Office

PTA. Parent-Teacher-Association

PTO. Parent-Teacher-Organization

SA. State Average

SF. Scott Foresman

SIP. School Improvement Plan

TERC. Technical Education Research Center

TP. Taped-Problem

TG. Treatment Group

WASL. Washington Assessment of Student Learning

WCH. White Center Heights

CHAPTER 2

Review of Selected Literature

Introduction

The literature review addressed three areas related to students who lacked the basic foundation of number sense skills and practice, specifically fluency in basic multiplication facts, to progress to the next grade level. Many students who entered 5th grade were deficient in computational fluency. Computational fluency consisted of having efficient, flexible, and accurate methods for computing. One thing that was really important to acknowledge was that computing was not all about paper and pencil. Students should be fluent in mental math, paper and pencil methods, and use of technology such as calculator in computing answers to situations involving whole numbers including fractions and decimals. As a result, students tended toward apathy, low self-esteem and confidence, behavior issues, and fell further behind in the education system, which later lead to higher dropout rates.

In the first section, research studies related to the impact of teachers providing students who struggled with number sense, specifically basic multiplication facts, with appropriate interventions were addressed. The second section focused on research studies about best practices for teaching number sense the old school way or the new. Finally, the third

section discussed research related to how students struggled academically, emotionally, and mentally brought upon by invisible factors that impeded students' learning such as poverty, lack of parent involvement, and home environments that caused stress.

Interventions or Lack of

There was a huge discrepancy among what our students needed to know by the end of the school year and what students learned in order to succeed into the next grade level. It was essential for students, especially at the Kindergarten level, to have these skills and strategies of mental math. By the time student reached the intermediate level of elementary schools; they needed to have a solid foundation of computational fluency (O'Brien, 2007). By the end of 5th grade, students needed to compute fluently with whole numbers because the curricular emphasis in these grades shifts to algebra, students were required to integrate and extend skills learned in prior years (Ketterlin-Geller, Chard, Fien, 2008). Many complex or higher level math tasks require students to complete basic facts (McCallum, Skinner, Turner, and Saecker, 2005). One of the components of algebra was procedural fluency with computational skills (Ketterlin-Geller, Chard, Fien, 2008).

McCallum, Skinner, and Hutchins (2004) developed the taped-problems (TP) interventions to enhance multiplication fact fluency. Many

students used time-consuming counting strategies to solve basic math facts. For example, when presented with the problem 2 x 9=___, students reverted to counting by multiples of 2's. That procedure allowed students to arrive at the correct answer and promoted a conceptual understanding of basic math operations; they may also prevent students from developing automaticity (McCallum et al. 2006). The TP intervention allowed students to listen to a series of multiplication facts and answers from an audiotape. Instead of listening and answering along with the audiotape, students were asked to write the correct answer before the audiotape gave the answers. Taped-problem intervention was another form of timed practice drill, but the TP intervention also included time-delay procedures, which involved multiple response trials between the problem and answers. Delays were adjusted in order to promote quick responses. Results showed immediate and sustained increases in multiplication fact fluency after intervention was applied (McCallum et al. 2006). Increasing opportunities for students to respond only increased math skills development.

Koran and McLaughlin (2009) compared the effectiveness of drill and a math game in teaching the basic multiplication facts. Teachers have supplemented tools and materials to help students with computational fluency in regards to multiplication facts. Usually teachers resorted to

traditional worksheets that provided drill and practice, but that was done before technology such as 21st century computers and laptops, iPhones, or game devices existed. As a result, teachers utilized math games to promote motivation and confidence in students. Koran and McLaughlin conducted a study to determine if the use of a math game or drill would be an effective procedure in teaching basic multiplication facts and which procedure (game or drill) would be more effective to increase students' achievement level in basic multiplication facts. Twenty-eight fifth grade students were randomly assigned to two groups, baseline, game, drill group and baseline, drill, game group, who either received a math game activity or drill for ten instructional days. The result of the study showed that both a math game and drill were effective methods for the instruction of the basic multiplication facts (Koran and McLaughlin, 2009). The awareness of appropriate interventions motivated students' learning.

