Increasing Fourth Grade MAP Scores

By Applying Math Connects

A Special Project

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Increasing Fourth Grade MAP Scores

by Applying Math Connects

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Abstract

The purpose of this project was to determine whether changing the mathematics materials from Math Investigations to Math Connects at Harrah Elementary School helped students increase their MAP scores in mathematics. The researcher gathered data pertaining to students in the 2008-2009 fourth grade class and the 2010-2011 fourth grade class. Each group was assessed in the fall and the spring using the MAP.

The research did not support the hypothesis. After being taught with Math Connects mathematics materials, the treatment group stayed statistically similar to the control group which had been taught with Math Investigations. The research conducted by the author did not provide expected results. The students in the study responded well to the strategies and practices modeled by the researcher and supported by the research, but success in the classroom did not transfer to success on the MAP test.

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CHAPTER 1

Introduction

Background for the Project

Harrah Elementary School had the opportunity to be part of the State of Washington Summit District Improvement Initiative (OSPI, 2012). The opportunity was afforded because of low scores on the state standardized test, the Measure of Student Progress (MSP). A requirement of the initiative was to adopt mathematics teaching materials that the state recommended. The recommended materials that Harrah Elementary School chose to adopt were Math Connects (MC).

The study provided evidence of Math Connects impact on academic achievement. The research provided a comparison of MC to the previous mathematics materials, Math Investigations, using the Measures of Academic Progress (MAP) assessment.

Statement of the Problem

Harrah Elementary students did not meet grade level standards in mathematics as shown by the results of the Measure of Student Progress. Consequently, students continued to be advanced to the next grade level but without the skills needed to be successful with the grade level standards. Due to the lack of achievement, a materials change needed to be made. Math

Investigations was abandoned for the state recommended Math Connects materials.

Purpose of the Project

The purpose of this project was to determine whether changing the mathematics materials from Math Investigations to Math Connects at Harrah Elementary School helped students increase their MAP scores in mathematics. The MAP test gave the researcher measurable data in order to support whether or not Math Connects was significantly better than Math Investigations.

Delimitations

The study took place over the school years of 2008-09 and 2010-11. The study was administered at Harrah Elementary School in Harrah, Washington. The students chosen to participate in the study were fourth graders taught by the researcher. The group of students represented a diverse population. Most of the students received free or reduced lunch, had transitory living conditions, and dealt with high poverty issues. The majority of the students were Native American, while the remaining students were Hispanic and Caucasian. Prior to the study, the researcher taught fourth grade for seven years. The researcher was also involved in extensive professional development in the area of mathematics, including specific training in both of the sets of mathematics materials involved in the study. During the 2008-09 school year, the students in the control group were taught by the researcher using the Math Investigations materials throughout the

entire year. The treatment group taught by the researcher in 2010-2011 received instruction with the Math Connects materials throughout the entire year.

Assumptions

The researcher attended all professional development opportunities provided for the Math Connects materials, as well as other professional development opportunities that covered mathematics strands such as number sense, measurement, algebra, and probability. The Math Connects materials were determined to be appropriate for fourth graders and covered the state standards adequately. The Math Connects materials had a technology component that allowed for student engagement and immediate feedback when needed for assessment. The students in the study were appropriately placed in fourth grade as determined by their successful completion of previous grade levels.

Hypothesis or Research Question

Through the change of the mathematics materials from Math Investigations to Math Connects, students significantly improved math scores on the Measure of Academic Progress (MAP). Mathematics was a fundamental component of education that was necessary for academic success.

Null Hypothesis

There was no significant difference between mathematics MAPS scores for those students who were taught with the Math Investigations materials and

those students who were taught with the Math Connects materials. Significance was determined for $p \geq .05, .01, .001$.

Significance of the Project

The Measure of Student Progress indicated that Harrah Elementary School did not meet standard in the area of mathematics for the fourth grade. The MAP scores and MSP scores for both of the study years were comparable. Because of this, intervention was necessary. The results of the study advised the district administration about future allocations of resources in the area of mathematics instruction.

Procedure

The researcher gathered data pertaining to students in the 2008-2009 fourth grade class and the 2010-2011 fourth grade class. Each group was taught one hour per school day, each used a different set of mathematics materials. Each group was assessed in the fall and the spring using the MAP. The reason for the fall and spring assessments was to collect data to see if any growth was made for each group during their fourth grade academic year.

Acronyms

HES. Harrah Elementary School

MAP. Measure of Academic Progress

MC. Math Connects

MSP. Measure of Student Progress

CHAPTER 2

Review of Selected Literature

Introduction

The researcher selected literature pertinent to the research topic. Many characteristics of a learning environment that fostered life-long learners in the area of mathematics were included. The literature supported components vital to success within the classroom. These components were included because they were promoted as being included in the Math Connects materials when they were purchased by Harrah Elementary School. The literature included study of students with low motivation, characteristics of reform-based mathematics materials as opposed to traditional mathematics materials, and a specific look at Math Connects mathematics materials.

Engaging Students With Low Motivation

Behavior was a major obstacle when teaching a large number of students at the same time. One behavioral issue was low motivation exhibited by students. Low motivation was caused by a variety of factors, but the effect was similar. The effect of low motivation was limited success in the classroom. Evidence of limited success was found in assignment and test scores, group interaction, homework return rate, and attitude toward school. Because of the evidence, there were many practices teachers changed in the classroom to raise motivation in

students. Teachers used high-yield strategies, checked often for understanding, and found innovative ways to engage students.

