Effects of Math Tutoring

On Test Scores

A Special Project

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Effects of Math Tutoring

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ABSTRACT

This project studied the effects that math tutoring would have on the test scores. Thirty-two fifth and sixth grade Level 2 Math WASL students took math tutoring while fifteen Level 2 Math WASL students did not. Tutoring took place outside of their regular math class for one hour three days a week. Pre and post test scores were utilized from the STAR Math assessment to determine significance.

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Introduction

Background for the Project

January of 2002 brought the No Child Left Behind Act (NCLB) that intended to close the achievement gaps between demographic strands of students. In addition, schools would test students in academic areas of math and reading each year. If a specific percent of the students failed to meet the given standard, the school was considered to be in failure of the law and would be placed in an improvement process. If improvement was not met, the school risked being restructured or taken over by the government. This pressure to perform at ever increasing levels had forced states to evaluate their educational plans. President George W. Bush placed importance on mathematics in education with this quote, "You've got to know math if you're going to compete in this 21st-century world" (United States Department of Education, 2006). For the United States to compete with the global market, the education of its people must also be competitive.

Washington State Governor Christine Gregoire had recently addressed the importance of mathematics in a press release "Governor Gregoire and Superintendent Bergeson Propose Temporary Change in Math Graduation Requirement" (2006). Governor Gregoire addressed the concern that students who do not get quality math instruction in schools end up paying tuition in institutions of higher learning for remedial math classes. The direct concern the Governor

addressed was that students and parents were paying for the same education twice. “We owe it to these students to prepare them before they graduate high school” (Office of Governor Christine Gregoire, 2006). United States Secretary of Education, Margaret Spellings, agreed with Governor Gregoire in December (United States Department of Education, 2006) when she said, “It is more important than ever that our students receive solid math instruction in the early grades to prepare them to take and pass algebra and other challenging courses in middle and high school.”

The focus of the national and state level educational leaders was heard quite clearly in every district. The Centralia School District, among many others, critically evaluated math programs and student performance at every level. The desire to ensure a solid math foundation for all students became a district goal. Each school within the district began to echo this goal by including detailed steps toward math improvement within the building’s School Improvement Plan.

Statement of the Problem

Oakview Elementary in the Centralia School District had 47.3% of fifth grade students and 50.3% of sixth grade students that did not pass the Math Washington Assessment of Student Learning, or WASL (Office of the Superintendent of Public Instruction, 2006). Without the tutoring program for math, the students who did not pass would not have the ability to gain the skills lost prior to high school. The basic math concepts not acquired during the years

up to the 6th grade would hinder the success on the Math WASL for high school graduation.

Purpose of the Project

The objective of this project was to find out whether the newly implemented math tutoring program had a positive effect on student math scores. The seventh grade math scores on the Math WASL in the district had never been at or above the average state performance according to the Office of the Superintendent of Public Instruction (OSPI) website from November update in 2006.

Delimitations

This project was done at Oakview Elementary in Centralia, Washington in 2006-2007. Oakview Elementary consisted of 437 students with 50.7% on free or reduced-price meals. Just over 80% of the students were of white ethnicity with the next largest group at eleven percent Hispanic. The math tutoring program was taught by a veteran fifth grade teacher with 30 years experience. The program started in October and ended the last week of March. Students attended the program three days a week and did not attend over vacations or holidays. The curriculum included WASL-released items for the appropriate grade level, STAR Math assessments, and teacher-created resources. There were thirty-two students that completed the program with eighteen fifth grade and fourteen sixth grade students.

Assumptions

The project assumed the teacher had the experience and knowledge to teach the subject matter appropriately and efficiently to the students. The classroom utilized had appropriate spacing and lighting with a welcoming atmosphere. The students involved were ready to learn and driven with the desire to achieve. The materials used in the program were assumed to be appropriate for the developmental level of the students. Also, STAR Math assessments were a valid assessment in measuring math competencies. Finally, the STAR Math assessment was given appropriately to all students involved.

Hypothesis

The fifth and sixth grade students who participated in the math tutoring program at Oakview Elementary would have a significant difference in improvement on STAR Math scores. The students who were in the math tutoring program would have different results compared to those students who did not participate.

Null Hypothesis

The fifth and sixth grade students who participated in the math tutoring program at Oakview Elementary would have no difference in improvement on STAR Math scores compared to those students who did not participate. Significance was determined at the following thresholds: .05, .01, and .001.

Significance of the Project

The number of students passing the Math WASL for the seventh grade in the Centralia School District had not significantly improved for three years. Without improvement in math skills and concepts, half of the students in the Centralia School District would not be able to meet standard on the Math WASL and therefore, would not be able to graduate from high school. The addition of the math tutoring program was a first step toward improving the students' academic performance in math.

Procedure

Students who had scored a Level 2 on the Math WASL of Spring of 2006 were invited to participate in the tutoring program. Notices were sent home the first week of October to invite those students to participate. Teachers discussed the purpose of the program with all potential students and their parents at the Fall Conferences in mid-October. The parents who chose for their child to participate registered their student by November the fifteenth.