Recent research indicated that students might benefit more by using timed practice drills to promote automaticity in math facts. Isaacs and Carroll (1999), for example note that automaticity was essential to estimation and mental computations. Math educators argued that emphasis on strategies help students organize facts into a coherent knowledge network (Isaacs & Carroll, 1999), thus facilitating long-term retention and direct recall. Woodward (2006) unveiled at least two

common approaches to developing automaticity in facts, strategies for teaching facts and the use of timed practice drill. Timed practice drills were a method for developing automaticity offered a clear alternative to strategy instruction for academically low-achieving students (Woodward, 2006). However, researchers[2] questioned the traditional emphasis in schools on rote memorization compared to the constructivist model, which was not to lecture, explain, or attempt to transfer mathematical knowledge, but to create situations for students that fostered their making the necessary mental constructions. Woodward's study was designed to examine the impact of the integrations of the two approaches, strategies for teaching facts and use of timed practice drill. There were a total of 58 4th grade students from the same elementary school who participated in the study. Thirty students were assigned to the intervention group and twenty-eight were assigned to the comparison group. The intervention group received only timed practice drills (e.g., 9x3 is 27 and 9x3?) compared to the comparison group who were taught new fact strategies or reviewed strategies (e.g., derived fact strategy for 9x3 with visuals) with timed practice drills. Results of comparative data shed light on the effectiveness of the respective instructional methods and both groups improved considerably in their knowledge of the harder multiplication facts.

Highline School District (HSD) current math curriculum—Investigations—lacked mental math strategies and skills to promote computational fluency. Investigations required students to solve math problems in a creative, non-algorithmic way, but not all students performed and thought in that manner. O'Brien's (2006) article shed a new light on the debate that continued to rage, but only within the math world. The math conflicts persist to rage between opinions and views upon reform curricula versus back-to-basics. The Bush Administration in 2006 formed a panel to discuss the improvement of achievement in mathematics in the schools. Concerns have been raised in regards to a different approach to teaching math, one that emphasized the need for drill and practice in basic computation in the early grades, but at the expense of problem solving. Millions of dollars were spent on the development of large-scale, multi-grade instructional materials in mathematics to support the National Council of Teacher of Mathematics (NCTM) standards in the classroom (O'Brien, 2006), but based upon the data that was collected, the question why hasn't math education improved still has not been answered. From another stand point, "there is reason to distrust confidence in goals that emphasizes rote memory and instant, atomistic responses, however correct the answers (O'Brien, 2006. p.3). A new question that needed answering was "When will the conflict end?"

Best Practices: Old or New or Old with New

Recent national test results provided documentation of the need to increase the focus on improvement of student achievement in mathematics. A recent research report, *Closing the Achievement Gap: Best Practices in Teaching Mathematics* (2006), published by the Education of Alliance, stated that best practices for teaching mathematics were based upon five critical factors: meaningful use of manipulatives to math concepts, effective instructional strategies such as one that emphasized the development of basic computational skills, professional development, meaningful use of assessments, and effective use of technology.

Johnson (2000) reported findings that suggested when applied appropriately, the long-term use of manipulatives appeared to increase mathematic achievement and improve student attitudes towards mathematics. Teachers using manipulatives needed to intervene frequently to ensure a focus on the underlying mathematical ideas, needed to account for the "contextual distance" between the manipulative being used and the concept being taught, and take care not to overestimate the instructional impact of their use (Education Alliance, 2006). Effective instructional strategies included expectations that teachers know what students needed to learn based upon what they know, questions focused

on developing conceptual understanding, written justification for problem-solving strategies, problem-based activities focused on concepts and skills, and mathematical curriculum emphasized conceptual understanding. Successful professional development for teachers was teacher driven, on-going and sustained, school-based and job-embedded, content-focused, focused on student needs and used appropriate adult learned strategies. Effective assessment practices were essential to support mathematics instruction that produces improved student performance (Education Alliance, 2006). The National Council of Teachers of Mathematics (NCTM) endorsed technology as an essential tool for effective mathematics learning. According to Billings (2009), "educational games and simulations . . . have a positive impact on students". True. Students at WCH joined an educational website called V-Math Live. The site allowed students to compete with others around the world—live. Students were motivated and excited to practice and improve their basic math skills to out-compete their opponents from around the world.

The need for effective instruction in mathematics was further documented in a February 2006 study by the U.S. Department of Education. The study discovered the single most significant pre-collegiate factor in determining students graduated from college was students who

took mathematics beyond Algebra II. Math curriculums provided students with opportunities to learn math at an early age. By the end of 5th grade, students should have a firm grasp on multiplication and division with all the numbers up to 12 and should be able to add, subtract, multiply and divide with decimals and fractions (http://math-and-reading-help-for-kids.org). Another essential skill for 5th graders was basic algebra. Students learned the order of operation in a math problem, how to complete math problems with multiple operations, and how to find a missing value in an equation involving multiple operations. The poor performance of U.S. students in math can be traced to the method used to teach math at the elementary level (Education Alliance, 2006). A study was done to compare number sense instruction between three traditional mathematic textbooks: Houghton Mifflin (HM), Harcourt Brace (HB), and Scott Foresman (SF) and reform-based textbook: Everyday Math (EM).