High-yield strategies were strategies good teachers used every day. Students were naturally motivated when teachers employed high-yield strategies. These strategies helped teachers provide the very best instruction. When high-yield strategies were used consistently, the product was better than what would have been produced if students were taught without them. Identifying similarities and differences was one effective high-yield strategy. The effect this strategy had on learning was that it enhanced students' understanding and ability to use knowledge. The strategy allowed students to figure out how two things were alike, but also how they were different which was sometimes more valuable. Reinforcing effort was another strategy that yielded higher results than if it wasn't used. Students realized their effort caused their success. Many analogies were made about professional athletes who only made it to their present position because of hard work, determination, and believing they could do it. "If you believe that effort is the most important factor in achievement, you have a motivational tool that can apply to any situation." (Marzano, 2001, p. 50) Teachers helped students make connections between effort and achievement. Explicitly telling students what they did well on helped them understand the effort they put forth had positive results. Another high-yield strategy was cooperative learning. Students naturally wanted to work together. Providing the structure and

environment for them to do this was highly motivating and resulted in student engagement. Marzano stated that "cooperative groups should be kept rather small in size, grouping should be applied consistently and systematically, but not overused."(Marzano, 2001, p. 88) Cooperative groups motivated students because they confirmed their understanding in a non-threatening way. High-yield strategies increased student engagement and motivation. These strategies were used on a regular basis to affect the most students.

Checking for understanding was essential for student motivation. Students needed to know they understood concepts correctly if they were to continue. Correcting misconceptions was a key in learning. If teachers didn't know their students had misconceptions and they continued to solidify those misconceptions the results were disastrous. Not only did the students not understand the intended learning, they had a perception in their mind that was very difficult to change. No wonder some students had low motivation to learn when they had never been told they were wrong in their thinking and the result was a poor grade on a test or in a class when they thought they were doing well.

Checking for understanding was done in a variety of ways. One quick and convenient way was to use oral language. Fisher explained that "through careful planning and analysis of student responses, teachers closed the gap between what students needed to know and what they already knew." (Fisher, 2007, p. 35) Questioning was another valuable way to check for understanding. Teachers

needed to be deliberate in their use of questioning. What was the purpose of the question? Who was responding to the question, individuals, partners, whole group? When students were unable to answer questions did the questions need to be rephrased or scaffolded? Teachers only asked questions that they truly wanted to know the answer to. An additional way to check for understanding was to use writing. One way to use writing was to do a Read-Write-Pair-Share. Students read a selection, wrote a response to a prompt, discussed response with a partner, and then shared with the group. During this process the teacher monitored by reading what was written, listened to pairs while they were discussing their responses, and observed during the whole group sharing time. Checking for understanding motivated students and was used often in the classroom.

Teachers found innovative ways to motivate students to learn. Traditional teaching resulted in students who were not motivated, sometimes to the point that they dropped out of school altogether.

> Many people who had difficulty in school might have prospered if the new ideas about effective instructional practice had been available. Furthermore, given new instructional practices, even those who did well in traditional educational environments might have developed skills, knowledge, and attitudes that would have significantly enhanced their achievements. (Bransford, 2000, p. 31)

Two innovative teaching techniques teachers used were technology and the design of the learning environment. The use of technology in the classroom was at the forefront of practices teachers used to motivate students. People of all ages were accessing technology at a variety of levels every day. Technology was engaging and highly motivating. Often, technology was self-pacing, allowing for the participant to learn at his or her own rate. This was motivating because the participant accessed technology at whatever level he or she was comfortable with, then progressed through the technology in a way that was understandable. One way technology was used in the classroom was connecting students with professionals, such as scientists, virtually. In one such partnership, students from around the world collected data about their immediate environment and were able to see how their community connected with the world community. "Working with practitioners and distant peers on projects with meaning beyond the classroom was a great motivator." (Bransford, 2000, p. 213)

The design of the learning environment was another crucial factor in engaging and motivating students. Education moved from a mass production idea where the goal was to get the answers the teachers had inside their heads to one that asked the learners to be the leaders. No longer was the end goal of a class or school year a mystery to students. Students designed what they wanted their end goal to be and also the steps they needed to take to reach the goal. Bransford spoke of highly motivating learning environments being learner-centered,

knowledge-centered, and assessment-centered. When students designed their learning, natural motivation occurred. They naturally wanted to solve problems they were invested in. "Knowledge-centered environments also focused on the kinds of information and activities that helped students develop an understanding of disciplines." (Bransford, 2000, p. 136) An understanding of disciplines was essential to give every student an access point to their learning. If a student had a project they wanted to complete that required an understanding of quantum physics yet his or her academic level only reached as high as basic computation, there would be no access point. That was why a combination of learner-centered and knowledge-centered education was so important. The teacher and the learner had to be aware of where the student accessed his or her understanding. The third component of a motivating classroom in regard to the design was the assessment-centered component. To gauge where a student accessed curriculum, relevant and valid assessments needed to be put in place. These assessments had to "provide opportunities for feedback and revision". (Bransford, 2000, p. 140) The assessments served as checkpoints for students so they knew whether they were on the right track or whether they needed to work in a different direction. Constructive feedback was motivating because it allowed students to know what they were doing well and the areas they needed to improve in.

There were many ways teachers increased student motivation in the classroom. A few ways to reach students who had low motivation were to use

high-yield strategies, check for understanding often, and use innovative teaching techniques. Whether students were eager or reluctant to learn, teachers could always make changes that positively affected all learners.

Reform-Based and Traditional Mathematics Curricula

"If schools were to achieve world-class status in mathematics, widespread efforts were needed to advance the mathematics opportunities of . . . students." (McKinney, 2009, p. 282) The United States lagged behind other countries in mathematics success. Changes had to be made to increase student understanding. "If the United States was to compete internationally, teachers needed to facilitate all students' learning of important mathematics to promote construction of mathematical meaning". (McKinney, 2009, p. 278) One way the United States tried to address the deficits was to implement teaching strategies and materials that sought to build conceptual understanding behind the computation because "a primary role to problem solving, stipulating that mathematics education sought to develop students' mathematical thinking, enabled students to identify and solve problems…and helped them appreciate the usefulness of mathematics" (Charalambos, 2010, p. 3) These teaching strategies and materials were often referred to as curriculum, or the plural form, curricula.