At this point, two groups were formed. The control group consisted of the Level 2 students who chose not to participate in the math tutoring program while the experimental group consisted of the Level 2 students who chose to participate in the program. The students were given the STAR Math test in September to establish the students' score when the experiment began. The students attended regular math classes that utilized the same math curriculum throughout the school

year. Math tutoring services began in November. Those students received math tutoring three days a week for one hour.

The experiment ended the last week of March. The students took the STAR Math test again in early May to measure the growth that occurred over the seven month time period. The results were tallied and the report was made.

Definition of Terms

Level 2. a one level below standard score on the Washington State Math WASL

Math WASL Released Items. sample assessment items from the WASL that were taken out of the tool from previous years

STAR Math. an electronic math assessment system by Renaissance Learning

STATPAK. software program that computes statistics

Acronyms

AYP. Adequate Yearly Progress

NCLB. No Child Left Behind Act

NCTM. National Council for Teachers of Mathematics

NIDI. National Institute for Direct Instruction

OERI. Office of Educational Research and Improvement

OSPI. Office of Superintendent of Public Instruction

WASL. Washington Assessment of Student Learning

CHAPTER 2

Review of Selected Literature

Introduction

When the researcher considered the categories to explore, four main areas surfaced. The student was the main concern of the project, so one must have considered whether the student's cognitive ability matched the concepts that were taught. If the concepts were appropriate for the age level, the question would be whether tutoring was an effective method of instruction for the student. When tutoring students, the type of instructional method applied would have an influence on the student as well. Finally, if one was to assess the progress, the tool utilized would need to be valid and reliable to show the student's true growth level.

Cognitive Development

The subject of mathematics compared to other subjects contained concepts that gradually become more difficult in nature. Each state in the United States had to develop a list of concepts that were appropriate for each grade level. States took into consideration the specific math concepts and ideas that needed to be learned by high school graduation and the cognitive development of age of students. This process required some knowledge base about past theories of cognitive development in relation to mathematics. Most recently, researches had

been evaluating neuroscientific research about how the human brain learns (Solomon & Hendren, 2003).

Jean Piaget was a psychologist whose theories have been a corner piece in today's education world. Piaget described cognitive development in four stages that must be sequential in order: sensorimotor from birth to about two years old, preoperational thought from two years old to about seven years old, concrete-operational thought from seven years to eleven years old, and formal operations from eleven years old to fifteen (Forman & Kuschner, 1977). As a person grew older, the brain would develop through each stage. The sensorimotor stage included development of motor coordination, sequencing, and representations. In the preoperational stage, the person developed the ability to problem solve through representation with perception dominating logic (Wadsworth, 1978). The ability to utilize logic on concrete problems entered in the concrete operational phase. Finally in the formal operational period, a person would be able to logically solve complex problems and could think scientifically. According to the works of Wadsworth in 1978, Piaget noted that math concepts could be constructed by the child's interactions with objects. The understanding of concepts and processes through exploration was a must before a child could understand a symbol. The idea of students constructing their understandings of math had recently been utilized in many math textbooks and programs including the Connected Math Program adopted by the Centralia School District.

In addition to cognitive development, Abraham Maslow's theory of the hierarchy of needs had great insight on a learner's ability to be ready to learn. Many educators and respected leaders have adapted the hierarchy to the field of education. Linda Hutchinson (2003) utilized Maslow's theory to explain the basics in learning and teaching. Abraham Maslow arranged five categories of needs in layers or steps. Those categories included the bottom four deficiency need sections: physiological, safety, love/belongingness, and esteem. The top category was the growth needs: self-actualization and transcendence. Each category needed to be mostly fulfilled in order to move up the hierarchy.

The hierarchy of needs was founded on physiological needs including food, water, clothes, and sleep. Due to these basic needs, schools have provided free and reduced breakfast programs for students and drinking fountains among many other support programs. For example, the Centralia School District offered breakfast to students either at cost or through the free and reduced prices. In addition, they ensured that water was available for every classroom and teachers were to provide breaks for bathroom, water, or stretching throughout the school day. After the physiological needs were met, the student would need their basic safety needs met including a safe building and environment. The needs included being safe from bullying, harassment, and physical violence. Belongingness followed safety. Belongingness was described mostly a social need that included love and acceptance. Expressed in the article *Quality of Life Theory III. Maslow*

Revisited (Ventegodt, S., et. al., 2003), without love and affection from parents, children often they were not worthy. With the feeling of belonging and acceptance, one would have advanced on to the esteem category. In this level, people had the opportunity to develop self-esteem, confidence, achievement, and respect for and by others. This level gave humans value. After fulfilling esteem, a person would have been able to grow and learn to their full ability. At this level, students would have been able to succeed in school and college.

In agreement with Maslow's theory, Markku Hannula, Hanna Maijala, and Erkki Pehkonene did a survey on 3057 fifth graders and seventh graders with follow up data one and a half years later on self-confidence and understanding of mathematics (2004). Their data showed significant development in topics measured on a mathematics test between the grades 5-8. The research also showed that self-confidence was a variable that seemed to predict future development for those students. "Regarding the relationship between beliefs and achievement, our analyses suggest that the main causal direction already from grade 5 onwards is from self-concept to achievement" (Hannula, Maijala, & Pehkonen, 2004).