The results indicated that traditional textbook included more opportunities for number relation tasks than reform-based textbook as opposed to reform-based textbook had more real-world connections than traditional textbooks. However, EM textbook did better than HB, HM, and SF in (a) promoting relational understanding and (b) integrating spatial relationship tasks with other more complex skills (Sood & Jitendra, 2007). Based upon the collected data, 44% of the lessons in traditional

textbooks provided direct and explicit instruction, compared to 0% in reform-based textbook. In reform-based textbook, the emphasis was on guided learning, with the teacher questioning and students inferring the concept and/or skill (Sood & Jitendra, 2007). Another factor that needed to be acknowledged was students with math disabilities and language barriers. Reform-based textbooks emphasized the use of a variety of models to develop number sense such as hands-on activities, which benefited students with math disabilities and language barriers. In contrast, traditional textbooks emphasized worksheet-type exercises that promoted procedural rather than conceptual knowledge, which benefited ELL students who just arrived from another country because numbers were considered a universal language. Furthermore, research highlighted the importance of adequate practice opportunities to promote acquisition and retention of learned skills and strategies for student at risk for mathematic disabilities (Sood & Jitendra, 2007). Finally, traditional textbooks excelled in providing more opportunities for students to practice newly introduced skills and concepts both within a lesson and in subsequent lessons (Sood & Jitendra, 2007).

The American Mathematical Society identified common areas of agreement about mathematic education. The identified areas of agreement were based upon three fundamental premises: basic skills with

numbers continued to be important and students needed proficiency with computational procedures, mathematics required careful reasoning and students needed to formulate and solve problems. One of the agreements that stood out was "use of calculators in instruction can be helpful, but must not impede the development of fluency with computational procedures and basic facts" (Education Alliance, 2006). The calculator rendered obsolete much of the complex pencil-and-paper proficiency traditionally emphasized in mathematic courses (Hechinger, 2006). The Thomas B. Fordham Foundation conducted three analyses of state mathematic standards. Overall, only six states received grades of A and B, twenty-nine states received grades D or F, and fifteen states received C's (Education Alliance, 2006). Also, only two dozen states specified that students needed to know the multiplication tables. The report identified nine major areas of concern including excessive emphasis on calculator use, memorization of basic number facts, lack of focus on the standard algorithm, insufficient focus on fractions, inadequate attention to mathematical patterns, counterproductive use of manipulatives, overemphasis on estimation skills, improper sequencing of statistics and probability standards, and lack of standards that appropriately guide the development of problem-solving (Klein, 2005). From another stand point, supporters of the reform math program were worried that students

returned to rote learning which left children without any understanding of concepts.

Invisible Factors

Most schools throughout the nation joined the Parent-Teacher-Association (PTA). One of the purposes of the PTA was to "bring into closer relation the home and the school, parents and teachers may cooperate intelligently in the education of the children and youth" (Hernando County Council PTA. 2004). Unlike other schools, WCH formed an association called Parent-Teacher-Organization due to lack of parent involvement caused by language and culture barriers, as well as socioeconomic issues. Parent involvement played a huge role in their child's success. Based upon long standing research, the family, not the school, provided the primary educational environment for children across all social, economic, and ethnic backgrounds. In general, studies found that creating a positive learning environment at home, including encouraging positive attitudes toward school and high expectations for children's success, has a powerful impact on student achievement (Merwin, 2010). Students who did not have parents/guardians involvement had a greater probability of academic failure, drop out, or even expulsion from school. Furthermore, children whose parents helped them at home and stayed in touch with the school scored higher than

children of similar aptitude and family background whose parents were not involved (Merwin, 2010). Research also noted that too much parent involvement impacted students' learning. Students' insecurities were brought out, ability was questioned, and students were compelled to compare themselves to everyone else.

For example, Michael was born with autism and developmental issues. Michael had an IEP in all academic areas, including behavior. Michael was held back in first grade because he was not developmentally and academically ready to progress to the next grade level. Michael's parents were very protective. They brought and served him lunch and volunteered in the classroom for three hours every day. As the years progressed, Michael's parents continued to serve him lunch, but did not volunteer in the classroom. By the time Michael reached 5th grade, he was embarrassed by his parents' presence during lunchtime. He struggled to tell his parents to stop hand feeding him. As a result, he directed his frustrations and anger towards his peers and in the classroom. After a lengthy meeting, Michael's parents finally realized and decided to let their son grow and learn on his own. According to Merwin (2010), students who received parental support had a greater chance of graduating and attending college, but there was a fine line. How much was too much?