> Three main meanings of the term *curriculum* are common in the US. First, a curriculum can be thought of as the set of written materials provided to teachers—the textbook, teachers' guide, assessment materials,

> etc. In addition, the term curriculum is used to refer to the lesson that is enacted in the classroom. Finally, for many teachers in the US a curriculum also exists in the form of district- or state-level learning objectives for students. (Sherin, 2009, p. 469)

Similarities and differences that were found between traditional mathematics curricula and mathematics reform curricula related to amount of practice provided, connections to the real world, and scaffolded experiences.

The amount of practice varied between traditional mathematics curricula and mathematics reform curricula. Traditional mathematics curricula generally provided much more practice, although, "many mathematics students spent much of their time on basic computational skills rather than engaging in mathematically rich problem-solving experiences"(McKinney, 2009, p. 279) As the move to reform based curricula progressed, practice lessened. Previously it was thought that providing more practice helped students memorize processes and the students became more fluent and accurate. "This type of instruction included the following: giving information and directions, monitoring seat work, reviewing assignments, and giving tests." (McKinney, 2009, p. 282) Unfortunately, it was found that if a student did not understand the concept, he or she continued to make the same mistakes and the process that got the student to the mistaken result was memorized. "There was the awareness that traditional methods of teaching mathematics had created a barrier for the construction of mathematics

instruction". (Saracho, 2008, p. 306) Reform-based mathematics provided the background for the concept so the student understood the process and it made sense. With this understanding, the student completed the process accurately and applied the understanding in new situations. Repeated practice was no longer necessary. Students understood concepts, applied acquired understanding to new situations, and those new situations naturally led to new concepts. It was more of an organic, cyclical pattern. "The research literature indicated that students who were taught by alternative approaches tended to develop conceptual understandings of different mathematical concepts without forfeiting basic arithmetic computational skills." (McKinney, 2009, p. 278)

Connections to the real world were seen as vital to mathematics reform and student success. If a student applied his or her understanding of a concept in a meaningful way, then the understanding would stay with the student and be used again. "Problem solving became "the central focus of the mathematics curriculum . . . a primary goal of all mathematics instruction, and an integral part of all mathematical activity" (Charalambos, 2010, p. 16) Traditional curricula failed to provide real world connections. "The direct instruction method was the one that was most frequently used in the schools. Its major weaknesses were that children were uninvolved in their learning and it had the most ineffective method." (Saracho, 2008, p. 306) Concepts were taught in isolation with no connections to related understandings or other academic areas. With real world

connections, students could make sense of ideas and they also became more engaged with the learning. Real world connections answered the question of why did I learn this? "Kilpatrick believed that children should be provided with a natural learning environment and provided with experiences that would stimulate their learning." (Saracho, 2008, p. 309) Intuitively, students saw mathematical concepts as tools they needed to solve problems. "Problem solving had long attracted the interest of researchers and mathematics educators alike, especially during the last quarter of the twentieth century when it had become the major theme in research and in mathematics curricula (Charalambos, 2010, p. 12)

Scaffolded experiences were necessary to provide students with a place they could access mathematics curricula. "Baroody (2006) acknowledged a continuum of methods to teaching mathematics including direct instruction, guided discovery learning, flexible guided discovery learning, and unguided discovery learning." (Saracho, 2008, p. 310) Traditional curricula put a concept in front of students with no regard to what the student already knew and could do in relationship to it. Reform-based curricula provided teachers with background students needed to be competent in their understanding. "Teachers adapted lessons in a variety of ways while still maintaining the goals of the lessons" (Sherin, p. 473). An emphasis was placed on "the importance of helping students attend to the structural—as opposed to the superficial characteristics of additive and multiplicative arithmetic word problems." (Charalambos, 2010, p. 7) A

variety of formative assessments were continuously administered to students to find out where they were on the continuum of understanding. With this continuum, teachers reached students and taught them the foundation they needed in a way that made sense. Teachers were "encouraged to respond to the ideas that students raised during instruction, and to use these ideas to determine how to proceed with a lesson." (Sherin, 2009, p. 473)

Before mathematics reform, "teachers were essentially teaching the same way they were taught in school". (McKinney, 2009, p. 278) Because of this, students failed to understand mathematics in a meaningful way. With traditional curricula, "many students were still left behind when lecture, limited chalkboard instruction, and individual seat work were the prominent instructional delivery methods. (McKinney, 2009, p. 280) Changes had to happen for students to be successful. Mathematics reform encouraged, "experiences that appreciated discovery, allowed for multiple paths in deriving at the correct answer, built on students' previous knowledge, and promoted student discourse." (McKinney, 2009, p. 280) The researcher used this information to provide the most beneficial instruction to students.

Math Connects

Math Connects was the set of mathematics materials chosen by Harrah Elementary teachers to use when they instructed students. The materials were suggested by OSPI as being the most aligned with Washington State mathematics

standards. "With the Washington State K – 12 Mathematics Standards firmly in place, Washington has turned its attention to finding instructional programs and materials that align with those standards." (Strategic Teaching, 2008, p. 2) Math Connects materials were desirable because they led to increased "conceptual understanding, procedural fluency, strategic competence, and adaptive reasoning." (Research Base of Effective Mathematics Instruction, 2007, p. 3) Each of the components was equally necessary for student success, but the sequence of the components was important.

Conceptual understanding was an important component of mathematics to teach before teaching procedural fluency. Math Connects researchers (Program Efficacy Research, 2007) proposed teaching concepts before teaching procedures because when students understood the concept, they could use that understanding to follow procedures quickly. This caused students to be more accurate because they were not confused about why they were following certain steps. (Research Base of Effective Mathematics Instruction, 2007) The research paper (Program Efficacy Research, 2007) explained that teachers needed to teach strategies explicitly. Students had to have experience with a variety of strategies so they could choose or disregard them efficiently to solve problems. Adaptive reasoning was used by students "to navigate through the many facts, procedures, concepts, and solution methods and to see that they all fit together in some way." (Research

Base of Effective Mathematics Instruction, 2007) The research done on Math Connects confirmed these components were in place.