The American Congress supported brain-based research for a decade from 1990-2000. The Congress offered resources to expand research on brain activity (Tall, 2004). In the beginning of this research, the focus was on brain imaging techniques to see where brain activity was occurring. The research eventually

included information on different forms of thinking which caused a transfer of activity from one part of the brain to another. These studies helped to kick-off a better understanding of how cognition works within the brain at different stages in one's life.

Marjorie Solomon and Robert Hendren studied brain-based education and declared that the middle school years were a very important time for brain development (Solomon & Hendren, 2003). "During this period, additional myelination – covering the nerves with conducting tissues – occurs and the connections between the neurons become more efficient" (Solomon & Hendren, 2003, p. 1). Due to this development, students were able to understand the more complex abstract thought and moral reasoning. Even though research has shown that some brains that were exposed to enriched environments have increased connections of neurons, not all situations of highly stimulating environments produce optimal learning. The authors cautioned teachers to be aware of the changes that occurred within early adolescents and to remember that children developed at different rates including the higher-level cognitive capabilities.

In addition to different growth rates of neurons and stimulation, Solomon and Hendren explained that emotions of the students had affected learning in both positive and negative ways. Much like Maslow's theory, Solomon and Hendren echoed that the mental health of our students needed to be considered and addressed in the classroom for optimal cognitive growth.

Effectiveness of Tutoring

The question that drove this research was how could schools increase student achievement in the area of math outside the school board adopted curriculum. According to Chi, Siler, Jeong, Yamauchi, &Hausmann (2001), tutoring was one effective way to increase learning. Human tutoring was one of the most feasible means to impact student achievement in a positive way. This method of human tutoring was not new to the world of education.

Since children started to go to school, they had also been coming home with questions on the lessons presented during the day from their teacher. The parents of yesterday performed the same tasks with their children as the tutors of today. In 2005, there were thirty-four percent of children in Washington State that had no adult supervision after school (Afterschool Alliance, 2005). The lack of supervision meant that 34% of the students did not have the ability to get support on homework or questions from school. This change in support at home helped to springboard the need for extra assistance on schoolwork. Tutoring popped up to become a very popular answer to that need. Two out of three voters in the public opinion survey conducted on election eve and day by the Afterschool Alliance (2006) agreed that after school programs were an absolute necessity. Beyond school-aged children, forty-eight percent of freshman college students would welcome math tutoring specifically (Noel-Levitz, 2007).

In the late 1990's the United States started to look closer at the academic needs and possible solutions. The creation of the 21st Century Community Learning Centers was a federally supported program that helped fund low-performing or schools in high poverty to create programs that added academic opportunities that included tutoring (Frerking, 2007). The Office of Educational Research and Improvement (OERI) took a closer look at the effectiveness of math tutoring in students as reported in the summer of 1999 Bringing Education to After-School Programs for the Department of Education. The OERI stated that the United States student math achievement had fallen below average in the middle grades. The Department of Education supported the focus of improving math performance with America Counts. The first of six goals for America Counts was to provide help, personal attention and additional learning time for students who needed extra assistance in mastering the fundamentals of mathematics in elementary and middle schools.

When President George W. Bush was elected, the President started the No Child Left Behind Act (NCLB). This act believed that all children can learn and demanded that schools perform up to Adequate Yearly Progress (AYP) in the areas of reading and math which writing and science was added later. The NCLB act also offered federal support for academic after school programs. According to Frerking (2007), the National Center for Education Statistics released results of a survey that showed one-third of public schools offered before and after school

programs in the 2003 -04 school year. Also, the 21st Century Community Learning Centers spent nearly one billion dollars annually to support such programs.

With so much support, one may have derived that there must have been research done to support the large amount of spending and time that was dedicated to after-school programs in academics. In fact, there was. One major report came out in the summer of 1982 in the American Educational Research Journal. The Educational Outcomes of Tutoring: A Meta-Analysis of Findings by Peter Cohen, James Kulik, and Chen-Lin Kulik studied sixty-five evaluations of school tutoring programs. The authors brought with them educations from Dartmouth College and the University of Michigan. The report was a study on students who received tutoring services and students who gave tutoring services to fellow students who were in need.

The reviews in the study took place in late 1960s through the late 1970s. All of the reviews came to the same conclusion. In 45 of the 52 achievement studies, the performance of students who were tutored was better than those who did not receive tutoring (Cohen, Kulik, and Kulik, 1982). The effects of tutoring seemed to vary in different situations. For example, the effects were larger in tutoring programs of shorter duration and in tutoring programs that were more structured. Also, the tutoring effects were larger in mathematics than in reading where basic skills were tested on examinations. According to the authors, the

tutoring programs had a definite and positive effect on the academic performance and attitudes of those who received the tutoring.

