The Effects of a Repeated Multiplication Intervention on Classroom Based Assessment Scores and the Measurement of Student Progress

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The Effects of a Repeated Multiplication

Intervention on Classroom Based Assessment Scores

and the Measurement of Student Progress

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ABSTRACT

The purpose of this study was to determine if administering multiplication fact sheets on a daily basis would increase the students' performance on the Classroom Based Assessments (CBAs) which are modeled after the Measurement of Student Progress (MSP).

The CBA was administered as a pre-, mid-, and post-trimester test to the study group. The daily fact multiplication timed sheet was administered to the study group on a daily basis.

The study group showd significant growth on the CBAs between the beginning of the trimester and the end. The difference in the growth could have been attributed to the students taking a four minute timed multiplication fact sheet on a daily basis.

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CHAPTER 1

Introduction

Sandra Zacher

Background for the Project

The No Child Left Behind Act (NCLB) of 2001 was signed by President George W. Bush on January 8, 2002. This law was designed to hold schools accountable so all students were receiving quality instruction from highly qualified educators and were able to attain mastery in reading and math.

Washington State created the Washington Assessment of Student Learning (WASL) in accordance with the Office of Superintendent of Public Instruction (2009). The WASL was given as the state's primary assessment from spring 1997 to summer 2009 and was replaced by the grades three through eight with the Measurement of Student Progress (MSP) and the High School Proficiency Exam (HSPE) in 2010. The WASL was administered to students statewide in grades three through eight, and again in tenth grade. The WASL and the MSP consisted of assessments in reading, writing, math, and science.

White Pass Elementary School (WPES) did not make Adequate Yearly Progress (AYP) for the 2008-2009 school year in Mathematics, and then again in the 2009-2010 school year. Therefore WPES was placed on Step 2 of School Improvement. This fact was what brought about the reason for this study. After examining what students needed to be more successful in

math, it was found that knowing the basic multiplication and division facts was a skill the students would need in order to be more successful in mathematics.

Statement of the Problem

The White Pass Elementary staff examined the results of the Mathematics section of the 2008-2009 Washington Assessment of Student Learning. They identified an area that needed improving. Out of the five areas in Math, 1) process, 2) data, probability and statistics,3) number sense, 4) geometry and measurement, and 5) algebra, the one in which scores were the lowest was number sense.

The school had to notify parents of its status in Washington state and take action in order to raise scores on the MSP in Math. White Pass Elementary would remain on School Improvement for two years. The school also created a school improvement plan that was revised annually.

The staff then cross-referenced the curriculum they were using to the learning objectives of the state of Washington. The name of the program was Bridges Mathematics which was an elementary school math curriculum covering kindergarten through fifth grade that focused on problem solving and skill building, and applied a combination of whole-group, small-group, and independent activities. Lessons incorporated visual models, including manipulative materials, to reinforce learning. The program was designed to implement the principles and standards for school mathematics from the National Council of Teachers of Mathematics (2000) and was

written and field-tested by teachers. The Bridges Mathematics program was developed with initial support from the National Science Foundation.

After the teachers did the cross referencing, they found where the curriculum was insufficient and began finding supplements within the Bridges curriculum to fill in the gaps. They compiled classroom-based assessments (CBM's) and administered these to their students. These assessments closely matched the same format as the WASL and the MSP. This helped the students also to realize what concepts in mathematics would be covered on the MSP.

The focus of this study was to determine if students who received instruction on the basic multiplication and division facts and were given a daily, written, timed test to test for multiplication computational fluency, would increase their overall math achievement. A multiplication fact sheet from the Bridges Mathematics program was administered on a daily basis to test their fluency in multiplication. The students were given the CBA's before instruction began, after four weeks of instruction and then again at the end of the study.

Purpose of the Project

The purpose of this study was to determine if daily practice of the multiplication facts and multiplication fact sheets administered on a daily basis would increase the students' performance on the CBA's which are modeled after the MSP in mathematics.

Delimitations

This study was delimitated to one fourth grade class over the first grading period at White Pass Elementary School (WPES) in the White Pass School District, located in Randle,

Washington. The project was conducted during the fall of 2010-2011 school year with thirteen students. There were three girls in the study group and ten boys. None of the students in this class had passed the MSP the previous school, 2009-2010. Out of the thirteen students, five of them had been retained between kindergarten and third grade. Four of them had strong behavior issues. White Pass Elementary had an enrollment of 268 on the September, 2010 child count. The ethnicity of WPES was White: 93.4%, Hispanic or American Indian/Alaskan Native: 6.2%, and Multi-racial: 0.4%.

The number of students that qualified for free and reduced lunches was 61% (Office of the Superintendent of Public Instruction, 2010).

Each student was assessed using the Classroom Based Assessments three times during the course of the study, once before the study began, again at the middle of the first trimester and finally after the intervention period, at the end of the first trimester. A four minute timed multiplication assessment, consisting of thirty random multiplication problems, was administered on a daily basis and corrected by the teacher. This assessment was progressive, meaning that when the students passed with at least 95% proficiency on the multiplying by fours, for example, they would progress up to the next level, multiplying by fives, and so on up through multiplying by twelve.

Assumptions

For this study it was assumed that all fourth graders in the classroom where the study was conducted gave good effort when they practiced the math facts, on the daily mathematics facts

sheets, and the CBMAs they took. Secondly it was assumed that the students gave honest answers on the post intervention survey. A third assumption was that the scores on the subsequent CBAs given to them were higher than they were on the pretest. Yet another assumption was that the students in this study would increase their fluency and accuracy on the fact sheet they did on a daily basis. Finally, this study assumed that the students answered math problems with less anxiety as they had before they did the extra practice, which a survey taken at the end of the course was able to show.

Hypothesis

Fourth grade students who practice the basic multiplication facts and take a daily assessment of thirty basic multiplication facts in a four minute time span would have a significantly higher score on the White Pass Elementary School's (WPES) Classroom Based Assessments (CBAs) than students that did not participate in this activity. After practicing and taking the daily facts sheet, students would have learned the basic multiplication facts and have felt more confident about multiplication facts, taking the WPES's CBAs, and taking the MSP.

Null Hypothesis

Fourth grade students who practiced the multiplication facts and took a daily multiplication timed assessment would not show a difference in their scores on the White Pass Elementary CBAs. After practicing the multiplication facts and taking the assessments, the students would feel the same as before about taking the fact assessment on a daily basis, about taking the CBAs three times a trimester, and feel the same about taking the MSP.

Significance of the Project

The purpose of this study was to determine the effectiveness of a daily fact fluency assessment on scores on the CBAs, and in turn, the MSP in math. The results of this study were shared with staff and administration at WPES in order to show the significant difference daily practice of math facts could make on the students' confidence in doing the CBAs, MSP, and the significant difference their scores showed at the end of the study compared to the beginning of the study in number sense because they had increased their fluency in multiplication.

Procedure

For the purpose of this project, the following procedures were implemented: Permission to conduct research at White Pass Elementary was granted by Principal Gary Stamper.

A review of selected literature was conducted at WPES, Heritage University, and internet search engines.

All students were given a CBA pretest before the study began. Scores from the CBA pretest were tabulated (see Table 1) and shared with the students. The daily multiplication fact sheet from *Level 4, Bridges Mathematics,* was implemented for all students in the fourth grade class of this study which contained thirty random multiplication facts up through the times twelve facts.

Data was collected by the students on a daily basis and their progress noted on a graph they kept in order to see their daily progress.

At midterm of the first trimester the researcher administered the CBA to the study group. Scores were tabulated of the trimester midterm CBA assessment (see Table 2) and shared with the study group.

At the end of the first trimester the researcher administered the CBA to the study group. The scores of the final CBA post test were tabulated (see Table 3) and shared with the study group.

At the end of the first trimester the study group was given a survey regarding how they felt about math facts, the CBAs, and how they felt about math in general.