Math Connects was researched in a variety of ways to ensure it was the very best set of materials to increase students' academic success. Glencoe conducted an experimental study and found that students who were taught with Math Connects had higher posttest scores than a control group that was taught with different materials. (Program Efficacy Research, 2007) The State of Washington did a curriculum review and found that Math Connects aligned with Washington State standards more than other materials.(Strategic Teaching, 2008) The state of Washington then asked Strategic Teaching to conduct a study of their review to make sure it was accurate. (Strategic Teaching, 2008)

Summary

The research provided a description of methods used to motivate students. The research also reviewed the similarities and differences between traditional mathematics curricula and reform based mathematics curricula. Additionally, research was chosen that reviewed Math Connects materials and how they improved student scores. Articles selected supported the author's research.

Low motivation was a hurdle that was hard to overcome in the classroom. The research conducted by Bransford, Marzano, and Fisher on ways to increase motivation provided the researcher with strategies that improved teaching and learning in the classroom, specifically in the area of mathematics. With these

strategies in place, and combined with the Math Connects materials, the researcher expected to see improved results on assessments, including the MAPS.

Math Connects was a reform-based set of teaching materials that the state of Washington approved for use in Summit schools. Harrah Elementary School adopted the materials based on the State of Washington's recommendations. Reform-based materials were created to help students with their understanding of mathematics. They were, "designed to encourage and sustain learning experiences for students and included the following: allowed students to tackle real-life mathematical problems; accept and encourage different approaches to solving a problem; and differentiate mathematics instruction." (McKinney, 2009, p. 282) The researcher believed implementing reform-based materials and instruction would reflect positively on student performance.

Math Connects was put through a variety of review processes. Glencoe conducted a study and the results provided evidence that students taught with the materials had improved scores. Washington State conducted a review that provided evidence that Math Connects was closely aligned with state standards. Strategic Teaching checked the work done by Washington State and found Math Connects was aligned with the state standards.

CHAPTER 3

Methodology and Treatment of Data

Introduction

The purpose of this study was to find out whether new mathematics materials increased student scores on standardized tests more than previous materials. At the time the study was conducted there were between seventy-five and ninety fourth grade students at Harrah Elementary School. Approximately 80%-90% of the fourth grade students failed to meet standard on the Measure of Student Progress. Many students also failed to meet standard on the Measure of Academic Progress.

In 2005, Harrah Elementary School adopted mathematics materials called Math Investigations for students in Kindergarten through fifth grades. One of the reasons Harrah Elementary School adopted these materials was because Math Investigations was the precursor to the Connected Math Program which was a sixth through ninth grade set of mathematics materials the district had adopted the previous year. The district assumed that Math Investigations would make it easier for students to transition between the two sets of mathematics materials. Another reason Math Investigations was adopted was because the research backing up the teaching in the curriculum was extensive. Unfortunately, teaching with Math Investigations did not help students make significant academic achievement gains. As the years progressed, the Math Investigations materials proved to be a struggle

for teachers, students, and parents because of the lack of explanation of number sense concepts and skills that were required for student success in mathematics. The Math Investigations materials did not provide students with enough computational fluency or mental mathematics skills to help students do well on the MSP. Harrah Elementary School had recently changed to new, state recommended math materials called Math Connects. These materials provided more computational practice and standard algorithm work along with the foundational support for mathematics reform.

Methodology

An experimental research method was used to find the effectiveness of Math Connects as measured by MAP. The two groups in the study received instruction by the same teacher under the same circumstances and had the MAP test administered at approximately the same time during the school year. Each group received a different treatment, the control group received Math Investigations, and the treatment group received Math Connects.

Participants

The participants were chosen using a convenient sampling method. (Gay, 2009, p. 134) Gay (2009) stated this sampling method used students who "happened to be available at the time". Students at Harrah Elementary were sorted into fourth grade classes by third grade teachers. Third grade teachers kept certain factors in mind, such as: gender, ethnicity, behavior, and previous test

scores. The fourth grade classes were made up of equal divisions of each of the factors. Therefore, all classes were theoretically the same. The same process for filling classes was done for many years, therefore, students in both years involved in the study were generally the same in all ways.

The 2008-09 group of sixteen students were made up of the following demographics: race/ethnicity: American Indian 64%, Hispanic 28%, Caucasian 7%, Other 1%. The percentage of students who qualified for free or reduced lunch was 86%. Special Education accounted for 15% of the group. One percent of the students received Migrant Services, and the unexcused absence rate was 5%.

The 2010-11 group of sixteen students were made up of the following demographics: race/ethnicity: American Indian 63%, Hispanic 30%, Caucasian 7%, Other ≥1%. The percentage of students who qualified for free or reduced lunch was 85%. Special Education accounted for 16% of the group. Three percent of the students received Migrant Services, and the unexcused absence rate was 2%. (OSPI, 2012)

The school was located in a rural setting on the Yakama Indian Reservation. Many families worked in agriculture or for the Yakama Nation Tribe in a variety of capacities. Most students had been a student at Harrah Elementary School since Kindergarten. No significant changes happened in the population throughout the length of the study.

The 2008-09 class had a total of twenty-three students and the 2010-11 class had a total of twenty-six students. The students who were de-selected from the study were those who were absent more than thirty days throughout the school years of the study and those who received special services for mathematics instruction. The researcher was the only teacher responsible for providing instruction for the sample students.