Some public schools had utilized grade retention or social promotion for students who struggled with math and other subjects. Through the years, the research has shown that retaining and promoting had negative effects with the largest being on the self-esteem and self-concept of the student. Jimerson, Pletcher, and Kerr (2005) discussed that grade retention increased the likelihood of students dropping out of school. The authors emphasized that evidence-based interventions was the direction that schools should go. The interventions included parent involvement, tutoring programs, continual progress monitoring, intensive reading programs, health programs, mentoring programs, and more.

The popularity of tutoring as an intervention was echoed in college freshman in the United States in 2007. The National Freshman Attitudes Report released that forty-eight percent of all freshman wanted access to math tutoring. Forty-six percent reported they had a hard time understanding and solving complex math problems.

So far the desire or need for tutoring in math surfaced in public schools and in colleges. So how did the parents and voters feel? The Afterschool Alliance ran a poll to find out how the voting public felt about after school services in the November 13, 2006 news release. Ninety percent of working parents said they were satisfied with the after school program their child attended. Seventy-two

percent of voters agreed that Congress should increase funding for after school programs. Eighty-two percent of voters agreed that there should be activities offered for children and teens that would have been a safe place to go that would provide more opportunities to learn. The support even crossed over three major political party lines. Democrats showed an eighty-eight percent support while Republicans agreed at a seventy-six percent level, and finally there was an eighty-four percent agreement from the Independents.

When looking at interventions and support for students, schools must have considered tutoring. Tutoring, especially in math, had proven to have a positive effect on student learning and the support of the public behind after school programs. The United States Secretary of Education, Richard Riley, once stated:

> We must get serious about offering youth safe and smart after school opportunities. For our children who need extra help with learning – let's provide it. Youth in after school programs earn better grades, watch less television and develop new skills and interests. For our children who need safe places to go, let's keep school doors open after the school day ends so youth have a place in the community to go and benefit from computers, tutoring, school libraries, music, art, and supervised recreation. With opportunities like these, young people in after school programs are more likely to stay out of trouble and learn more (OERI, 1999).

Instructional Methods

Instructional methods have increased in numbers in order to master the art of skill and conceptual understanding for the student. Many educational leaders have developed methods to deliver instruction to students in an effective and efficient manner. Each method had some or little research to support it.

The traditional classroom would have teacher-directed lessons that utilized direct instruction. The National Institute for Direct Instruction (NIDI) in 2007 defined direct instruction as "a model for teaching that emphasizes well-developed and carefully planned lessons designed around small learning increments and clearly defined and prescribed teaching tasks." The NIDI had documentation of several research projects they completed with positive results. With direct instruction, the teacher delivered the skills and instruction which was quite different from the inquiry approach.

The inquiry based approach to teaching included the student as the center of learning. The inquiry method required students to think like scientists when given a task or problem. Teachers would give students a question or problem to investigate that would require the students to independently ask more probing questions that lead them to answers and eventually conceptual understanding. Alan Colburn (1998) defined inquiry based instruction as, "the creation of a classroom where students are engaged in (essentially) open-ended, student-centered, hands-on activities." During student activity, the teacher would monitor

student progress and would give one-on-one assistance where needed. Inquiry-based instruction had allowed students to interact with each other to discover their answer. The social opportunity allowed in the inquiry method was also present in cooperative learning.

Cooperative learning was a teaching method that placed students in groups to discover a concept as a team. Each member of the group was assigned a task or job for the group and through teamwork students would reach their common goal. Cooperative learning offered additional benefits to students including diversity, and relief from many social problems such as loneliness, reduction of stereotypes, and antisocial behaviors (Johnson, Johnson, & Stanne, 2000).

As with most researchable items, there were several pieces of research that could not support any one of these methods as the one method that would fit all fields of study. In 2003, Zohar and Kravetsky published results from a study that compared the effectiveness of cognitive conflict to direct teaching for students who were two academic levels behind. The study included 121 ninth grade biology students that were divided into four experimental groups (2 x 2). The results of the study showed that findings were inconclusive. The high level students benefited from the cognitive conflict model while the direct teaching students were delayed. The direct teaching method had the opposite effect.

Yet another research finding by Keith Weber in 2005 compared standard instruction to experimental instruction with two groups of college trigonometry

students. The result of the experiment had suggested that students who received the experimental method were able to perform satisfactorily on the final exam as compared to those with standard instruction and who performed poorly. The students who had experimental instruction outperformed those without in the ability to show strong understanding of trigonometric functions.

Even at the sixth grade level, research on different types of instructional methods that had signs of positive effect on instruction had non-satisfactory results. Technology had been a relatively new piece to the educational field and teachers were excited at the prospects that technology could have with students in their classroom. There were many programs for classrooms that were intended to boost student performance in many subject areas. This inspired Yixin Zhang to research the effectiveness of computer-assisted instruction with traditional lecture-type instruction on triangles with sixth graders in 2005. Zhang conducted two quasi-experiments with 108 students. The results of the experiment showed no significant difference between the two methods and their effect on the students.

The National Council of Teachers of Mathematics (NCTM) released a research brief the topic of effective teaching in 2007 on their website. After documenting many articles and reading through research, the unidentified author commented, “No single study can prove that one method or feature of teaching is better than another for helping students achieve a particular goal because too

many factors affect the result." The focus of the article was on two learning goals, skill efficiency and conceptual understanding. Skill efficacy required some whole class instruction with seatwork and practice. On the other side, conceptual understanding offered opportunities for students to wrestle with mathematical ideas and required students to do more demonstrating and explaining.