White Center Heights (WCH) had a high student population of low-

income and poverty. Poverty was caused by interrelated factors such as parental employment status and earnings, family structure, and parental education. As a result, students dealt with issues of homelessness and abandonment. Apart from race or ethnicity, poor children compared to non-poor children were more likely to suffer developmental delay and damage. For example, 10-year-old Joseph struggled emotionally and academically due to his home environment. Joseph was two to three years below grade level and had anger issues. He was an English language learner (ELL) and qualified for an individual education program (IEP) for math, writing, and behavior. His mother gave birth to him when she was only a teen and his father was never around. Joseph's mother struggled to raise him and therefore, Joseph was sent to live with other family members until he was nine years old. WITH a single mother with no child support, home life was very hostile. Often, Joseph's mother expressed her frustrations and anger towards Joseph. As a result, he brought his frustration and anger to school. Students' home environment played a huge role on their ability to learn and perform. Emotional resources came in part from the role models who were present for the child. When the appropriate role models were present, the child could go through the developmental stages at appropriate times and build emotional resources (Payne. 1998. p. 84). Given that stress could powerfully affect learning,

children living in high-anxiety households would not perform as well academically as kids living in more nurturing households (Medina. 2008. p. 184). Other research suggested that the stronger degree of conflict, the greater effect on children and children from disrupted home rates lower in both aptitude and intelligence. Educators needed to figure out how to better support kids who lived in poverty so that the circumstances within which they lived did not determine their future (Monsebraaten, 2009).

Teachers (specifically math teachers) needed to understand their students' brain cycles as they develop mathematical concepts and competencies. Other professionals (pediatricians, psychologist, speech pathologist) who worked with children received information about the brain, its development, and structure/processes, but educators often did not. The most important organ of the human body was the brain. In the middle of one's head laid a pea-size organ called hypothalamus. When the body detected stress, the hypothalamus reacted by sending signals to the adrenal glands in the kidneys. The glands dumped adrenaline into the bloodstream. If stress was too severe or too prolonged, stress impacted student learning. Medina stated, "stress hurts declarative memory (things you declare) and executive function (the type of thinking that involves problem solving)" (Medina. 2008. p. 178). For students, stress in their home environment impacted their ability to do well in the classroom—

specifically in math. Barbara Whitehead, a social activist who wrote a piece in the *Atlantic Monthly*, stated that "Teachers find many children emotionally distracted, so upset and preoccupied by the explosive drama of their own family lives that they are unable to concentrate on such mundane matters as multiplication tables." Children who lived in aggressive environments were at greater risk for disorders such as depression and anxiety. As a result, such disorders impacted cognitive processes important to successful academic performance (Whitehead, 1997).

Summary

The common thread among the studies that were discussed was that basic computational skills were needed for students' success, but how much? Regardless of all the research and studies, the primary focus continued to be on not building the foundations necessary for understanding higher-level math. The merger of best practices, appropriate interventions, and knowledge of invisible factors were best for teaching mathematics. The only solution to end the math war was to work together. Educators from both perspectives (old and new) needed to come to a mutual agreement, which was to blend together the reform-math programs otherwise known as constructivist math with back-to-the-basics drill and practice to truly help children become mathematical thinkers.

CHAPTER 3

Methodology and Treatment of Data

Introduction

The purpose of this experimental study was to prove how important it was for 5th grade students to receive an additional ten minutes daily of multiplication flash card drill intervention outside of the math block to increase computational fluency as well performance on district standards and high stakes tests. Currently there were sixty-six 5th grade students at White Center Heights (WCH) Elementary. Approximately 80% of the 5th grade students struggled with number sense, specifically computational fluency with multiplication facts. Eight years ago, Highline School District (HSD) adopted a math curriculum called Investigations for students in Kindergarden to 5th grade. One of the reasons why HSD adopted this curriculum was because Investigation and Connected Math Program (CMP), which was a 6th through 12th grade math curriculum that HSD adopted a year or two before Investigations, were from the same publishers. The district assumed that Investigation was easier for students to transition between the two math curriculums. The district was informed that Investigations curriculum did not show significant achievement until after the first few years of implementation of the new curriculum. As the years progressed, Investigation curriculum was a

struggle for teachers, students, and parents because of the lack of number sense concepts and skills that required for students' success in math—especially on high stakes tests. The Investigation curriculum did not provide students with enough computational fluency and mental math skills to help students as they progressed into the next grade level due to past high stakes tests such as the Washington Assessment of Student Learning (WASL). In the past, additional materials for number sense were prohibited up until this year. The HSD recently provided teachers with some supplemental materials for number sense, but the huge concern was, where do we start?