The findings of the survey were tabulated and presented on Tables 4 – 7.

Results of this study were shared with parents at conference time and shared with staff and administration at a WPES staff meeting.

A conclusion was drawn regarding the use of a daily fact sheet for student's accountability on learning the basic multiplication facts.

A discussion ensued regarding a decision to implement fact sheets in additional classrooms for daily practice of the multiplication facts.

Definition of Terms

For the purpose of this study, the following words were defined:

Adequate Yearly Progress. The yearly measurement of student progress measured by the MSP.

Computational fluency. The ability to compute in an efficient, flexible and accurate manner.

Washington Assessment of Student Learning. A state assessment to measure student's levels of proficiency in reading, writing, mathematics, and science.

Math facts. The basic multiplication facts.

Acronyms

AYP. Annual Yearly Progress

CBA. Classroom Based Assessments.

MSP. Measurement of Student Performance

NCLB. No Child Left Behind

OPSI: Office of Superintendent of Public Instruction

WASL: Washington State Assessment of Student Learning.

WPES: White Pass Elementary School

CHAPTER 2

Review of Selected Literature

Introduction

This chapter was organized around the following topics: (a) High Stakes Testing, (b) Mathematics Instruction, (c) Computational Fluency, (d) Theories of Learning, and (e) Summary.

High Stakes Testing

The No Child Left Behind Act of 2001 was a United States Act of Congress concerning the education of children in public schools. No Child Left Behind was originally proposed by the administration of George W. Bush immediately after he took office. The bill received overwhelming bipartisan support in Congress. No Child Left Behind supported standards-based education reform, which was based on the belief that setting high standards and establishing measurable goals could improve individual outcomes in education. The Act required states to develop assessments in basic skills that were to be given to all students in certain grades. If districts within those states had chosen to not receive federal funding for schools they were exempt from this law. The Act did not assert a national achievement standard; standards were set by each individual states.

Since enactment, Congress increased federal funding of education from $42.2 billion in 2001 to $54.4 billion in 2007. Funding tied to NCLB received a 40.4% increase from $17.4

billion in 2001 to $24.4 billion. The funding for reading quadrupled from $286 million in 2001 to $1.2 billion, (United States Department of Education).

According to the United States Department of Education, the focus of No Child Left Behind was directed toward targeted groups of students that traditionally had been left out (low-income, English Language Learners (ELL). No Child Left Behind enacted in the theory of standards-based education reform, which was founded in the assumption that setting high standards and creating measurable goals would increase individual student achievement (2009).

No Child Left Behind required all government-run schools receiving federal funding to administer a state-wide standardized test annually to all students. The students' scores were used to determine whether the school had taught the students well. Schools which had received Title I funding through the Elementary and Secondary Education Act of 1965 had to make Adequate Yearly Progress (AYP) in test scores. For example, each year, its fifth graders must do better on standardized tests than the previous year's fifth graders in order to make AYP. If the school's results were repeatedly poor, then a series of steps had to be taken to improve the school. Schools that missed AYP for a second consecutive year had to be publicly labeled as being in need of improvement and were required to develop a two-year improvement plan for the subject that the school was not teaching well. Students were given the option to transfer to a better school within the school district, if any existed. Missing AYP in the third year forced the school to offer free tutoring and other supplemental education services to struggling students. If a school missed its AYP target for a fourth consecutive year, the school was labeled as requiring

corrective action, which might have involved actions like the wholesale replacement of staff, introduction of a new curriculum, or extending the amount of time students spend in class. The fifth year of failure resulted in planning to restructure the entire school. This plan would have been implemented if the school failed to hit its AYP targets for the sixth year in a row. Common options for the districts were to close the school, turn the school into a charter school, hire a private company to run the school, or they could have asked the state office of education to directly run the school.

Under No Child Left Behind expectations, 100% of students must have achieved academic proficiency by 2014. However, states were granted leeway in a number of variables. The states had the ability to create their own academic standards, design their assessments, and define proficiency in reading and math and secondly the states were able to establish their own annual targets (Cronin, Dahlin, Xiang, McCahon, 2009).

Washington State prepared two documents to help teachers align what was taught at each grade level to state and national standards; all this with the hope that they had created students that were well equipped to pass the Washington State Assessment of Student Learning.

The Essential Academic Learning Requirements (EALRs) was the foundation that the grade level expectations were built on. The Washington State Office of the Superintendent of Public Instruction's (OSPI's) Reading Standards stated (2009) there were EALRs in eight curriculum and instruction areas that included reading, communication, art, health and math. The EALRs acted on the continuum where as, for example, the EALR 1.0 in reading stated: The

student understands and uses different skills and strategies to read (Reading, 2009). That EALR did not change as the student continued throughout the educational process. Each grade-level expectation assumed the student was reading at grade level. Since reading was a process, some grade-level indicators and evidence of learning applied to multiple grade-levels. What changed was the text complexity as students moved through the grade levels (Reading, 2009). For a student in kindergarten the expectation was to identify front cover, back cover, and title of books (Reading, 2009). While in sixth grade the expectation was to use dictionaries, thesauruses, and glossaries to find or conform word meanings…(Reading, 2009).

Teaching standards had been implemented to assure that teachers were competent. This was the second course Washington state had taken to assure that their teachers were qualified. Among these standards were performance-based standards for teacher preparation at the residency and professional certificate levels (Endorsement Competencies, 2009). Washington also required a basic skills assessment for admission to a teacher preparation program or for out-of-state teachers. Washington State has embarked on an initiative to develop sets of teacher competencies - what teachers are expected to know and be able to do - in each of the endorsement areas (Endorsement Competencies, 2009).

Mathematics Instruction

Just like reading was related to academic language, mathematics was reflective of a specific academic language.

Math had two types of language, words and symbols. Although math had been considered a universal language, it could be difficult for any student to understand. Math had new terms, such as coefficient and tessellation, and common words that were used in a specific mathematical way, such as scale and change (Freeman and Crawford, 2008). Math used terms that could have been used in other subject areas with different meanings, such as table, slope and run. Additionally, there were multiple math terms that meant the same thing, such as slope, rate of change, rise/run and delta y over delta x.

The academic language of math included the ability to read, write and engage in substantive academic conversations (Freeman and Crawford, 2008). Mathematics had a language all of its own.

Mathematics is a visual language of symbols and numbers. However, mathematics had also expressed and explained through written and spoken words. Although students may have excelled in computation, their ability to apply their math skills may be hindered if they did not understand the vocabulary utilized in instructions and word problems. Research (Beimiller, 2001) had indicated that vocabulary knowledge was strongly related to overall academic achievement in school. The relationship between vocabulary mastery and scholastic performance had been clearly established in the research; this was particularly true in the area of mathematics. It had been shown that students must understand math vocabulary if they were to master content and would be able to apply it in future situations (Thompson & Rubenstein,

2000). Thus, teaching vocabulary in the mathematic content area was a critical element of effective instruction (Dr. Madeline Kovarik, 2010).

In the article Building Mathematics Vocabulary, Dr. Kovarik quoted several other researchers including Dr. Robert Marzano who had identified eight characteristics of effective vocabulary development. Marzano also proposed principles of indirect teaching of vocabulary which included activate background knowledge, use of the three types of memory which include sensory, permanent, and working memory; prior experience of the student; and multi-level knowledge. These were indirect methods of teaching vocabulary which could also have included games, physical movement activities, mnemonics, and visualizations.

Math achievement was critical for all students. In fact, it was considered the strongest predictor for college success (Sciarra and Seirup, 2008). Thus, improvement of instruction and student achievement in math had been at the forefront of educational topics in recent years. The final report of the National Mathematics Advisory Panel had an array of recommendations to improve math achievement in U.S. schools, which included strengthening teacher math preparation for elementary teachers (U.S. Department of Education, 2008). For instructional practices, the panel recommended a combination of student centered and teacher directed methods. Research also supported other instructional methods under specified circumstances.