The idea of utilizing a variety of instructional methods was echoed inside the results of an experiment done by Dara Wakefield in 2001. This study focused on the students' attitudes towards learning Korean through six teaching strategies: mastery learning, cooperative learning, non-directed learning, and three direct teaching strategies. The students' attitudes towards the effectiveness of these methods were measured through a survey given at the end of the course. The results showed that students preferred the more traditional approaches, but enjoyed the change the other approaches offered. In addition, some students found they performed better through one of the different strategies.

According to Maslow (Wadsworth, 1978), students must have felt safe and as if they belonged prior to being mentally prepared to learn. Negative past experiences children have encountered often formed blocks or hurdles for students when approaching math or other subjects. Ventegodt, Merrick, and Andersen in 2003 noted that children often reacted to emotional pain by making poor or negative decisions. Many students feared being called on by the teacher to answer questions allowed in class after such an event for fear of shame or

embarrassment. In 2003, one study by Judith Larkin and Harvey Pines suggested that the practice of calling on students without their volunteering caused avoidance behaviors in participation in the learning activities. Females had a higher rate of avoidance behaviors than males. This negative change in attitude affected the level of engagement the students had in the lesson.

To overcome past issues, James Ginn and Henry North have published strategies and tips through Texas Southern University. Ginn and North identified the negative attitude toward math as needing change in order to improve the students' ability to learn. The philosophy that one grew through failure was a beginning point with their students. Ginn and North utilized historical and cultural happenings that paralleled their points. Abraham Maslow's hierarchy of needs was a clear explanation of the steps to fulfill including safety and belongingness. A tip for teachers that needed to be incorporated was to create a safe classroom environment for story sharing. Those steps helped to create change with students in their classroom and others.

The various instructional methods have research to both support and question their effectiveness with students. This circumstance did not come from an unknown reason. The NCTM stated:

> The features of teaching that facilitate skill efficiency and conceptual understanding do not fall neatly into categories frequently used to contrast methods of teaching, such as expository versus discovery, direct

> instruction versus inquiry-based teaching, student-centered versus teacher-centered teaching, and traditional versus reform-based teaching . . . features of teaching that promote conceptual understanding (and perhaps skill efficiency) cut across these common labels.

STAR Math Assessment

William S. White, President and CEO of the Charles Stuart Mott Foundation, said, ". . . afterschool programs, like our public school systems, are being held to higher levels of accountability and performance" (White, 2005, p. 5). The No Child Left Behind Act (NCLB) required schools who were receiving federal money for after school programs as supplemental services to report results of intermittent assessments (Toch, 2006). Those assessments carried consequences because if schools did not meet proficiency as designate by NCLB for five consecutive years, those schools would have been at risk for reorganization or would have been taken over by the state (Guilfoyle, 2006). Utilizing a progress monitoring tool to verify the effect of tutoring would have helped schools create high quality programs for student achievement.

The STAR Math assessment had been validated with a nationally representative sample of more than 60,000 students (producing a very high test-retest reliability range of 0.76-0.87) and was highly correlated to state and national standardized tests, including ITBS, CAT, SAT, and TerraNova (Renaissance Learning, 2006). More specifically, the STAR Math program

significantly correlated at the .05 threshold to the Washington Assessment of Student Learning at the sixth grade level with a 0.54 r-score (Renaissance Learning, 2007, Table 3). According to the National Center on Student Progress Monitoring (2005), the STAR Math demonstrated sufficient evidence to meet the basic standard in reliability and validity. Also in a quasi-experiment in Texas that involved 898 students, the Math Assessment students demonstrated significantly higher scores than those students who did not use the Math Assessment by an effect size of .20 Standard Deviations in grade 5 (Yeh, 2006, p. 628).

However, there were skeptics to programs that were like the STAR Math program. Those critics doubted the ability of the fill-in-the-blank and multiple choice electronic assessment programs to accurately depict what a child had or had not learned from the instruction that they had received. One such critic was W. James Popham. Popham (2006) wrote an article for the Association for Supervision and Curriculum Development that expressed the need for teachers and school administrators to look at what skills were actually being tested and whether those skills matched the skills being taught during the day. Just as important, Popham expressed that each test needed to be scrutinized for whether it was indeed instructionally informative. Most schools looked for tests that were able to diagnose the weaknesses of the students to assist the teacher in the direction of future instruction. Instructional psychologists defined instructionally informative tests as those that included learning progressions of sequenced

subskills and knowledge. Popham (2006) added that the developers of the test should have used heavy input from educators in that area.

Another evaluator of the STAR Math program for the Mental Measurements Yearbook was Mary Garner (2003). Garner noted that the emphasis of the test was on basic skills and was not focused on higher order thinking or open-ended problem solving. However, Garner also stated that the test was technically sound and very convenient for assessing students on the basic skills.

