Using Math Intervention to Improve Student Performance in Measurement

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Using Math Intervention

to Improve Student Performance

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ABSTRACT

The purpose of this project was to examine the effects of math intervention on student achievement in measurement. A middle school implemented a preventative multi-tier intervention model for struggling math students. The math intervention teacher used pre- and post-test results to measure the success of the math intervention.

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CHAPTER 1

Introduction

Background for the Project

In 2007, the school district began the Response to Intervention program, requiring all schools to provide mathematics and reading intervention for struggling students. Every grade level was expected to implement the framework during the 2007-2008 school year.

The project was designed to test the effectiveness of the intervention. The project was conducted in a school located on the outskirts of the Tri-Cities. The middle school was relatively new in an area of high growth. The community was centered between a large government facility and an agricultural area rich in wheat, hay, fruits, vegetables, and wine.

In the fall of 2007, 801 students were enrolled in the middle school. The distribution was 273 sixth graders, 258 seventh graders, and 270 students in eighth grade. The school demographics included 683 white, 53 Hispanic, 37 Asian, 18 black, 8 American Indian, and 2 multi-ethnicity students. The number of students receiving free and reduced lunch in the school was 134 students.

According to the Washington State Office of Superintendent of Public Instruction website, in the spring of 2007, only 58.8% of sixth graders passed all

sections of the math portion Washington Assessment of Student Learning. Only 52.9% of sixth graders passed the measurement strand of the Washington Assessment of Student Learning. Sixty-six and one-half percent of sixth graders passed the reading portion of the assessment (Washington State OSPI b, 2007).

The middle school had remedial classes in previous years, but not to the specific expectations of the district's Response to Intervention program. In 2007, the school implemented three tiers of instruction at each grade level. One tier was focused on students at or above grade level. Two tiers included intervention for students below level in one or more strands of math and/or reading.

Tier 1 sixth grade students performing at or above grade level continued to use *Connected Math Project* curriculum. According to What Works Clearinghouse, "*Connected Math Project (CMP)* is a problem-centered mathematics curriculum designed for all students in grades 6-8…The program seeks to make connections with mathematics, between mathematics and other subject areas, and to the real world" (What Works Clearinghouse, 2007). Students carried out a variety of mathematical investigations to construct meaning. The lessons were student-centered and required students to explore and create individual understanding based upon daily math experiences. The lessons involved cooperative learning and a variety of hands-on manipulatives. Teachers used supplemental materials as needed to ensure that all Washington State Grade Level Expectations were being met.

Sixth grade students performing just below grade level, Tier 2, continued to use *Connected Math Project* for one period per day. The students also attended an additional period of math instruction focused on math computation, vocabulary, and practice of a specific math strand. The class was called Math Plus. An inclusive curriculum and pacing chart were not provided. The Math Plus educator used *Guided Language Acquisition Design* strategies for vocabulary and content instruction and classroom management. The educator researched how the brain learned mathematics and employed best practices to enhance learning opportunities. The educator used *Accelerated Math* to provide appropriate individualized computation practice for each student.

Math Plus was a quarter-long class. Each quarter focused on a different math strand. The focus for the first quarter was number sense. The second quarter focused on measurement, while third quarter focused on geometry. The fourth quarter focus was probability and statistics. There were five mathematical content strands in the State Grade Level Expectations; only four were focused on during remediation. Scheduling was simplified by scheduling four strands over four quarters. Algebraic thinking was not addressed in the model.

Sixth grade students performing a year or more below grade level, Tier 3, spent two hours in a math and science block. English Language Learners were also placed in the block for additional support in math along with an educational assistant. The focus of the block was math; science was secondary. The block

teacher used *Guided Language Acquisition Design* strategies for vocabulary and content instruction. The strategies were used in conjunction with the developmental teaching practices from John Van De Walle and Marilyn Burns. The district approved *Connected Math Project* curriculum for general math education, but the educator chose not to use the program for math support classes. The district approved an intervention curriculum, *Accelerated Math,* to provide appropriate individualized practice for each student. However, due to lack of professional training opportunities, the educator was unable to use *Accelerated Math* with the measurement students. The intervention classes were not provided with a pacing chart. The educator led instruction at a rate appropriate for student success.

Students were placed in math classes based upon the Fifth Grade Measure of Academic Progress scores and the Fifth Grade Washington Assessment of Student Learning scores in specific math strands. Tier 1 students performing at or above grade level on both assessments were placed in a general or honor's math class. Tier 2 students performing at grade level on one assessment, but below grade level on the second assessment were placed in Math Plus one to four quarters depending upon areas of weakness. Tier 3 students performing below grade level on both assessments were placed in the math/science block.