We've all heard about the fourth-grade slump in reading (Kristen Grayson, M. Ed., and Veronica Betancourt, M.A.). Jeanne Chall first defined the fourth-grade reading slump in 1983 as the time when students fall behind in reading. The premise was that the slump in reading

occurred because of the change in academic language required to read grade-level content texts. Starting around the fourth grade, reading shifted from learning to read to reading to learn with the inclusion of a more extensive vocabulary, a heavier content load and a need for more background knowledge (Chall and Jacobs, 2003). Gerald Coles stated that this type of reading required students to be familiar with less common words, employ wider reading and have a deeper comprehension of the content material (Coles, 2007). But there was a comparable slump that occurred in math achievement. Achievement gaps in math increased as the grade level went up.

One approach that addressed the drop in math achievement scores, which was especially as related to the fourth-reading slump, was to consider student engagement during math instruction. In a 2008 study of U.S. high school students, investigators conducted a two-way analysis of covariance to test for the interaction of race and three levels of engagement and the effect on math achievement (Sciarra and Seirup, 2008). Key findings showed that the overall combination of three types of engagement was significantly related to math achievement for all racial groups. Emotional engagement was a more significant predictor for Hispanic students than for other groups. Student engagement and math achievement were related.

The Sciarra and Seirup study described three types of school engagement. Behavioral engagement had to do with effort and appropriate conduct. Emotional engagement concerned students' feelings and a sense of belonging. Cognitive engagement related to the student investment in learning, the belief in the importance of doing well in school and doing what it

takes to go beyond the minimum requirements for completion of coursework (2008). Research was clear that increased engagement correlated with increased achievement in mathematics. By having focused on student engagement, teachers could help students improve in mathematics achievement.

Computational fluency

The research on computational fluency suggested that the ability to fluently recall the answers to basic math facts was a necessary condition for attaining higher-order math skills. The rationale for this thinking was that all human beings had a limited information-processing capacity. That is, an individual simply could not attend to too many things at once. Grover Whitehurst, the Director of the Institute for Educational Sciences (IES), noted this research during the launch of the federal Math Summit (2003). (Ted S. Hasselbring, Alan C. Lott, and Janet M. Zydney (2006).

According to Hasselbring, Lott, and Zydney (2006), cognitive psychologists had discovered that humans had fixed limits on the attention and memory that could be used to solve problems. One way around these limits was to have had certain components of a task which had become so routine and over-learned that they had become automatic.

The implication for mathematics was that some of the sub-processes, particularly basic facts, needed to be developed to the point that they were done fluently and automatically. If the fluent retrieval did not develop, then the development of higher-order mathematics skills—such

as multiple-digit addition and subtraction, long division, and fractions—could have been severely impaired (Resnick, 1983).

Indeed, studies had found that lack of math fact retrieval could impede participation in math class discussions (Woodward & Baxter, 1997), successful mathematics problem-solving (Pellegrino & Goldman, 1987), and even the development of everyday life skills (Loveless, 2003). Rapid math fact retrieval had been shown to be a strong predictor of performance on mathematics achievement tests (Royer, Tronsky, Chan, Jackson, & Merchant, 1999).

While the research of Hasselbring, Lott, and Zydney (2006) cited above highlighted the importance of math fact fluency, the computation capabilities of American students could well have been spiraling downward. Tom Loveless of the Brookings Institute had reviewed responses to select items on the National Assessment of Educational Progress (NAEP) and concluded that performance on basic arithmetic facts declined in the 1990s (2003). More emphasis needed to be placed on developing rapid, effortless, and errorless recall of basic math facts (Hasselbring, Lott, and Zydney (2006).

Given the importance of the fluent recall of basic facts, the main concern was how this ability developed. For many children, at any point in time from preschool through at least the fourth grade, they would have some facts that could be retrieved from memory automatically and some that needed to be calculated using some counting strategy. From the fourth grade through adulthood, answers to basic math facts were recalled from memory with a continued

strengthening of relationships between problems and answers that resulted in further increases in fluency (Ashcraft, 1985).

The acquisition of math facts in most normally developing children generally progressed from a deliberate, procedural, and error-prone calculation to one that was fast, efficient, and accurate (Ashcraft, 1992; Fuson, 1982, 1988; Siegler, 1988). In contrast, most students with math difficulty, along with those that lacked consistent math fact instruction, had shown a serious problem with respect to the retrieval of elementary number facts. Hasselbring, Goin, and Bransford (1988) found that students with math difficulty were substantially less proficient than their non-math-difficulty peers in retrieving the answers to basic math facts in addition and subtraction.

Although information was still emerging about the particular difficulties experienced by these children in the retrieval of this information, the evidence that did exist suggested that these children did not suffer from a conceptual deficit (Russell & Ginsburg, 1984) but rather from some sort of disruption to normal development. What this suggested was that there were huge differences in the amount of instruction individual children needed to become fluent at retrieving answers to basic math facts.

Hasselbring and Goin (2005) found that educators had turned to technology with varying degrees of success to help students achieve fluency in math facts. Although it seemed intuitive that using technology in a drill-and-practice format helped students develop the declarative fact

knowledge, evidence suggested that this was not the case. In an early study by Hasselbring, Goin, and Sherwood (1986), it was found that computerized drill and practice was ineffective in developing declarative fact knowledge in students with math difficulty.

The identified problem was that typical drill-and-practice software was designed in such a way that students practiced procedural counting strategies instead of having had developed the ability to recall facts from memory. Even studies that report reduced response latencies had been a result of the use of computerized drill and practice and could not demonstrate that facts were being retrieved from memory, only that procedural counting time had been reduced (Christensen & Gerber, 1990; Pellegrino & Goldman, 1987).

Theories of Learning

There were three main categories or philosophical frameworks under which learning theories had fallen, behaviorism, cognitivism, and constructivism. Behaviorism focused only on the objectively observable aspects of learning. Cognitive theories looked beyond behavior to explain brain-based learning. Constructivism viewed learning as a process in which the learner actively constructed or built new ideas or concepts (Wikipedia, 2011).

Merriam and Caffarella (1991) highlighted four approaches or orientations to learning: Behaviorist, Cognitivist, Humanist, and Social/Situational. These approaches involved

contrasting ideas as to the purpose and process of learning and education, and the role that educators could have taken.

Yet there was another important part of the teaching/learning process which was scaffolding. Scaffolding had been defined as a process that enabled a child or novice to solve a problem, carry out a task or achieve a goal which would be beyond his unassisted efforts (Wood, Bruner, & Ross, 1976, p. 90). This supported structure, or scaffold, is faded, or reduced, over time as the student became more independently proficient. Scaffolding was rooted in the learning theories espoused by Vygotsky and Piaget (Greenfield, 1984; Rogoff & Gardner, 1984; Stone, 1993). The term scaffolding was first introduced by Wood, Bruner, and Ross (1976) in their article entitled, The Role of Tutoring in Problem Solving and the practice of scaffolding was primarily couched in the constructivism school of learning. Although scaffolding drew from the work of both Vygotsky and Piaget, it was influenced heavily by Vygotsky's (1935/1978) learning construct called the zone of proximal development (ZPD). This construct asserted that a more knowledgeable person could help learners perform beyond their actual developmental level.

The original concept of scaffolding applied to the context of tutoring or one-on-one support. However, a classroom had multiple children with multiple ZPDs (Brown et al., 1993).

A single teacher was often provided scaffolding for up to thirty five students at the same time, usually having had based their help not on what any individual required at the moment, but

rather on what they believed most of the class needed in order to be successful (Puntambekar & Kolodner, 2005, p. 189).

As a result, students who had faced learning challenges often struggled to achieve parity with their peers, and students who grasped the concepts quickly were often bored and unchallenged by the review of material.