The STAR Math test was created to be a curriculum-embedded assessment program that created individual performance reports immediately which showed teacher's what areas a student was weak in. The teacher's would take this knowledge to create future lessons to strengthen those areas and create an individualized tutoring program. The STAR Math program also created an electronic tutoring program for each student as well (Yeh, 2006).

Research results on the STAR Math assessments showed that quick feedback on student weaknesses allowed the teacher time to address those issues within the adopted curriculum whether it was an inquiry based lesson or other. The STAR Math program addressed issues for each individual student and provided remedial tutoring designed for those issues. The program also gave valid and reliable measures to report for the Title I portion of the NCLB act. Support for the program was strong throughout the majority of the research.

Summary

Studies have shown that tutoring programs have had some success. The math program utilized in this study followed the works of Piaget and taught students in the middle years formal operations with several different types of instructional methods. The instructional methods were chosen to suit to the type of concept or skill being taught. This strategy had come from the results of several studies including Dara Wakefield.

When faced with the struggle to understand while other students had grabbed onto concepts, the self-confidence of any person would suffer or be unsettled. School programs must have considered the work of Maslow and others. Self-confidence should have been built by meeting the physiological, safety, and belongingness needs in each student. By keeping the students involved in school programs after school, the student was more likely to have had their basic needs met.

As stated quite clearly from William S. White, “Afterschool programs are a critical first step in the process of changing not just how we educate our children, but how we come together, in partnership – school and community – to ensure their success” (White, 2005, p. 8).

CHAPTER 3

Methodology and Treatment of Data

Introduction

With increasing pressure of high stakes testing from the Washington Assessment of Student Learning (WASL), Oakview Elementary in the Centralia School District had been focusing on increasing student achievement levels in the area of mathematics. As with many options available to implement, Oakview Elementary decided to start a tutoring program for their fifth and sixth grade students in math.

Methodology

The participants involved were fifth and sixth grade students who attended Oakview Elementary School in 2006-2007. Oakview Elementary hosts fourth through sixth grade students with an enrollment of 437. Within the 437, eighty percent were of white ethnicity, eleven were Hispanic, and other populations were represented with less than two percent each. The math tutoring program included thirty-two students in comparison to fifteen students who did not participate. Students in both groups were not involved in other programs such as Special Education or Learning Assistance Program for Math. Both groups of students had placed into a Level 2 on the Math WASL. The validity issues considered were the small sample size and the limited time devoted to the project.

There were several instruments that were utilized for this project. Students were selected by Math WASL scores from spring of 2006. Fall and spring STAR Math assessments were utilized to measure academic growth throughout the 2006-2007 school year. The STAR Math test consisted of twenty-four multiple choice items that covered numeration concepts, computation processes, word problems, estimation, data analysis, statistics, geometry, measurement, and algebra (Garner, 2003).

This quantitative project was done with non-equivalent control group design in the quasi-experimental category. More specifically, it used the pretest-posttest control group design. Two groups of students were given the STAR Math test in the fall and again in the spring. Although students can naturally get better at taking a test if they see the instrument more than once, the spacing of the test had a total of eight months distance that helped to keep this to a minimum.

The procedure began in mid-September when the groups of students were selected by the Spring Math WASL scores. Students who scored at a Level 2 and were not receiving assistance from Special Education or Learning Assistance Program for Math were invited to participate. All students at Oakview Elementary took the STAR Math assessment at the end of September. Thirty-two students volunteered to participate in October and started the program in November. Fifteen students qualified for the tutoring program, but opted not to participate.

Both sets of students received the STAR Math assessment in September of 2006. Both sets of students received the same curriculum during the school day. Students who participated in the math tutoring program began in November and finished at the end of March. The students took the spring STAR math test in May. The math tutoring program was delivered for one hour each day by the same teacher to all students using Math WASL-released items, and a teacher-created curriculum that included math computation skills, math games, individualized skill and concept assistance, and inquiry lessons.

The limitations of the study included a small sample, maturation, attendance, medicine for disabilities, and other factors.

Participants

The participants for this study were the fourth, fifth, and sixth grade students of 2006-2007 at Oakview Elementary in the Centralia School District located in Centralia, Washington. Oakview Elementary had a total of 437 students enrolled of which 54% were male and 46% were female. The school had a population that was 80% white and 20% other ethnicity. The free and reduced lunch program enrolled 50.7% of the student body. There were 30 classroom teachers with an average of 16.9% years of experience. The teacher of the tutoring program had retired with over thirty years of experience and was hired specifically for the tutoring program. Approximately half the student body had

passed the Math WASL. All students in the tutoring program had scored a Level 2 on the Math WASL and volunteered to participate.

Instruments

The Math WASL results were utilized for potential placement in the tutoring program. Students who had volunteered to participate and those who chose not to participate were given the fall and spring STAR Math assessments to measure growth.

Design

The non-equivalent control group design in the quasi-experimental category was utilized in this study where there were two groups of students: one who received math tutoring, and one who did not. Therefore, this study was a quantitative project.

Treatment of Data

The delta score from the fall-spring STAR Math assessments was utilized on a *t* test from the STAT Pak program. The results from the treatment group were compared to the results of the control group to show significance.