Instruments

The instrument the researcher used was the Measure of Academic Progress. The MAP was "designed to provide educators the information they need to improve teaching and learning in the areas of reading, language usage, mathematics, and science as well as develop instructional strategies and promote school improvement." (Mental Measurement Yearbook, 2012) Harrah Elementary School administered the assessment in reading and mathematics. The assessments were administered in the fall and spring for both subjects. "Advantages of MAP assessments include increased measurement precision for most students, increased efficiency in terms of testing time, and the availability of rich individual and aggregated feedback that supports a range of standards-based, norm-referenced, and growth interpretations." (Mental Measurement Yearbook, 2012)

Design

The researcher used a quasi-experimental design called the non-equivalent group design.(Gay, 2009, p. 259) The non-equivalent group design was chosen because the author was comparing pretests and posttests of two different groups. The groups were made up of students in the author's classroom during the project years, therefore students were not chosen individually to participate, but as a group.

The sources of invalidity controlled for in the non-equivalent group design were history, maturation, testing, instrumentation, selection, mortality, and the external source of invalidity, multiple-X interference. According to Gay (2009), history was not a factor in this study. History referred to any changes that happened during the study. In general, the years of the study passed with no significant differences. Maturation referred to the changes all fourth graders go through physically, intellectually, and emotionally. Since fourth graders were the same in the study as they were anywhere else at any other time, Gay (2009) stated that this factor was controlled for. Testing was controlled for since the participants all took an identical pretest and posttest. Also, Gay (2009) indicated the instrumentation was controlled for by the use of the MAP test as the pretest and the posttest. Selection was controlled for studying the findings of the pretests and finding both groups similar.(Gay, 2009, p. 245) Gay (2009) stated mortality was controlled for by eliminating students without two sets of scores. The

external source of validity, multiple-X interference was controlled for because it was not relevant. (Gay, 2009, p. 256)

The sources of invalidity not controlled for in the design were regression, selection interaction, and the external source of invalidity, pretest-X interaction. Gay (2009) indicated regression was not controlled for because there was no way of controlling for how students would score on each test. Students included in the study were going to score based on their understanding and that could not be changed. Selection interaction could not be controlled for because there was no way to change the fact that one group may have come in with advantages or disadvantage over the other, or if they were going to profit more or less from the treatment they were given. (Gay, 2009, p. 244) The external source of invalidity, pretest-X interaction could not be controlled for because the researcher worked with students who were in the classroom regardless of what they had or had not been exposed to in previous classes our outside the classroom. (Gay, 2009, p. 256)

Procedure

During the 2008-09 school year, students were taught math lessons by the researcher using the mathematics materials Math Investigations. These materials were

> designed to support students to make sense of mathematics so they could learn that they could be mathematical thinkers, focused on computational

> fluency with whole numbers as a major goal of the elementary grades, provided substantive work in important areas of mathematics—rational numbers, geometry, measurement, data, and early algebra—and connections among them, emphasized reasoning about mathematical ideas, communicated mathematics content and pedagogy to teachers, and engaged the range of learners in understanding mathematics. (TERC, 2012)

Instruction was given sixty minutes per day, five days a week. Use of manipulatives was modeled by the researcher and used by students when relevant. Students explored ideas and constructed their own meaning of concepts through experimenting and questioning. Cooperative peer groups were essential in the understanding of concepts.

The researcher participated in grade level and school-wide meetings and workshops to align Math Investigations with the Washington State standards. During that school year and the year that followed Harrah Elementary School developed a plan that required all students to master specific standards by the end of each grade level. This was to promote understanding of specific standards that the next school year built upon. Another component of these meetings and workshops was to develop pretests and posttests for each of the standards. The researcher taught Math Investigations in the order recommended by the publisher. This was a school-wide decision that all grade levels followed. A pacing guide

was developed by grade level teachers so all standards were covered and an appropriate amount of time was spent on each.

A fourth grade placement test was given to each student at the beginning of fourth grade. This was used to get a basic understanding of each student's understanding of the standards and to group students in a way that was conducive to their learning. Unit pretests were administered before each unit to get a more specific understanding of how students were answering questions related to the standards covered in the unit. During the unit, the researcher provided a variety of examples and strategies to solve problems. Students often shared their strategies and processes with small groups and the whole class. They solved problems on white boards, computers, and in workbooks. Posttests were given after each unit. Students who mastered standards were given enrichment activities so they could apply their understanding in different situations. Students who did not master standards were given more small group and individual instruction and practice.

The 2010-11 group received math instruction from the researcher who used the Math Connects teaching materials. These materials were selected because they

> provided opportunities for students to build their understanding of mathematical concepts and ample practice to master important skills. All concepts were taught through and practiced within a strong problem-

> solving environment, insuring that students became life-long problem solvers. (McGraw Hill, 2012)

Instruction was given sixty minutes a day, five days a week. Use of manipulatives was modeled by the researcher and used by the students when relevant. Instruction was provided with strategies identified as best practice in mathematics reform.

The researcher participated in grade level and school-wide meetings and workshops to align Math Connects with the Washington State standards. During that school year and the year that followed Harrah Elementary School developed a plan that required all students to master specific standards by the end of each grade level. This was to promote understanding of specific standards that the next school year built upon. Another component of these meetings and workshops was to develop pretests and posttests for each of the standards. The researcher taught Math Connects in the order grade level teachers found to be most relevant for students. This was a school-wide decision that all grade levels followed. A pacing guide was developed by grade level teachers so all standards were covered and an appropriate amount of time was spent on each. The Harrah Elementary math committee approved the pacing guide and assisted the grade level in adding entry and exit tasks that would be used as quick formative assessments.