Summary

The focus of this chapter was to present evidence of the topics of (a) High Stakes Testing, (b) Mathematics Instruction, (c) Computational Fluency, (d) Theories of Learning, and (e) Summary. The purpose of the summary was to highlight daily mathematical fluency practiced and assessed and how student performed on other classroom-based and state assessments that had met national standards. The procedure and treatment of the data were reported in Chapter 3.

The focus on the No Child Left Behind Act, signed into law in 2002, was to focus on those children who had previously been left out (low-income, English Language Learners (ELL). This law brought about Education Reform in every state, high standards had been set and consequences for school districts not meeting standard were in place. This was being dealt with by individual states. However, school districts could choose to opt out and not receive federal funds, so they did not have to meet the same requirements that the remainder of the schools did.

Instruction in the language of mathematics was vital. Mathematics had its own vocabulary significant to it. A connection between vocabulary mastery and academic performance had been established by researchers. Teaching this mathematical vocabulary to students was a very critical part of instruction since math achievement during the elementary years had been noted to be a window into how successful the student would be in college. This had made it clear that teachers of elementary children needed to address the needs of their students after they had assessed them with instruments that matched their states' standards. Vocabulary instruction needed to come first in order for the students mastery of the content could apply to what they had known and be able to apply what they knew to future situations. Student engagement was a critical component in the development of successful mathematics students.

Computational fluency was necessary for students to achieve in order for them to have attained higher level math skills. This skill needed to be practiced and mastered so the student could participate in a math class successfully. For some children this skill developed earlier than others. By fourth grade students needed to have the ability to recall math facts fluently and efficiently. Without this skill they would be hampered from a conceptual deficit which disrupted the normal mathematical development.

Several theories of learning provided insight into how children learned mathematics. Those included behaviorism, cognitivism, constructivism, as well as the humanistic approach

and that of the social/situational approach. Scaffolding was a process that teachers used in their classroom which allowed help to those who needed it, but allowed the teacher to find the zone of proximal development which allowed those students in the zone to learn, but often this theory lost those who were struggling and bored those less challenged.

CHAPTER 3

Methodology and Treatment of the Data

Introduction

This chapter was organized around the following topics: (a) Methodology, (b) Participation, (c) Instruments, (d) Design, (e) Procedure, (f) Treatment of Data, and (g) Summary.

Methodology

The researcher chose to do an action research project. The researcher was given permission to conduct this study by the principal, Gary Stamper. The researcher sought to determine if after having administered a daily multiplication fact sheet of thirty problems to the class, that the class would score higher on the classroom based assessments consecutively, that had been administered at the beginning of the trimester, the middle of the trimester, and at the end of the first trimester of school.

The researcher collected data after each classroom based assessment was administered. The students kept track of the scores using a graph on the daily multiplication fact sheets they did Students were also given a survey at the end. This survey allowed for them to give their perception of the treatment, which was the daily fact sheet. The data from both the surveys and

assessments were entered into the spreadsheet program, Excel, for simplicity of data analysis. Graphs were created to represent both surveys and assessment data.

The collected data was entered into a statistical calculator (Stat Pak) and a t-chart. The results of the t-chart were then compared to distribution of t table to ascertain if the treatment did provide a significant change in student mathematic skills.

Participants

The researcher chose fourth graders of the class of 2019 at the White Pass Elementary School for the subjects of this project. The students had been assigned this group by the administration. Students in the study group were from the communities of Packwood, Randle, and Glenoma, each a small town on Highway 12, eighty miles west of Yakima. The majority of the families had been employed by the lumber industry in some manner or was unemployed.

This group included thirteen students and all participated in this study. The study group contained three girls and nine boys. None one in this group had passed the mathematics portion of the Measurement of Student Progress the previous year, 2009-2010. Two of them had been retained between first and third grade one time. Four out of the thirteen had behavior issues.

Instrument

A four minute timed multiplication fact sheet was the tool used for the students to gather data about their own computational fluency rate. The group completed one the fact sheets on a daily basis. The Classroom Based Assessments was the tool that was used to gather data over the course of the first trimester of the school year of 2010-2011.

After the data was gathered the researcher entered it into the spreadsheet program, Excel. Excel was the software program written and distributed by Microsoft. Excel was used to create graphs and charts. Statpak was the statistical calculator used to determine significance of the data results.

Design

The group of twelve fourth graders who participated in the study was predetermined. This study group falls into the category of quasi-experimental because the group was predetermined. The researcher prepared a survey the students took before the study began and then at the end of the study. This survey was to show how the students felt they had done on the classroom based assessments after having practiced the multiplication facts on a daily basis and their attitude about math in general at the end of the study.

Procedure

The researcher wanted to determine if math fact practice and administering a daily multiplication fact sheet of thirty problems to each student in the study, and having the participants graph their own scores, would increase the scores of the study group on the classroom based assessments given before the study began, at midterm of the study, and again at the end of the study.

The researcher gathered data the first trimester of the 2009-2010 school year of student achievement on the classroom based assessments. This occurred three times during that time span of the study.

The data from the assessments and the survey were entered into an Excel program. Results were tabulated and graphs created. The differences between each of the three assessments given the first trimester were entered into the statistical calculator. The answers from the survey were tallied, entered into Excel, and analyzed. Results from the study were evaluated and conclusions drawn. Findings of the study were shared at a White Pass Elementary staff meeting where a decision was made regarding the daily use of a multiplication fact sheet of thirty random problems would have an impact on the study group's scores on the classroom based assessments that were administered three times the first trimester of school year 2010-2011.

Treatment of Data

The data gathered from the post intervention mathematics survey was calculated and examined using the Microsoft Excel program. Responses from the survey were numerically presented on a scale from 1 – 4, and participants were categorized as male or female. All information from the surveys was represented in Microsoft Graphs.

The data gathered from the daily multiplication timed fact sheet was graphed by each individual student in the study and reviewed by the researcher during the study. During the study, the scores of the classroom based assessments was gathered, tabulated, and examined using the Microsoft Excel Program. This program was used to find the mean, mode, and t-score of the classroom based assessments data gathered by the researcher.

Summary

This chapter was designed to review the methodology and treatment of data related to the study to determine if students who practiced the multiplication facts on their own and took a daily, four minute, multiplication fact sheet assessment of forty random multiplication facts would score progressively higher on the classroom based assessments than if they had not taken the daily multiplication fact sheet and posted their own results on a graph. The analysis of data and findings from this study are reported in Chap

CHAPTER 4

Analysis of the Data

Introduction

Chapter 4 was organized around the following topics: (a) Description of Environment, (b) Hypothesis, (c) Results of the Study, (d) Findings, and (c) summary.

Description of Environment

This study was delimitated to one fourth grade class over the first grading period at White Pass Elementary School (WPES) in the White Pass School District, located in Randle, Washington. The project was conducted during the fall of 2010-2011 school year with thirteen students. Three girls and ten boys were in the class. None of them had passed the mathematics portion of the Measurement of Student Progress the previous year, 2009-2010. Five of the thirteen students had been retained once between kindergarten and third grade. Four of the students had behavior issues. White Pass Elementary School had an enrollment of 268 students on the September, 2010 child count. The study group consisted of three girls and ten boys. The population of WPES was 93.4% Caucasian, 2.7% American Indian or Alaska Native, 3.4% Hispanic, and 0.4% multi-racial. The number of students that qualified for Free and reduced lunches was 61% (OSPI).

Hypothesis

Fourth grade students who practice the basic multiplication facts and take a daily assessment of thirty basic multiplication facts in a four minute time span would have a significantly higher score on the White Pass Elementary School's (WPES) Classroom Based Assessments (CBAs) than students that did not participate in this activity. After practicing and taking the daily facts sheet, students would have learned the basic multiplication facts and have felt more confident about taking the WPES's CBAs.

Null Hypothesis

Fourth grade students who practiced the multiplication facts and took a daily multiplication timed assessment would not show a difference in their scores on the White Pass Elementary CBAs. After practicing the multiplication facts and taking the assessments, the students would feel the same as before about taking the fact assessment on a daily basis and about taking the CBAs three times a trimester.