Summary

Two sets of students with two sets of scores were compared through a *t* test. The *t* test was utilized to show if there was a significant growth in math academic performance from students who attended an after school math tutoring program and those who did not.

CHAPTER 4

Analysis of the Data

Introduction

Introducing a math tutoring program was a critical first step for improving student achievement in math for Oakview Elementary in the Centralia School District. Math Washington Assessment of Student Learning (WASL) scores showed that approximately half of the student body had not passed the state assessment. Students that left the elementary school behind in their math skills would have struggled to catch up and to keep up with other classmates. Without a change in the system, student scores would continue to suffer risking low graduation rates in the high school.

Description of the Environment

The fifth and sixth grade students of the 2006-2007 school year that scored a Level 2 on the 2006 Math WASL were invited to participate in the math tutoring program. The students who chose to participate would receive math tutoring instruction three days a week for one hour each day provided by a 30 year veteran teacher. All students attended their regular math class with school district adopted curriculum during the school day and received tutoring services at a different scheduled time. The math tutoring program utilized Math WASL released-items and teacher created materials. The teacher created materials

included direct instruction on computational skills, inquiry lessons on math concepts, math games, and individualized instruction for other needs.

The program ran from the beginning of November to the end of March. The class was hosted in a regular classroom with carpeting, desks, tables, and inspirational posters on the wall. The students were provided with snacks at the beginning of the tutoring and a drinking fountain was also available. The students were placed into small groups of less than ten and offered services at scheduled times during the school day and after school.

Hypothesis

The fifth and sixth grade math tutoring program students at Oakview Elementary would have a significant difference in improvement on fall to spring STAR Math scores. The students who were in the math tutoring program would have different results compared to those students who did not participate.

Null Hypothesis

The math tutoring program fifth and sixth grade students at Oakview Elementary would have no difference in improvement on STAR Math scores compared to those students who did not participate. Significance was determined at the following thresholds: .05, .01, and .001.

Results of the Study

Fall STAR Math test scores were collected and compared to the spring STAR Math test scores. The delta scores from the two tests were utilized through a *t* test for independent samples because the groups were randomly formed.

The delta scores in Table 1 were compiled at the end of May. Group X consisted of thirty-two students who participated in the math tutoring program. Group Y consisted of fifteen students who qualified but did not choose to take the tutoring program.

Table 1

Data Table of STAR Math Pre-Test, Post-Test, and Delta Scores

Experimental Group	Pre-Score	Post-Score	Delta Score	Control Group	Pre-Score	Post-Score	Delta Score
S1	2.7	4.0	1.3	T33	6.4	5.5	-0.9
S2	6.0	10.0	4.0	T34	4.4	4.6	0.2
S3	3.6	6.1	2.5	T35	8.5	7.0	-1.5
S4	4.2	5.2	1.0	T36	4.8	5.6	0.8
S5	4.1	3.9	-0.2	T37	3.7	4.5	0.8
S6	6.7	6.3	-0.4	T38	4.7	5.3	0.6
S7	4.4	6.6	2.2	T39	4.9	4.2	-0.7
S8	4.0	5.6	1.6	T40	4.6	5.8	1.2
S9	3.1	6.5	3.4	T41	5.3	7.4	2.1
S10	5.9	10.0	4.1	T42	5.1	8.9	2.5
S11	3.9	9.1	5.2	T43	3.4	4.8	1.4
S12	4.7	6.9	2.2	T44	5.6	7.4	1.8
S13	3.7	4.3	0.6	T45	3.2	4.4	1.2
S14	5.2	5.1	-0.1	T46	4.7	5.8	1.1
S15	5.3	5.1	-0.2	T47	4.8	5.6	0.8
S16	4.1	7.7	3.6				
S17	6.3	9.9	3.6				
S18	3.9	2.9	-1.0				
S19	4.1	5.0	0.9				
S20	7.0	8.7	1.7				
S21	4.9	12.9	8.0				
S22	6.5	8.0	1.5				
S23	5.0	7.9	2.9				
S24	7.0	6.0	-1.0				
S25	6.1	7.8	1.7				
S26	6.1	7.2	1.1				
S27	4.9	9.0	4.1				
S28	2.6	4.4	1.8				
S29	7.3	11.9	4.6				
S30	7.0	7.9	0.9				
S31	4.7	5.5	0.8				
S32	6.1	8.8	2.7				

After utilizing a *t* test on the delta scores, Group X, math tutored students, sum of the scores was 65.1 and the average of the group was 2.03. This led to the sum of squares to equal 121.09. Group Y's fifteen students not in program had a sum of scores of 11.4 and their average calculated to 0.76. The sum of squares for Group Y was 17.16. The resulting t-value was 2.32 with 45 degrees of freedom.