Methodology

The researcher conducted a quasi-experimental research where the researcher "manipulates at least one independent variable, controls other relevant variable, and observes the effect on one or more dependent variable" (Gay, Mills, and Airasain, p.240). The researcher was able to "control over the selection and assignment of groups" (Gay, Mills, and Airasian, p. 240). The researcher manipulated the method of instruction, type of treatment for the intervention, the location where the intervention took place, the materials that were used, and the time frame of the treatment. The result of the study was reliant upon the dependent variable because of the change or difference of the groups that occurred due to the

independent variable. Both groups (treatment and control) received the same amount of time to complete the pre-test, which was ten minutes to complete 100 multiplication problems with facts that ranged from zero to twelve. The experimental group was exposed to the treatment for eight weeks. The researcher then collected data from groups, treatment group (received an additional ten minutes of multiplication flashcard drill intervention) and control group (did not receive an additional ten minutes of multiplication flashcard drill intervention) to test whether there was significant difference from the students' performance between the pre-test and the post-test.

Participants

According to HSD database website, 86% of students in the school were on free or reduced-cost lunch, 37% percent were categorized as English Language Learners (ELL), and over forty different languages spoken. The participants were 65 fifth grade students at WCH from three classrooms. The student population consisted of 31 girls and 34 boys from various ethnic and socioeconomic backgrounds. The results from the Washington Assessment of Student Learning (WASL) the previous school year (20008-2009) showed only 27.6% for school wide math proficiency. Based upon the multiplication fact pre-test scores, sixteen students (7 girls and 9 boys) who scored under 80% were divided into two groups and

received treatment in the pod area. Of the sixteen students, three were in the Individual Education Program (IEP). The ethnic demographic of the sixteen students in the treatment group were: six Hispanic, two Somali, one Iraqi, two African American, two Samoan, two Vietnamese, and one Anglo American. The researcher used a convenience sample that consisted of two groups (treatment and control) to conduct the study. The fourth grade teacher taught students the basic multiplication facts, from 0-10, the previous year. The researcher for this experimental study was the students' math teacher.

Instruments

The instrument that the researcher used was a computer generated 100-problem multiplication fact sheet with facts that ranged from 0-12. The instrument was administered to all sixty-five 5th grade students in two different time periods. In the first period, sixty-five 5th grade students were given exactly ten minutes to complete a pre-test on January 1, 2010. In the second period, the same instrument and amount of time was administered to all sixty-five 5th grade students completed their post-test on February 26, 2010. This instrument directly related to the researcher's hypothesis because the instrument was able to test whether students who received the intervention scored significantly higher on their post-test.

Design

To determine the effectiveness of multiplication flash card drill intervention, a quasi-experimental design was used that worked with non-equivalent groups (control and treatment). A pre and posttest was administered to both control and treatment group to see if there was significance gains on students' posttest. The only source of invalidity that was not controlled was pretest-x interaction. According to Gay, Mills, and Airasian, students who received the intervention may react differently to the intervention because they had taken the pre-test (2009, pg. 259). Throughout the duration of the multiplication intervention for the treatment group, there were no natural disasters or threats to the school. Students' maturation was controlled due to the time frame of the intervention, which was only eight weeks and right after the first quarter of the school year.

Procedure

On January 1, 2010, all sixty-five students took a multiplication fact pre-test that was generated from a website (www.math-drills.com) at 9:30am. The researcher collected the pre-tests and organized the students' scores. Students who scored below 80% on the multiplication fact pre-test were selected for the treatment group. All sixty-five 5th grade students received math instruction at their given time and in their respective classrooms. The treatment group received an additional ten

minutes of multiplication fact (0-12) drill outside of the math block for a total ten minutes a day, five days a week, for eight consecutive weeks. After four weeks of intervention, a mid-interim test was given on February 1, 2010 at 9:30am to all sixty-five 5th grade students. At the end of eight weeks, students were given a post-test on February 26, 2010 at 9:30am.

The treatment group who received multiplication fact interventions followed three distinct phases within the ten minutes. Each group was pulled out of their classrooms, gathered in the pod, and were given whiteboards, markers, and erasers. The researcher informed students of the procedure of the intervention with multiplication flash cards that consisted of facts 0-12. The researcher selected random stacks of facts (e.g., 2's: 2x0, 2x1, 2x2, 2x3, 2x4, 2x5, 2x6, 2x7, 2x8, 2x9, 2x10, 2x11, 2x12) for each intervention. The first phase was for students to be able to see and hear the multiplication equation from the flash cards and responded by writing the answer on their whiteboards. Once students agreed upon the answer, the researcher continued to the second phase. In the second phase, students were only allowed to hear the multiplication equation and responded by writing their answer on the whiteboard. Once students agreed upon the answer, the researched finished with the third phase. In the third phase, the researcher only gave the treatment group one minute to answer all thirteen-multiplication flash cards. In the end, researcher

read aloud the answers, students checked to see if their answers were correct or incorrect, and reported their scores (e.g., 100%, 1/13, 2/13).