Schedules were adapted as sixth grade teachers identified specific student needs. Tier 1 students identified as needing additional support by general

education math teachers' observations, classroom assessments, or the fall Measure of Academic Progress were moved to the appropriate level of intervention. Tier 2 students in Math Plus or Tier 3 students in the math/science block class identified as not needing the level of additional support based on teacher recommendation and fall Measure of Academic Progress were moved into the appropriate math class. Counselors and sixth grade math teachers worked together to allow the intervention program some flexibility based on the needs of the students.

All Tier 3 students identified as significantly below level in math were placed in the math/science block class. However, due to master scheduling issues, not all Tier 2 students performing just below grade level attended Math Plus during the quarter most suited to the students' areas of struggle. Other factors such as class size, required electives, and year-long classes such as band prevented students from being placed in the appropriate quarter of Math Plus. Overall, the schedule met the needs of all Tier 3 students and most Tier 2 students.

Statement of the Problem

Measurement was a critical component of both math and science education. Students needed to be successful in measurement to be successful in math and science at the secondary level and into college. According to the Office of Superintendent of Public Instruction website, at the middle school only 52.9%

of the sixth graders passed the measurement strand of the Washington Assessment of Student Learning in the spring of 2007 (Washington State OSPI b, 2007). Intervention was used to improve student achievement in measurement.

Purpose of the Project

The purpose of the project was to determine if math intervention focused on measurement would improve student achievement in measurement. The assessment to measure growth used was the Measure of Academic Progress. The intervention consisted of using *Guided Language Acquisition Design* strategies to instruct fifth and sixth grade level math.

Delimitations

The project was from September 2007 to January 2008. The project included 25 sixth grade students from the middle school. Thirteen struggling measurement students received intervention in Math Plus or the math/science block class. Twelve struggling measurement students did not receive intervention. However, the students may or may not have received math intervention for other strands. The students were identified as struggling through the Measure of Academic Progress.

The intervention program used was a delimitation. *Accelerated Math*, the intervention curriculum adopted by the district, was not available during the project. The educator used the Grade Level Expectations to create objectives. The educator pooled resources from a variety of sources. The key program used

to implement intervention was *Guided Language Acquisition Design*. The educator also used a variety of research-based best practices and instructional strategies to deliver content and vocabulary. The educator gathered materials from a variety of sources or created and formatted materials to fit highly-effective teaching strategies and *Guided Language Acquisition Design* organizers and posters. To provide appropriate computation practice, the educator used flashcards, games, and student-created materials.

The master schedule paired with the number of students was a delimitation. Thirteen struggling students attended an intervention class during the third quarter, focused on measurement. Twelve struggling students did not attend an intervention class due to scheduling conflicts. There were approximately 300 students in the sixth grade.

The environment of the assessment was a delimitation. The Measure of Academic Progress was a computer-based assessment. Classes of 15-30 students left the classroom environment and took the assessment in a computer lab. The lab had 40 computers. The environment was quiet, but students swayed and turned continually in office style chairs.

The assessment was a delimitation. The Measure of Academic Progress was a computer-based assessment. Students were not used to doing math work on a computer due to the lack of classroom computers in the middle school. All questions on the assessment were multiple choice. Once a student selected an

answer, he or she could not return to change the answer. Students were provided scratch paper and pencils to solve problems.

Maturation was a delimitation. The intervention took place during the second quarter of the year. The Measure of Academic Progress fall assessment occurred in September and the spring assessment occurred in January. The students matured 4 months between assessments. Research showed that most students show some growth other time regardless of instruction used.

The experience of the educator was a delimitation. The intervention educator had two and a half years experience at the fifth grade level, but was a first year middle school teacher. The three other sixth grade math teachers had a variety of teaching experience and taught 6th grade math using *Connected Math Project* curriculum for several years prior to the project. Also, because math and science curriculum shared common content, struggling measurement students in the general sixth grade math classes were exposed to measurement during the course of the year in science classes.

Assumptions

The educator created a safe learning environment. Students felt safe admitting struggles, taking risks, and setting goals. The educator implemented The Big Three Rules from *Guided Language Acquisition Design*: make good choices, show respect, and solve problems. Students explored, defined, and followed the Big Three Rules. The educator guided the students in cooperative

learning groups. The students learned to work together, provide support, and give constructive criticism.

The educator understood the Grade Level Expectations for both fifth and sixth grade. The educator used the fifth grade Grade Level Expectations to build background knowledge. Next, the educator used the sixth grade Grade Level Expectations to create course objectives and student goals. The educator chose and aligned materials with the Grade Level Expectations to promote student success.