Table 2

t Test for Independent Samples

Statistic	Values
No. of Scores in Group X	32
Sum of Scores in Group X	65.1000
Mean of Group X	2.03
Sum of Squared Scores in Group X	253.53
SS of Group X	121.09
No. of Scores in Group Y	15
Sum of Scores in Group Y	11.4000
Mean of Group Y	0.76
Sum of Squared Scores in Group Y	25.82
SS of Group Y	17.16
t – Value	2.32
Degrees of Freedom	45

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

$$t = \frac{2.03 - 0.76}{\sqrt{\left(\frac{121.09 + 17.16}{32 + 15 - 2}\right)\left(\frac{1}{32} + \frac{1}{15}\right)}}$$

$t = 2.32$

Even though the *t* test resulted in 45 degrees of freedom, the author had chosen to use a benchmark step of 40 as shown in Gay, Mills, & Airasan's 2006 book Educational Research Competencies for Analysis and Applications on page 571. The distribution of t for 40 degrees of freedom at the .05, .01, and .001 thresholds were 2.021, 2.704, and 3.551 respectively.

Table 3

Distribution of t

	p		
df	.05	.01	.001
40	2.021	2.704	3.551

Findings

The math tutoring program at Oakview Elementary made somewhat of a difference on math tests scores for the students that participated. Significance was found at the .05 threshold which led to the rejection of the null hypothesis with a t-value of 2.32 being higher than the threshold of 2.021. The rejection of the null hypothesis offered support for the hypothesis at this level. However, the null hypothesis was accepted at the .01 and .001 thresholds due to the t-value of 2.32

being below the 2.704 threshold. So, the hypothesis was not supported at the higher levels.

Discussion

The purpose of this study was to determine the effectiveness of a math tutoring program at Oakview Elementary. The finding of this study was in agreement with Chi, et. al. (2001) that human tutoring was one effective way to increase student achievement with the significance found at the .05 threshold. The performance of students who were tutored was better than those who did not receive tutoring overall during the 2006-2007 school year at Oakview Elementary which was consistent with the results from Cohen, Kulik, and Kulik results from sixty-five compiled tests in 1982.

The results were also consistent with the author's expectations. The program was in the beginning years of development with no financial support for materials for the program. The program facilitator had thirty years experience in the education field and a strong desire to succeed. With success at the beginning stages, the students would surely benefit from the continuation and improvements.

Summary

The math tutoring program started with 32 Level 2 Math WASL students who pre-tested in September and began program at the first of November. These students were compared to fifteen students who chose not to participate in the program and who had similar Math WASL scores from spring 2006. The students

received tutoring services three days a week for one hour each day through the end of March in addition to their regular math class. The final piece of the sequence was the post-test that was taken in May. The results of comparing the delta scores with a *t* test showed t ›.05 threshold which rejected the null hypothesis. The hypothesis was supported at this threshold.

CHAPTER 5

Summary, Conclusions and Recommendations

Introduction

Washington state Governor Christine Gregoire shared a concern in a press release in 2006 that students who were not getting a high quality math education in schools were having to pay twice for the same instruction. This concern was shown when nearly half of the students at Oakview Elementary in the fifth and sixth grades had passed the state assessment in mathematics. This problem had occurred for several years which led the School Improvement Team to develop a math tutoring program to offer to students who were just below standard at Level 2. This program was to be offered as an addition to the regular math instruction they received during school day.

The math tutoring program was offered to students on a voluntary basis. Pre- and post-tests were given to the thirty-two students who signed up and to the fifteen students who chose otherwise. The pre-test was given in September and post-test was given in May.

Summary

The need for math assistance at Oakview Elementary was not uncommon. Many educational and national leaders have recognized such needs throughout our country. The No Child Left Behind Act of 2002 pushed the need to the top of many school's priority list with the philosophy that schools will be held

accountable for student achievements in reading and math. Washington state Governor Christine Gregoire shared her concern that students were paying for remedial math courses in college when it was our duty to provide them with it the first time during a press release. Only half of Oakview Elementary students were passing the math WASL in spring of 2006. This led the school to start a math tutoring program.

The ability to grasp conceptual knowledge and utilize higher order thinking skills develop around the middle school years. It was noted by the Office of Educational Research and Improvement in 1999 that math achievement had fallen below average in the middle grades. Also, the America Counts had their top goal be to provide help, personal attention, and additional learning time for students who needed it in the area of math.

The math tutoring program took place in November through March with providing students with additional instruction. The instruction given varied and included direct instruction for computational skills, math games for concepts, inquiry lessons for conceptual understanding, and Math WASL released items for practice.

The fall STAR Math scores were tallied for a Delta score along with the spring STAR Math scores for the thirty-two participants and fifteen students in the control group. The experimental group had an average growth of 2.03 years as

the control group had an average growth of 0.76 years. Significance was determined by a t test for independent samples at the .05 threshold.

Conclusions

The math tutoring program had significantly helped the fifth and sixth grade students who volunteered to participate at the .05 threshold. Students who participated in the program had benefited and the program did show positive effects on math scores.

Recommendations

In order to have results that can relate to the masses, the study should be with more students and continued at schools of different size and demographics over a longer period of time. The study should include students at different levels instead of the limited sample selection in this study. When researching whether tutoring was effective, it is recommended to research what types of teaching methods would be utilized as well as the partnering of method with skill. Students attitudes toward learning may have been a factor in the results which would also be an area to go into more depth on in the future.

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