Treatment of the Data

To determine if the use of ten minutes multiplication flashcard intervention was an effective tool in the teaching of the basic multiplication facts, a Statpak was used to compare the pre and post-test scores of the treatment and control group. The researcher used a t-test on the independent group to determine if there were any significance gains in the treatment group due to the intervention. A t-test for independent sample was used to compare the treatment group with the control group. The significance was determined by $p \geq .05, .01, .001$.

Summary

The researcher conducted an experimental study using the quasi-experimental design. The treatment group received an additional ten minutes of multiplication fact drill intervention outside of their math block. The control group did not receive additional intervention. The gain was compared using a t-test. The calculated value of the t-test was checked for significance.

CHAPTER 4

Analysis of the Data

Introduction

By the time students reached the intermediate level of elementary schools; they needed to have a solid foundation of computational fluency (O'Brien, 2007). The fifth and sixth grades marked the end of elementary school. From there students who moved on to a middle school or junior high encountered more demanding subjects and lessons.

Fifth and sixth grade math put a heavy focus on pre-algebra. In order for students to succeed in the new environment, students needed to fully understand the skills were presented to them in elementary school. By the end of 5th grade, students needed to have the ability to compute fluently with whole numbers because the curricular emphasis in these grades shifted to algebra, students were required to integrate and extend skills learned in prior years (Ketterlin-Geller, Chard, Fien, 2008). The lack of automaticity and basic fluency in multiplication facts impacted students' abilities to compute answers to situations involving whole numbers including fractions and decimals.

Description of the Environment

The experimental study was conducted at White Center Heights (WCH) elementary school in the Seattle area. The test used to measure

the students' computational fluency in multiplication was computer generated from a website (wwww.math-drills.com). The scores from the test indicated whether the student did not have computational fluency in multiplication if their score was below 80%. The data were collected from all 66 5th grade students among three classrooms on January 1, 2010. The group of sixteen 5th grade students was divided into two groups of eight students (7 girls and 9 boys). Of the sixteen students, three had IEP's and four were ELL. The treatment group received an additional ten minutes of multiplication fact (0-12) drill outside of the math block for a total ten minutes a day, five days a week, for eight consecutive weeks. The treatment of the first group took place in an open area in the pod at 1:40pm. The second group received the same intervention in the same place, but at 2:00pm. The materials that were used were flashcards made of index cards, whiteboards, markers, and erasers. The researcher informed students of the procedure of the intervention with multiplication flash cards that consisted of facts 0-12. The researcher selected random stacks of facts (e.g., 2's: 2x0, 2x1, 2x2, 2x3, 2x4, 2x5, 2x6, 2x7, 2x8, 2x9, 2x10, 2x11, 2x12) for each intervention.

Hypothesis/Research Question

Fifth grade students who received an additional ten minutes of multiplication flash card drill intervention daily for eight weeks had a

significantly higher post assessment score. As students progressed through each grade level, math facts were critical in order to perform higher-level math skills.

Null Hypothesis

Fifth grade students who receive ten minutes of multiplication flash card drill intervention daily for eight weeks showed no significant difference on their post assessment scores. The significance was determined by p≥.05, .01, .001.

Result of the Study

The results indicated that there was significant difference in ten minute multiplication math fact intervention pre and post test scores between the treatment and control groups, t (9.26) = 3.551, p ‹ .001. According to the statpak, Table 2 showed students who received an additional ten minutes of multiplication fact flashcard intervention (treatment group) had a significantly greater mean improvement (M = 35.64) than the students who did not receive an additional ten minutes of multiplication fact flashcard intervention (control group) (M = 1.53). The calculation of the mean was based upon the difference between the pre and post-test for each group (treatment and control). However, the researcher also noted that the post-test average for the treatment group (M = 90.36) was less than the post-test average of the control group (M =

95.73) and *t*-value was -2.67.

Findings

Table 3 showed that when the researcher used a t-test for independent group, the t-Value was 9.26 and degrees of freedom were 52. The students were the same at the onset. The researcher found significant difference numerically. Students in the treatment group showed significant difference from the students in the control group due to the negative numbers between the pre and posttest listed in Table 1. According to the statpak, the calculation for the mean of group Y was 1.88 due to nine of the 49 students whose score was the same on the pre and post-test was not included in the calculation. For validity and reliability reasons, the researcher believed it was pertinent to include all 49 students. The researcher was confident that the treatment group was 80% ahead of the control group. The null hypothesis was rejected and the hypothesis was supported.