A fourth grade placement test was given to each student at the beginning of fourth grade. This was used to get a basic understanding of each student's

understanding of the standards and to group students in a way that was conducive to their learning. Unit pretests were administered before each unit to get a more specific understanding of how students were answering questions related to the standards covered in the unit. During the unit, the researcher provided a variety of examples and strategies to solve problems. Math Connects had an extensive technology component. The researcher often shared standards related songs, games, and online examples that were highly engaging to students. Students often shared their strategies and processes with small groups and the whole class. They solved problems on white boards, computers, and in workbooks. Posttests were given after each unit. Students who mastered standards were given enrichment activities so they could apply their understanding in different situations. Students who did not master standards were given more small group and individual instruction and practice.

Treatment of the Data

To determine if the change from Math Investigations to Math Connects was effective in raising student standardized test scores, a Statpak was used to compare the results of test data from the two groups.(Statpak, 2012) The researcher used a *t*-test for independent variables.

Summary

The researcher conducted an experimental study using the experimental design. The participants were selected from the Harrah Elementary fourth grade

class. The twenty-three students in the 2008-09 control group received mathematics instruction from the researcher using Math Investigations. The nineteen students in the 2010-11 treatment group received mathematics instruction from the researcher using Math Connects. The gain was compared using a t-test. The calculated value of the t-test was checked for significance.

CHAPTER 4

Analysis of the Data

Introduction

An experimental study was conducted by the author to determine whether Match Connects had greater effect on student achievement than the previous mathematics materials, Math Investigations. The author researched whether MAP scores improved because of the change to the newly adopted Math Connects materials.

The MAP test was the instrument used to compare the effectiveness of the newly purchased Math Connects materials with the previously used Math Investigations materials. Statistical evidence was provided by the author that showed the results.

Description of the Environment

The study took place over the school years of 2008-09 and 2010-11. The study was administered at Harrah Elementary School in Harrah, Washington. The students chosen to participate in the study were fourth graders taught by the researcher. Twenty-three students were in the control group; with sixteen of those chosen participate in the study. Sixty percent of the students were male. Sixty-four percent of the students were American Indian, twenty –eight percent were Hispanic, seven percent were Caucasian, and one percent was considered other. The group of students represented a diverse population. Eighty-six percent of the

students received free or reduced lunch. Fifty-eight percent had transitory living conditions, which meant they commonly stayed in homes belonging to people other than their biological parents. High poverty issues affected seventy-three percent of the students, acknowledged by household income of ≤$20,000. Nineteen students were in the treatment group; with sixteen of those students chosen to participate in the study. Fifty-five percent of the students were male. Sixty-three percent of the students were Native Americans, thirty percent Hispanic, seven percent Caucasian, and less than one percent other. The group of students represented a diverse population. Eighty-five percent of the students received free or reduced lunch. Fifty-eight percent had transitory living conditions, which meant they commonly stayed in homes belonging to people other than their biological parents. High poverty issues affected seventy-one percent of the students, acknowledged by household income of ≤$20,000.(OSPI) The researcher was involved in extensive professional development in the area of mathematics, including specific training in both sets of materials involved in the study. During the 2008-09 school year, the students in the control group were taught by the researcher using the Math Investigations materials throughout the entire year. The treatment group, taught by the researcher in 2010-2011, received instruction with the Math Connects materials throughout the entire year.

Hypothesis/Research Question

Through the change of the mathematics materials from Math Investigations to Math Connects, students significantly improved math scores on the Measure of Academic Progress. Mathematics was a fundamental component of education that was necessary for future academic success.

Null Hypothesis

There was no significant difference between mathematics MAP scores for those students who were taught with the Math Investigations materials and those students who were taught with the Math Connects materials. Significance was determined for $p \geq .05, .01, .001$.

Results of the Study

The MAP test given in the fall and spring of each of the academic years used in the study provided data for the results of the study. Both the experimental group and the treatment group took the fall MAP test to provide a baseline so the researcher was able to prove that the groups were essentially equal at the beginning of fourth grade. Both groups took a spring MAP test to show how much growth was made throughout the fourth grade school year. The results of the MAP test were analyzed by the researcher using the Statpak.(Statpak, 2012) Based on the results, the researcher identified the treatment group as not having statistically higher achievement than the control group.

Sixteen students were selected to be part of the study in each of the study years. The 2008-2009 student pretest data had a range of 46. The 2010-2011 student pretest data had a range of 43. The median of the 2008-2009 student pretest data was 189.5, the median of the 2010-2011 student pretest data was 191. The 2008-2009 student pretest data was bi-modal, having modes of 183 and 189. The 2010-2011 student pretest data was uni-modal, having a mode of 190.

Table 1
MAP Pretest Data

Pretest Data 2008-2009	Pretest Data 2010-2011
211	187
185	193
188	186
189	190
210	165
189	202
178	190
183	203
204	189
203	201
165	181
198	199
190	208
183	192
199	190
191	208

A *t* score of .28 was determined in the statistical analysis (Gay, Mills, & Airasian, 2005). The means of the control and experimental group's MAP scores determined the value of *t*. The mean of the treatment group was 192.75, and the mean of the control group was 191.63. The degrees of freedom were 30. The evidence suggested that students entering fourth grade at Harrah Elementary started with essentially the same mathematical understanding in each of the study years.

Table 2
Statpak Analysis of Pretest Scores

Statistic	Value
No. of scores in Group X	16
Sum of Scores in Group X	3084.0000
Mean of Group X	192.75
Sum of Squared scores in Group X	596228.00
SS of Group X	1787.00
No. of Scores in Group Y	16
Sum of Scores in Group Y	3066.0000
Mean of Group Y	191.63
Sum of Squared scores in Group Y	589730.00
SS of Group Y	2207.75
t-value	.28
Degrees of freedom	30

Significance was determined for $p \geq .05$, .01, and .001 (Gay, Mills, & Airasian, 2009). The calculated value of *t*, which was .28, was less than the threshold value for *t* at .05, which was 2.042. The calculated value of *t*, .28, was less than the threshold value at .01, which was 2.750. The calculated value of *t*, .28, was less than the threshold value at .001, which was 3.646. At the .05, .01, and .001 levels the null hypothesis was accepted, therefore there was no support for the hypothesis. There was no significant difference between students entering the fourth grade in the 2008-2009 school year and the 2010-2011 school year.