Results of the Study

Mean scores of students who participated in the study by taking the multiplication fact sheet on a daily basis and then taking the CBA increased by 69.24%. During the first trimester of the 2009-2010 school year thirteen students participated in the study. Of those thirteen students 92.3% showed improvement from pre test to post test. They had improved 42.74% on

the assessment from the middle of the trimester to the end. Only one student showed NO increase in scores on the CBAs and one student's score on the CBAs declined. (See Graphs 1 – 3 below.)

Student	Pre-term	Mid-term	Post-term
1	12	20	27
2	10	16	26
3	11	15	23
4	8	14	21
5	2	5	10
6	4	10	20
7	16	21	28
8	2	4	5
9	12	19	25
10	15	25	29
11	5	11	16
12	3	6	10
13	1	5	5

Table 1: Scores on Pre-, Mid-, and Post-tests

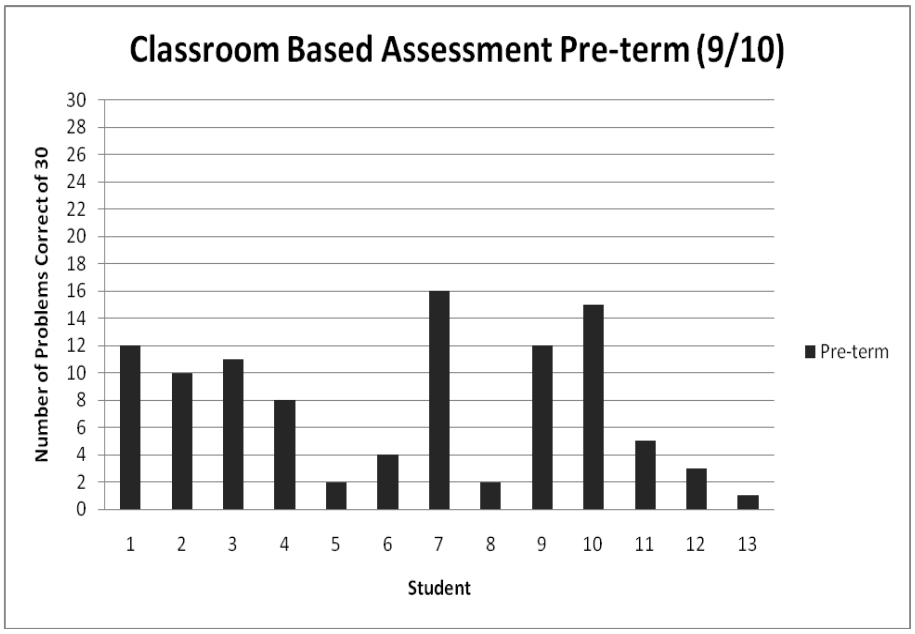
Classroom Based Assessment Pre-term (9/10)
Number of Problems Correct of 30
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
8
9
10
11
12
13
Student
Pre-term

Figure 1

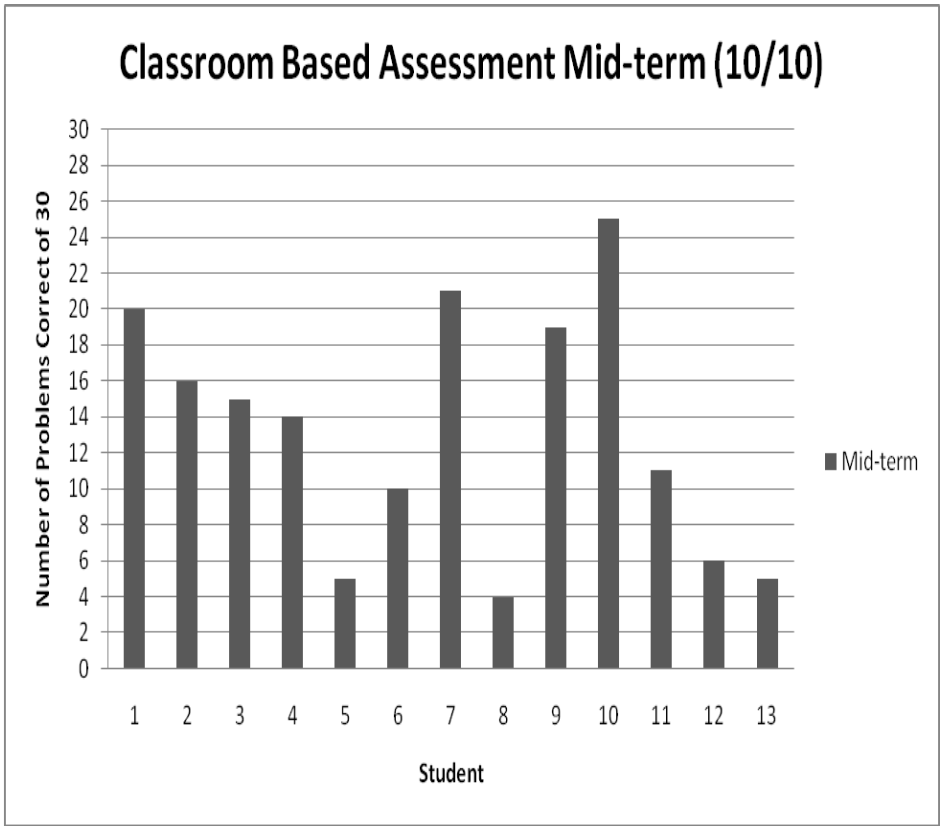
Classroom Based Assessment Mid-term (10/10)
Number of Problems Correct of 30
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
8
9
10
11
12
13
Student
Mid-term

Figure 2

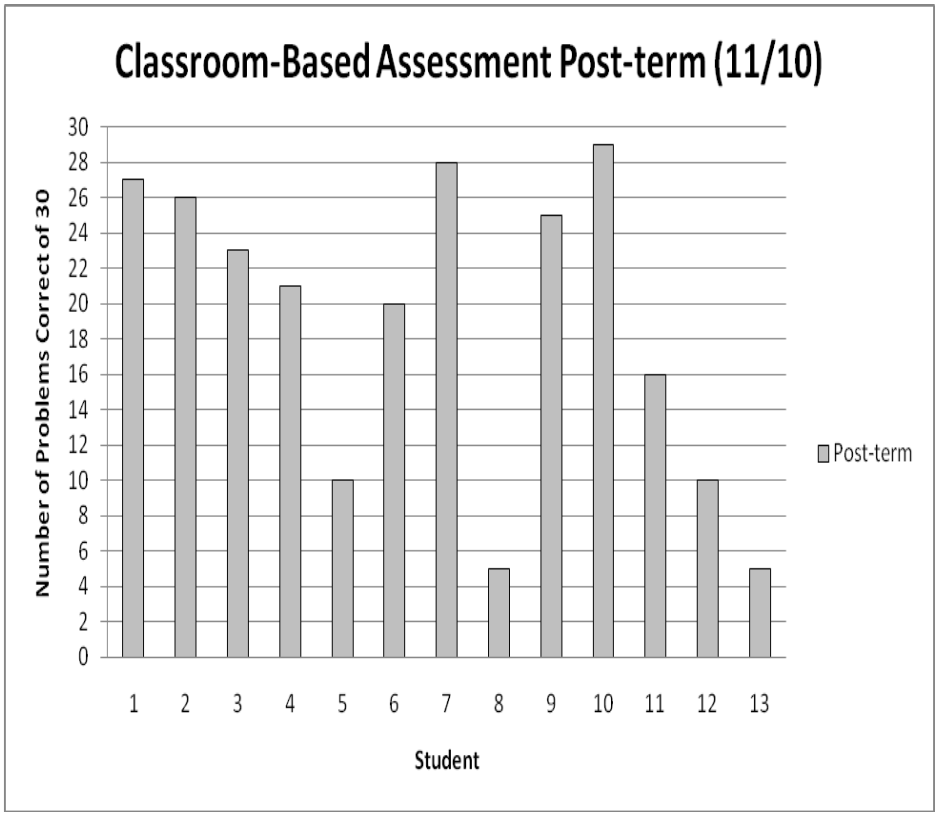
Classroom-Based Assessment Post-term (11/10)
Number of Problems Correct of 30
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
8
9
10
11
12
13
Student
Post-term

Figure 3

A student survey was conducted at the end of the study which showed that twelve students strongly agreed that the daily multiplication fact sheets had helped them learn the multiplication facts. Students were asked if doing the daily fact sheet had helped to do better on the CBAs. All twelve of the students in the study agreed that the fact sheets had helped them. (See Graphs 4 – 7 below).