Table 3

Distribution of *t*

	p		
df	.05	.01	.001
52	2.021	2.704	3.551

Table 1

Data Analysis of Control and Treatment Group Pre and Post Test

CG (Y)	Pre	Post	Difference	TG (X)	Pre	Post	Difference
S1	99	100	1	T1	73	89	16
S2	98	97	-1	T2	70	100	30
S3	98	99	1	T3	70	88	18
.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.
S47	93	99	6	T13	44	72	28
S48	99	100	1	T14	54	84	30
S49	100	100	0	T15	59	71	12

Discussions

By the time students reached the intermediate level of elementary schools; they needed to have a solid foundation of computational fluency (O'Brien, 2007). According to the Education Alliance (2006), a study was done to compare number sense instruction between three traditional math books: HM, HB, and EM. The result indicated that traditional textbooks included more opportunities for paper and pencil computational fluency as opposed to reform-based textbooks that had more real-world connections. Based upon the collected data, 44% of the lessons in traditional textbooks provided direct and explicit instruction, compared to 0% in reform-based textbooks. Most students and parents at WCH, specifically the ELL, struggled with the district's math curriculum Investigations and CMP. Based upon the results of the pre and posttest data (*t*-value was 9.11 and degrees of freedom were 52), the researcher concluded that math should be taught from both perspectives old (back-to-the-basics drill and practice) with the new (constructivist math) to truly help children learn and become mathematical thinkers.

Summary

The objective of the additional ten minutes of multiplication fact flashcard intervention was to provide students with the basic necessity in order to progress on to the next grade level, which was fluency with

multiplication facts. The results indicated that there was significant difference in the ten minute multiplication math fact intervention pre and post test scores between the two groups, t (9.11) = 3.551, $p < .001$. As a result, the researcher was able to conclude that the hypothesis was supported and the null hypothesis was rejected.

CHAPTER 5

Summary, Conclusions and Recommendations

Introduction

Proficiency in mathematics was central to academic success from pre-K through post secondary education, to the workplace, and to everyday life. Along with teaching students' basic numerical concepts and skills, instruction in number sense and operations prepared students for algebra. In 2009, WCH students from third to sixth grade scored well below the state average (SA) on the WASL test. According to the Office of Superintendent Office (OSPI), third grade had 33% passing (SA: 66%), fourth grade 26% (SA: 52%), fifth grade 32% (SA: 62%), and sixth grade 29% (SA: 51%). The HSD's math curriculum (Investigation) for 5th grade students lacked a vital component, which was number sense, specifically computational fluency. Investigations required students to solve math problems in a creative, non-algorithmic way, but not all students performed and thought in that manner. As a result, student struggled with other math concepts (conceptual understanding, strategic competence, adaptive reasoning, and productive disposition) due to lack of basic skills such as computational fluency.

Summary

There were a total of sixty-five 5th grade students who took a

multiplication fact pre-test that had 100 problems with facts that ranged from zero to twelve within ten minutes. Based upon the multiplication fact pre-test scores, sixteen (seven females and nine males), fifth grade students who scored below 80% were in the treatment group. The treatment group received multiplication fact intervention for eight consecutive weeks. The researcher then collected data from groups, treatment group (received an additional ten minutes of multiplication flashcard drill intervention outside the math block) and control group (did not receive an additional ten minutes of multiplication flashcard drill intervention). The result of the study was reliant upon the dependent variable because of the change or difference of the groups that occurred due to the independent variable. It was concluded that the treatment group scored significantly higher on their posttest compared to their pre-test within an eight-week span of ten minutes of multiplication flashcard intervention. Furthermore, their confident level also increased after the eight-week intervention.

Conclusions

Like reading comprehension, mathematic proficiency was multi-faceted in nature, draws on many different skills, and influenced by factors at the level of the child, the classroom, the school, and the task itself. All children needed to learn to think mathematically, not only for the sake of

learning mathematics, but also more generally for much of their overall academic success. In order to do so, educators must start from the ground up, which started with number sense, specifically computational fluency. The researcher's hypothesis was supported based upon the pre and posttest data that was collected. 5th grade students who received an additional ten minutes of multiplication fact intervention scored significantly higher on their post test compared to 5th grade students who did not receive the additional ten minutes of multiplication fact intervention.

Recommendations

I would highly recommend the multiplication flashcard intervention to any educator (principal, teacher, interventionist, math coach, para, volunteer). The intervention doesn't have to start at fifth grade, but for any students struggling at any grade level. In particular our ELL students because there are a number of skills that need to be well developed and integrated, and that learning and performance proficiency relies on well-developed language skills. By the end of the multiplication flash card intervention, students in my treatment group were more confident because they felt like they were able to complete a task or an assignment without being pulled out for additional support. Also, they were more willing to participate in whole group discussions.