Table 3
Distribution Of t For Pretest Data

	p		
df	.05	.01	.001
30	2.042	2.750	3.646

Sixteen students were selected to be part of the study in each of the study years. The 2008-2009 student posttest data had a range of 46. The 2010-2011 student posttest data had a range of 43. The median of the 2008-2009 student posttest data was 199, while the median of the 2010-2011 student posttest data was 205. The 2008-2009 student posttest data was tri-modal, having modes of 182, 199, and 206. The 2010-2011 student posttest data was bi-modal, having modes of 198 and 205.

Table 4
MAP Posttest Data

Posttest Data 2008-2009	Posttest Data 2010-2011
210	198
188	202
199	198
186	198
216	168
206	215
182	199
194	211
209	205
206	213
170	189
197	207
182	221
191	205
207	205
199	225

A *t* score of 1.60 was determined in the statistical analysis (Gay, Mills, & Airasian, 2009). The means of the control and experimental group's MAP scores determined the value of *t*. The mean of the treatment group was 203.69, and the mean of the control group was 196.39. The degrees of freedom were 30. The evidence suggested the treatment of the experimental group was not significantly different from the control group. Math Connects did not statistically improve fourth grade student scores as seen on the MAP test results, but the effect was not negative.

Table 5
Statpak Analysis Of Posttest

Statistic	Value
No. of scores in Group X	16
Sum of Scores in Group X	3259.0000
Mean of Group X	203.69
Sum of Squared scores in Group X	666467.00
SS of Group X	2649.44
No. of Scores in Group Y	16
Sum of Scores in Group Y	3142.0000
Mean of Group Y	196.38
Sum of Squared scores in Group Y	619374.00
SS of Group Y	2363.75
t-value	1.60
Degrees of freedom	30

Significance was determined for $p \geq .05$, .01, and .001 (Gay, Mills, & Airasian, 2009). The calculated value of *t*, which was 1.60, was less than the threshold value for *t* at .05, which was 2.042. The calculated value of *t*, 1.60, was less than the threshold value at .01, which was 2.750. The calculated value of *t*, 1.60, was less than the threshold value at .001, which was 3.646. At the .05, .01, and .001 levels the null hypothesis was accepted, therefore there was no support for the hypothesis. No significance was found at the .10 level, which had a threshold value of 1.697. The researcher did however find significance at the .20 level. At .20, the threshold value for *t* was 1.310. Given that the calculated value of *t* was 1.60, significance was found at the .20 level. Although, there was no significant difference between students taught with the Math Investigations materials in the 2008-2009 school year and students taught with the Math Connects materials in the 2010-2011 school year found at higher levels, significance was found at the .20 level.

Table 6
Distribution of t for Posttest Data

			p		
df	. 20	.10	.05	.01	.001
30	1.310	1.697	2.042	2.750	3.646

Findings

No difference was found in mathematics achievement between the control group and the treatment group when they entered the fourth grade. Statistically, the students were academically the same as measured by the MAP test in the fall of each of the study years. The Statpak analysis calculated a *t* score of .28 (Gay, Mills, & Airasian, 2009). The results suggested that students who entered fourth grade at Harrah Elementary School were the same academically.

There was no significant difference found between the control group and the treatment group at the end of fourth grade as measured by the highest three threshold values for *t*. Math Connects did not improve student learning. Significance was determined for $p \geq .05$, .01, and .001 (Gay, Mills, & Airasian, 2009). The calculated value of *t*, which was 1.60, was less than the threshold value for *t* at .05 which was 2.042, .01 which was 2.750, and .001 which was 3.646. The null hypothesis, which stated there was no significant difference in MAP test scores between those that received math instruction using Math Connects materials and those who received math instruction with Math Investigations was accepted at $p \geq .05$, .01, and .001. (Gay, Mills, & Airasian, 2009, p. 563). There was no support for the hypothesis, through the change of the mathematics materials from Math Investigations to Math Connects, students significantly improved math scores on the MAP. The *t* score was less than the threshold values provided by Gay at the three highest levels. The researcher did

find significance at the .20 level. At that level the *t* value of 1.60 was greater than the threshold value of *t* at .20, which was 1.310.

Discussion

The researcher wanted to find out if changing mathematics materials to Math Connects caused a significant improvement in student achievement. The evidence obtained through the research confirmed there was slight improvement, but it was not statistically significant at the three highest levels. Statistically, students who were taught by the researcher using Math Connects performed no better on the MAP test than students who were taught using the Math Investigations, although significances was found at lower levels.

Because of the significance found at .20, and the fact there was no harm done by the Math Connects materials, the researcher found that the materials supported academic achievement in a variety of ways. Research had been done in the area of student motivation that provided teachers with strategies that helped students engage with the materials and improved their understanding. Math Connects encouraged the use of technology and provided supplemental materials on compact disc and online. (McGraw Hill, 2012) High-yield teaching strategies were provided in the teacher dialogue sections of the teachers' manuals. The materials also included a multitude of ways to check for understanding and providing relative feedback.

Math Connects was a reform-based set of materials and therefore it met different criteria than traditional materials previously had. Math Connects provided students with problems with real-world application and provide an amount of practice that was necessary to master a skill. Making mathematics relevant to students was a goal achieved by Math Connects.

Summary

Harrah Elementary fourth graders did not significantly improve academically in mathematics, as measured by the MAP test, when they were taught with Math Connects. Support was not found for the hypothesis. The null hypothesis was accepted at .05, .01, and .001. The author's hypothesis was not supported at the three highest levels. The null hypothesis was accepted at the three highest levels. Significance was found at the .20 level. Students who used Math Connects performed better 80% of the time than students who used Math Investigations.