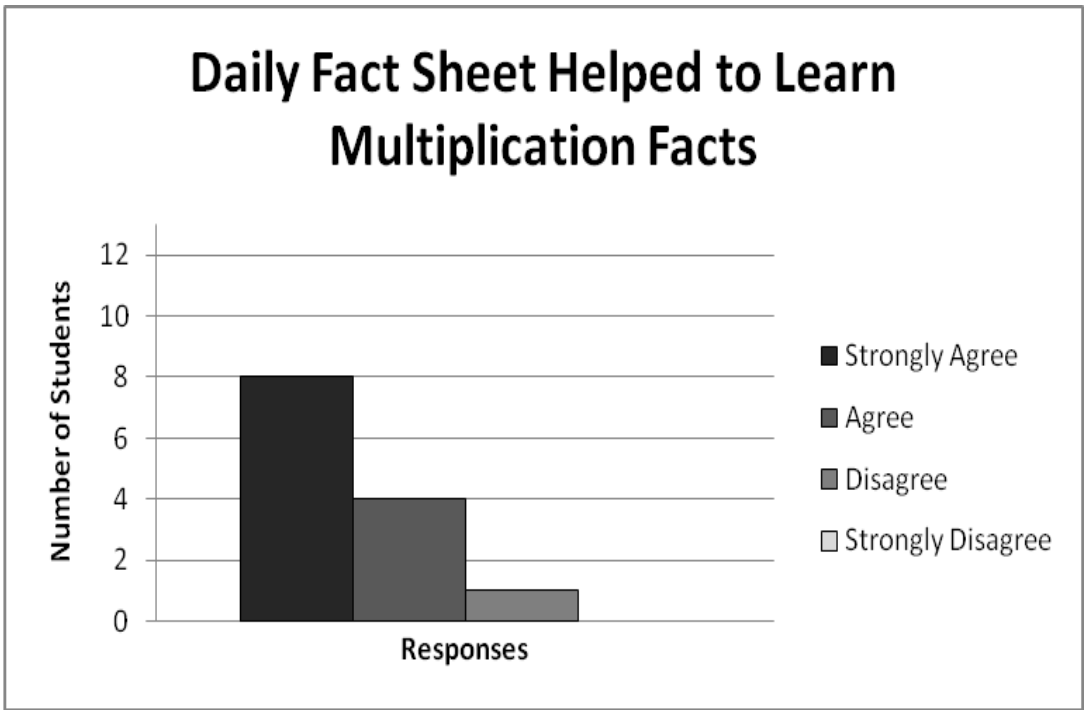

Figure 4

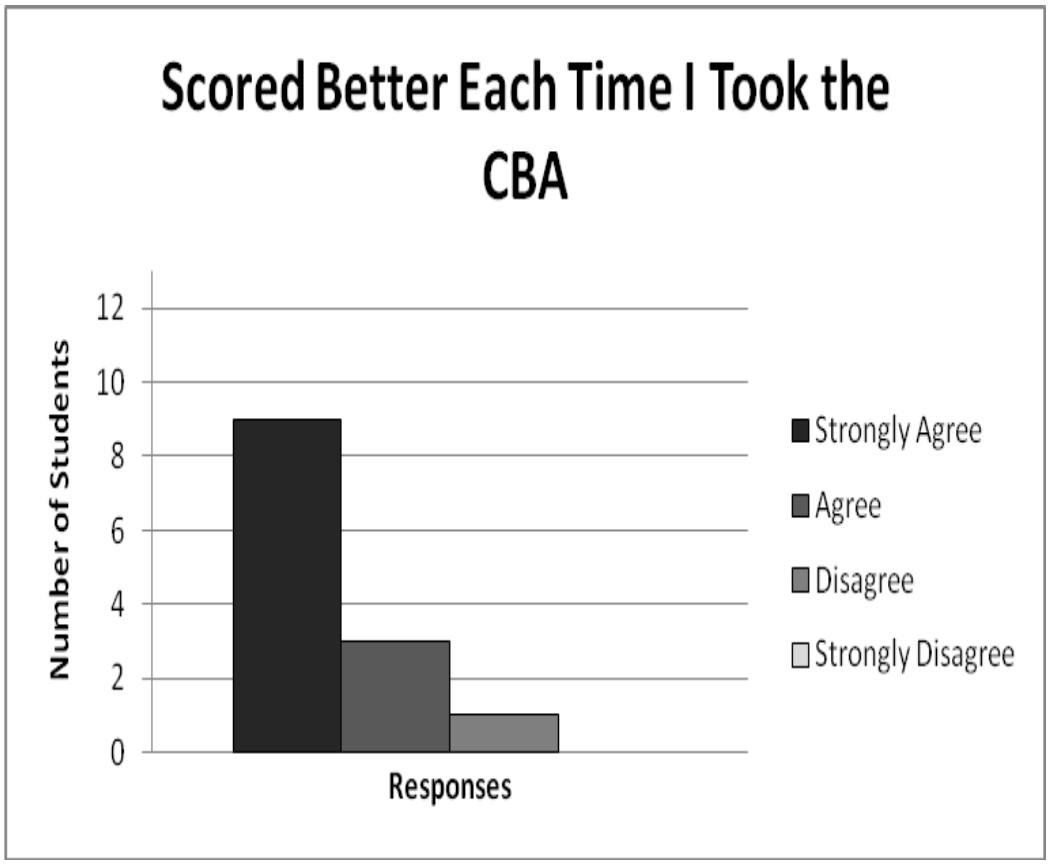
Scored Better Each Time I Took the CBA
Number of Students
12
10
8
6
4
2
0
Responses
Strongly Agree
Agree
Disagree
Strongly Disagree