REFERENCES

Billings, Karen. (2009, October). Lessons from the trenches. *School Library Journal*, 55 (10), 26. Retrieved February 19, 2010, from Social Science Module. (Document ID: 1876033821).

The Education Alliance. (2006). *CLOSING THE ACHIEVEMENT GAP: BEST PRACTICES IN TEACHING MATHEMATICS*. Charleston, WV: author. Retrieved March 1, 2010, from http://www.educationalliance.org.

Elementary Math Help: 5th and 6th Grade. (n.d.). Retrieved March 1, 2010, from http://math-and-reading-help-for-kids.org.

Faulkner, V .. (2009). The components of number sense: An instructional model for teachers. Teaching Exceptional Children, 41(5), 24-25,27-30. Retrieved February 7, 2010, from *ProQuest Education Journals*. (Document ID: 1707288131).

Gay, L.R., Mills, G.E., Airasian, P. *Educational Research: Competencies for Analysis and Application*. Columbus, Ohio: PEARSON.

Hechinger, John. (2006, September 12). Arithmetic problem: New report urges return to basics in teaching math, critics of 'fuzzy' methods cheer educator's finding; Drills without calculators; Taking cues from Singapore. *Wall Street Journal* (Eastern Edition), p. A. 1.

Retrieved February 23, 2010, from *Wall Street Journal*. (Document ID: 1125933101).

Issacs, A.C. and Williams M Carroll. 1999. Strategies for basic-facts instruction. Teaching children mathematics.

Ketterlin-Geller, L., Chard, D.J., Fien, H. Copyright *PRO-ED Journals* Jan/Feb 2008. Making connections in mathematics: Conceptual interventions for low-performing students.

Koran, L.J., McLaughlin, T.F., *Journal of Instructional Psychology*, 00941956 Dec.09, Vol. 17, Issue 4. Games of drill: Increasing the multiplication skills of students.

MATH FORUM: CONSTRUCTIVISM IN THE CLASSROOM. Retrieved February 23, 2010 from http://mathforum.org/mathed/constructivism.html

McCallum, E., Skinner, C., Turner, H., Saecker, L., *School Psychology* Review; 2006, Vol. 35 Issue 3, p419-434, 16p, 5 charts, 1 graph. The tapped-problems interventions: Increasing multiplication fact fluency using a low-tech, classwide, time-delay intervention.

Medina, John. *Brain Rules: 12 Principles for Surviving and Thriving at Work, Home, and School*. Copyright 2008. First Pear Press trade paperback edition 2009.

Merwin, Greta. Parent involvement: Just good PR or a learning strategy

that make sense. 2010.

Monsebraaten, Laurie. Does poverty impair brain? *Toronto Star* (Canada). 2009.

O'Brien, Thomas C. (2007). The old and the new. *Phi Delta Kappan*, 88(9), 664-668. Research Library Core.

Payne, Ruby K. Ph.D. *A Framework for Understanding Poverty.* Copyright 1998. Published by RFT Publishing Co.

Sood, S., & Jitendra, A. (2007). A comparative analysis of number sense instruction in reform-based and traditional mathematics textbooks. *The Journal of Special Education*, 41(3), 145-157. Retrieved February 7, 2010, from Education Module. (Document ID: 1373550761).

Whitehead, Barbara. (1997). The divorce culture. *Atlantic Monthly*. Retrieved February 23, 2010, from Atlantic Monthly.

Woodward, John. Developing automaticity in multiplication facts: Integrating strategy instruction with timed practice drills. *Learning Disability Quarterly*. Glenside: Fall 2006. Vol. 29, Isss 4; pg. 269, 21 pgs.

APPENDIX

Table 2

Statpak Table Analysis for Independent t-test of Pre-test

Statistic	Value
No. of Scores in Group X	14
Sum of Scores in Group X	499.0000
Mean of Group X	35.64
Sum of Squared Scores in Group X	23433.00
SS of Group X	5647.21
No. of Scores in Group Y	40
Sum of Scores in Group Y	87.0000
Mean of Group Y	2.17
Sum of Squared Scores in Group Y	1823.00
SS of Group Y	1633.78
t-Value	9.11
Degrees of freedom	52

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\left(\frac{SS_1 + SS_2}{n_1 + n_2 - 2}\right)\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

$$t = \frac{35.64 - 2.17}{\frac{5647.21 + 1633.78}{14 + 49 - 2}\left(\frac{1}{14} + \frac{1}{49}\right)}$$

$t = 9.11$