The research did not provide support for Math Connects' positive effect on student learning at the three highest levels. Students entering fourth grade at Harrah Elementary School were found to be statistically similar as measured by the MAP test. After being taught with new Math Connects mathematics materials, the treatment group stayed statistically similar to the control group which had been taught with Math Investigations.

CHAPTER 5

Summary, Conclusions, and Recommendations

Introduction

The purpose of this study was to find out whether Math Connects had a more positive effect on student achievement than Math Investigations. Harrah Elementary School was part of the Summit District Improvement Initiative. The initiative provided funds to purchase mathematics materials. To have access to the funds, the district agreed to use materials recommended by the state of Washington. Math Connects was the set of materials Harrah Elementary agreed to use.

Harrah Elementary became part of the Summit District Improvement Initiative because of low test scores on the state test, the MSP. A variety of changes were implemented, of which changing the mathematics materials was one. Other changes included teaching strategies that would yield high student engagement and administrative support for coaching teachers on best teaching practices.

The researcher believed combining best practices and teaching strategies with new mathematics reform materials would improve student achievement in mathematics. The researcher chose a non-equivalent group design to compare MAP scores of a control group and a treatment group. Each group was

statistically similar at the beginning of the fourth grade. The study showed how the implementation of Math Connects affected the treatment group.

Summary

Harrah Elementary students did not meet grade level standards in mathematics as shown by the results of the Measure of Student Progress. Consequently, students continued to be advanced to the next grade level but without the skills needed to be successful with the grade level standards. Due to the lack of achievement, a materials change needed to be made. Math Investigations was abandoned for the state recommended Math Connects materials. The researcher hypothesized through the change of the mathematics materials from Math Investigations to Math Connects, students significantly improved math scores on the MAP test. Scores on the MAP test correlated to how well students scored on the MSP. The researcher gathered data pertaining to students in the 2008-2009 fourth grade class and the 2010-2011 fourth grade class. Each group was taught one hour per school day, each used a different set of mathematics materials. Each group was assessed in the fall and the spring using the MAP. The reason for the fall and spring assessments was to collect data to see if any growth was made for each group during their fourth grade academic year.

The research in Chapter 2 provided a description of methods used to motivate students and reviewed the similarities and differences between

traditional mathematics materials and reform based mathematics materials. Low motivation was targeted in the research. The researcher was provided with strategies that improved teaching and learning in the classroom, specifically in the area of mathematics. With these strategies in place, and combined with the Math Connects materials, the researcher expected to see improved results on assessments, including the MAP. Reform-based materials were created to help students with their understanding of mathematics. The researcher believed implementing reform-based materials and instruction would reflect positively on student performance.

The methodology and treatment of the data was found in Chapter 3. The researcher conducted an experimental study using the experimental design. The participants were selected from the Harrah Elementary fourth grade class. The twenty-three students in the 2008-09 control group received mathematics instruction from the researcher using Math Investigations. The nineteen students in the 2010-11 treatment group received mathematics instruction from the researcher using Math Connects. The gain was compared using a t-test. The calculated value of the t-test was checked for significance.

Analysis of the data was conducted in Chapter 4. Harrah Elementary fourth graders did not significantly improve academically, as measured by the MAP test, when they were taught with Math Connects. Support was not found for the hypothesis at the three highest levels. Significance was found at the .20 level.

Students who were taught with Math Connects performed better 80% of the time on the MAP test than students who were taught with Math Investigations. The data was measured using a *t*-test. The *t*-value that resulted was 1.60. The hypothesis was not supported at .05 which had a threshold value of 2.042, .01 which had a threshold value of 2.750, or .001 which had a threshold value of 3.646. The hypothesis was also not supported at the .10 level which had a threshold value of 1.697. The hypothesis was supported at .20 which had a threshold value of 1.310. This meant the null hypothesis was accepted at the three highest levels, but was rejected at the .20 level. After being taught with new Math Connects mathematics materials, the treatment group performed better than the control group which had been taught with Math Investigations.

Conclusions

The research conducted by the author did not provide expected results. The selected literature was research based and had been proven to improve student achievement in many ways with many different groups of students. The students in the study responded well to the strategies and practices modeled by the researcher, but success in the classroom did not transfer to significant success on the MAP test.

The results from the research did not support the hypothesis that through the change of the mathematics materials from Math Investigations to Math Connects, students significantly improved math scores on the Measure of

Academic Progress. Harrah Elementary fourth graders did not significantly improve academically in mathematics, as measured by the MAP test, when they were taught with Math Connects. Support was not found for the hypothesis at the three highest levels, but support was found at the .20 level. The null hypothesis was accepted at .05, .01, and .001, but rejected at .20. The author's hypothesis was not supported. The null hypothesis was accepted at the three highest levels.

Recommendations

Based on the results of the study, the author has several recommendations. First, the study should be repeated. Math Connects was newly implemented in the 2010-2011 school year. With more familiarity with the program, higher scores may be achieved. Also, as younger grades are exposed to the materials they will be more likely to have a solid understanding of how to access all of the components of Math Connects when they reach the fourth grade. A second recommendation is to conduct a study that compares pretest and posttest MAP scores of fourth graders within the same demographic parameters, but taught using a variety of mathematics reform materials. This way, there can be greater understanding of what materials work best with students. Third, the author recommends deeper analysis of MAP data. Students' misconceptions need to be identified specifically so teachers can target the misconceptions. Another recommendation is to continue use of the high-yield strategies such as immediate, relevant feedback, and cooperative learning. These strategies foster

understanding in an engaging way. They need to be continued and used at all grade levels so students become familiar and confident with them. A final recommendation is to give families access to the online materials that come with Math Connects. At this time families can only access games and a few examples for the standards. A component needs to be purchased by Harrah Elementary School that would allow parent access to the student text book and workbooks online. When families have a full understanding of what is being taught in class, it can translate to better success for their student.

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