Figure 5

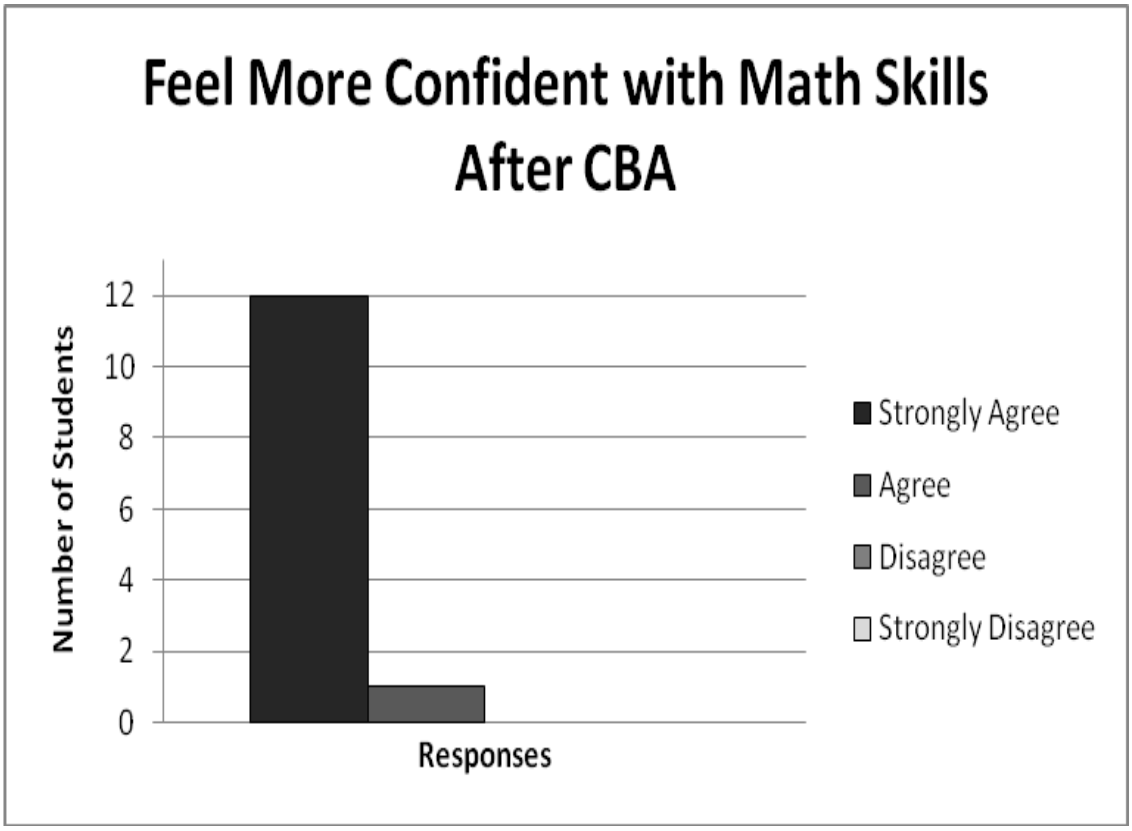
Feel More Confident with Math Skills After CBA
Number of Students
12
10
8
6
4
2
0
Responses
Strongly Agree
Agree
Disagree
Strongly Disagree

Figure 6

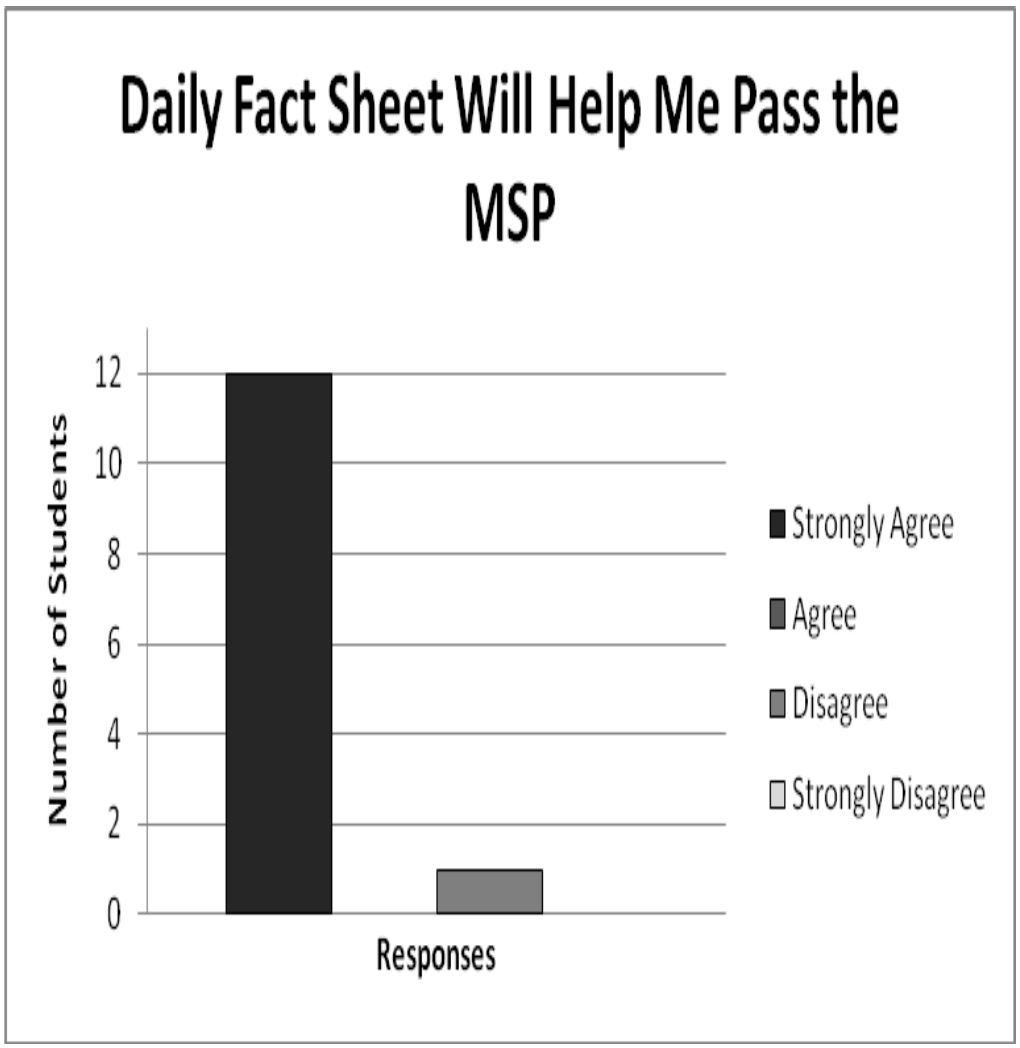
Daily Fact Sheet Will Help Me Pass the MSP
Number of Students
12
10
8
6
4
2
0
Responses
Strongly Agree
Agree
Disagree
Strongly Disagree

Figure 7

Findings

Table 1 demonstrated the scores the study group received on the pretest of the Classroom Based Mathematics Assessments. Table 2 displayed the scores the study group received on the CBAs when they took another CBA at the midpoint of the trimester. Table 3 displayed the scores the study group received on the post CBA test at the end of the trimester.

Between the beginning of the first trimester to the middle of the trimester the study group T score was 2.23 which showed they made significant progress. From the mid trimester to the post test the study group did not make significant progress because the T score was 1.84. The test scores revealed that the study group made significant progress between the pre CBA and the post CBA. The T score was 3.93.

The first three tables did show that the study group did receive significantly higher scores on the CBAs from the beginning of the trimester to the end of the trimester. The average score of the study after taking the pre CBA was 26%. The average score of the study group after taking the CBA at the end of the trimester was 60% making an overall gain for the whole study group as 34%.

Therefore the hypotheses that fourth graders who take a daily multiplication fact sheet of forty problems, which is a supplement of the *Bridges Mathematics* program, would show significant growth on the CBAs administered at the beginning of the trimester and at the end of the first trimester of the 2010-2011 school year trimester was supported by the data. The null hypothesis that fourth grade students who participated in the study taking the daily multiplication fact sheet, a supplement from the *Bridges Math* program, would not make significant growth after taking the daily assessments and the CBAs at the beginning of the trimester and at the end of the trimester was not accepted.

Based on the data of the survey the study group took at the end of the study, certain findings were supported through the analysis of the data. These findings were:

4^{th} graders believed that doing the daily fact sheet did help them to learn the multiplication facts.

Most of the 4^{th} graders scored better in the CBAs as the trimester progressed

Most of the 4^{th} graders felt more confident with overall math skill after taking the CBAs three times during the first trimester

Most of the 4^{th} graders felt that the daily fact sheet and learning their multiplication table will help them to pass the MSP the next time they were to take it.

The finding from the survey did prove the hypothesis that the students in the study group would feel better having learned more multiplication facts than they did before, that they would score better each time they took the CBA, that they felt more confident with math skill overall after completing the study, and they felt that taking the daily fact test helped them pass the MSP. Again the findings were conclusive with the hypothesis.

Discussion

The study resulted in findings that were consistent with the expectations of the author. The hypothesis of the study was that the study group would show growth on the CBAs from the beginning of the first trimester of school to the end of that trimester after taking a multiplication fact sheet on a daily basis. The results did show that the study group made significant growth in their scores on the CBAs during that first trimester.

The group chosen for this study collectively had not passed the mathematics portion of the MSP the previous year. Therefore this group was chosen for the study in order to afford them with extra study of the multiplication facts and thus improving their scores on the Classroom Bases Assessments and the Measurement of Student Progress.

Summary

This chapter was designed to analyze the data and identify the findings. From the data, the hypothesis was supported and the null hypothesis was not accepted. The study group showed

significant growth on the CBA scores between the beginning of the first trimester of the 2010-2011 school year and the end of that same trimester. The difference in the growth from the beginning to the end of the trimester could have been attributed to the students taking a four minute timed multiplication fact sheet on a daily basis during the study.

CHAPTER 5

Summary, Conclusion, and Recommendations

Introduction

This chapter has been organized around the following topic: (a) introduction, (b) summary, (c) conclusions, and (d) recommendations.

Summary

The Third Grade Mathematics portion of the Measurement of Student Progress at the end of the 2009-2010 school year showed scores of White Pass Elementary (WPES) to be below standard. T. The school had been placed on Step 2 of the academic improvement law in Washington state. This brought the teachers of WPES to find out more specifically what part of the test the students had scored lowest in. That area was found to be number sense.

One fourth grade group was chosen for this study. This class completed a daily multiplication fact sheet of thirty problems and was given four minutes to complete it. This was a progressive test whereas after passing the times five facts the student would move on to the times sixes. The study group took the mathematics Classroom Based Assessment during the first trimester of the 2010-2011 school year, one as a pretest, once in the middle of the trimester, and again at the end of the trimester as a post test. The CBAs were used as the measure of growth to determine if the hypothesis could be proven or rejected.

Conclusion

After conducting the study, gathering the data, and evaluating the implications, the data did support the hypothesis. The multiplication fact sheet from the *Bridges Mathematics* program was given daily. Significant gains were shown on the Mathematics Classroom Based Assessment between the first part of the trimester of the 2010-2011 school year and the end of that first trimester. Table 1 shows the study group's scores on the CBA at the beginning of the trimester and Table 3 shows scores on the CBA taken at the end of study, the end of the trimester. The T score had been 3.93.

Recommendations

The literature discussed in this study indicated the direct correlation between mathematical fluency and overall mathematical achievement. Various studies have proven that when students practice their math facts to memory, then overall mathematics achievement in improved.

Since the study group did show a significant amount of growth in mathematical achievement between the beginning of the first trimester to the end of that first trimester, the recommendation of the researcher is to continue the use of the daily multiplication fact sheets to another group of fourth graders for the one trimester, as well as continuing to the second trimester if need be. The researcher would also recommend using this method in other classrooms.

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APPENDIX A

White Pass School District No. 303

White Pass Jr. Sr. High School
516 Silverbrook Rd.
Randle, WA 98377
360/497-5816

White Pass Elementary School
P.O. Box 278
Randle, WA 98377
360/497-7300

Home of the Panthers
Preparing Students Today For Tomorrow
P.O. Box 188, RANDLE, WASHINGTON 98377-0188

Letter of Permission to Conduct Research

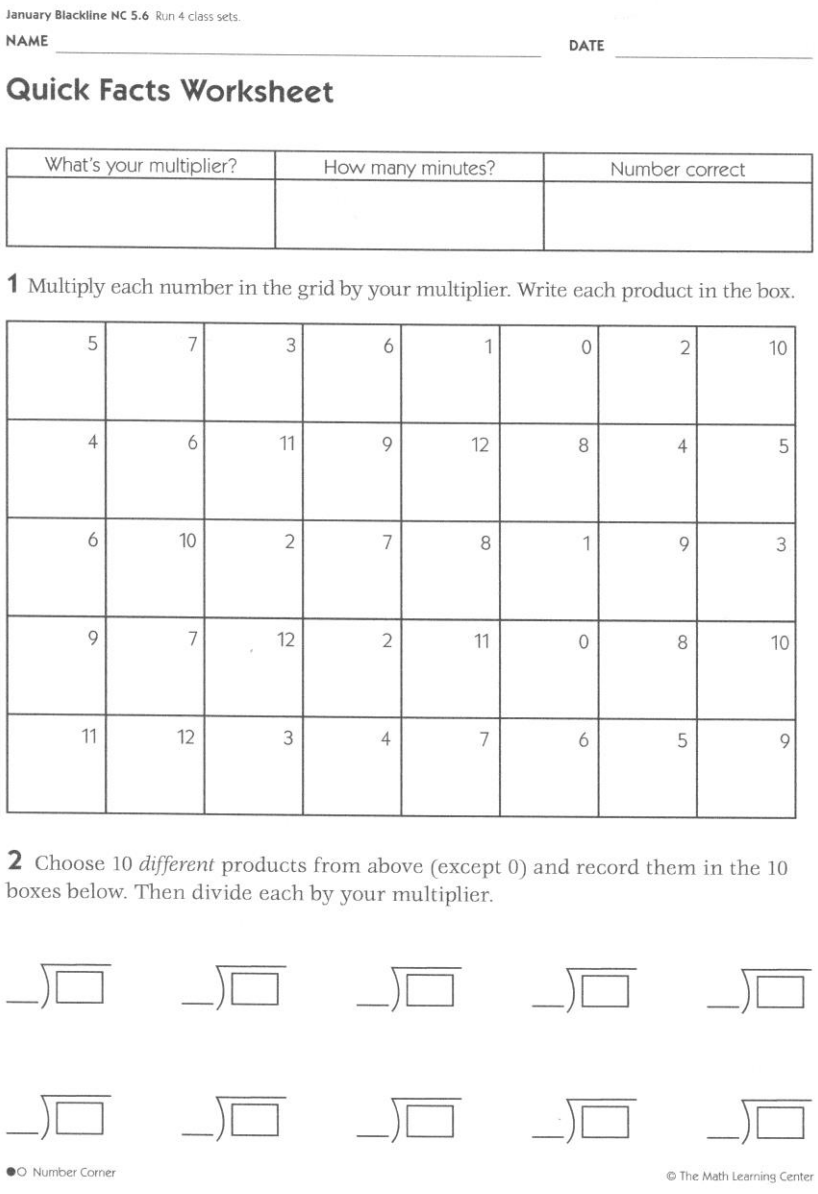
I, Gary Stamper, give Sandra Zacher, permission to conduct research for the Masters Degree at Heritage University during the 2010-2011 academic school year at White Pass Elementary School, with the hypothesis that fourth grade students who practice the basic multiplication facts and take a daily assessment of thirty basic multiplication facts in a four minute time span would have a significantly higher score on the White Pass Elementary School's Classroom Based Assessments than students that did not participate in this activity.

Gary Stamper — 8/24/2010

Gary Stamper, White Pass Elementary School — Date

Figure 8

APPENDIX B



January Blackline NC 5.6 Run 4 class sets.

NAME _____ DATE _____

Quick Facts Worksheet

What's your multiplier?	How many minutes?	Number correct

1 Multiply each number in the grid by your multiplier. Write each product in the box.

5	7	3	6	1	0	2	10
4	6	11	9	12	8	4	5
6	10	2	7	8	1	9	3
9	7	12	2	11	0	8	10
11	12	3	4	7	6	5	9

2 Choose 10 *different* products from above (except 0) and record them in the 10 boxes below. Then divide each by your multiplier.

_)□ _)□ _)□ _)□ _)□

_)□ _)□ _)□ _)□ _)□

●○ Number Corner

Figure 9

APPENDIX C

January Blackline NC 5.5 Run 1 or 2 copies as needed.

Multiplication Facts Class Checklist

Use the table below to keep track of which students have mastered which set of multiplcation facts.

Student Names	2's	3's	4's	5's	6's	7's	8's	9's	10's	11's	12's

Figure 10