The Measure of Academic Progress was aligned with Washington State Grade Level Expectations. Struggling students in a specific math strand were accurately identified by the Measure of Academic Progress. Also, the sixth grade math teachers could individually identify students who were inaccurately identified by the Measure of Academic Progress.

The educator employed research-based strategies considered to be highly effective. *Guided Language Acquisition Design* was a set of strategies designed to build vocabulary and provide support for students at all learning levels. The educator adapted *Guided Language Acquisition Design* strategies when appropriate. The educator conferenced with individual students and focused on specific needs. The educator worked with small groups to address misconceptions and practice strategies.

Hypotheses

A population of struggling measurement students who received intervention would show greater than expected gains as measured by the Measure of Academic Progress. Also, a population of struggling measurement students who received intervention would show greater gains than a population of struggling measurement students who did not receive intervention as measured by the Measure of Academic Progress.

Null Hypotheses

A population of struggling measurement students who received intervention would not show greater than expected gains as measured by the Measure of Academic Progress. Also, a population of struggling measurement students who received intervention would not show greater gains than a population of struggling measurement students who did not receive intervention as measured by the Measure of Academic Progress.

Significance of the Project

The district adopted the Response to Intervention framework for math and reading at all levels. The educator understood intervention must be focused, research-based, and aligned to state standards to be successful. The educator implemented best practices and strategies as a basis for intervention, but was unable to use district approved supplemental curriculum due to lack of training. The educator provided learning opportunities in the form of vocabulary

development, direct content instruction, and computation practice in a safe learning environment. The educator used clear objectives and focused instruction. With success of the project, the district's adopted Response to Intervention framework as it related to measurement in mathematics at sixth grade would be significant.

Procedure

The students took the Measure of Academic Progress assessment in September. Students were placed in math classes based upon sixth grade Measure of Academic Progress scores and fifth grade Washington Assessment of Student Learning scores in specific math strands. Tier 1 students performing at or above grade level on both assessments were placed in a general or honor's math class. Tier 2 students performing at grade level on one assessment, but below grade level on the second assessment, were placed in Math Plus one to four quarters depending upon areas of weakness. Tier 3 students performing below grade level on both assessments were placed in the math/science block.

The students identified as Tier 2 in measurement attended the Math Plus class second quarter from November to January. The educator created specific course objectives for Math Plus and the math/science block classes based on the fifth and sixth grade Grade Level Expectations. Students reviewed objectives and set academic and behavioral goals for the quarter.

Systematically following the objectives, the educator found and created lessons aligned with the Grade Level Expectations. The educator used *Guided Language Acquisition Design* strategies to teach vocabulary and manage the classroom. The educator created classroom based assessments aligned to the objectives and used the assessments formatively and summatively throughout the quarter. As lessons progressed, the educator conferenced with individual students, and worked with small groups to teach specific concepts and address misconceptions. Students worked as a whole class, in small groups, and individually during the course of the quarter.

In addition to the measurement objectives, the educator specifically taught basic computation strategies related to number sense and measurement. Students set individual goals, took weekly timed tests on multiplication and division and graphed weekly computation progress on individual charts.

Biweekly, the students visited the measurement course objectives and individual goals. The class discussed progress and students updated goals based on progress. At the end of January, the students completed the Measure of Academic Progress as a post-assessment.

Definition of Terms

Accelerated Math. *Accelerated Math* was a computer-generated worksheet program used to track student computation progress and create appropriate practice worksheets.

Connected Math Project. *Connected Math Project* was a student-centered math program designed to allow students to investigate math and build meaning through experiences and use of manipulatives.

Manipulatives. Manipulatives were tools used to enhance mathematical learning such as base-ten blocks, snap cubes, three-dimensional solids, fraction strips, etc.

Math Plus. Math Plus was a quarter-long intervention class designed to provide extra support to students who are just below grade level.

Response to Intervention. Response to Intervention was a framework used to providing appropriate instruction and intervention at three levels or tiers of learning.

Tier 1. Tier 1 was a learning level of students at or above grade level.

Tier 2. Tier 2 was a learning level of students from six months to one year below grade level.

Tier 3. Tier 3 was a learning level of students a year or more below grade level.

Acronyms

CMP. Connected Math Project

EALR. Essential Academic Learning Requirements

GLAD. Guided Language Acquisition Development

GLEs. Grade Level Expectations

RIT. Rausch Indicator Unit

RTI. Response to Intervention

MAP. Measure of Academic Progress

NCLB. No Child Left Behind

OSPI. Office of Superintendent of Public Instruction

WASL. Washington Assessment of Student Learning

WWC. What Works Clearing House

CHAPTER 2

Review of Selected Literature

Introduction

The educator researched a variety of topics related to math achievement in math and intervention. The areas found in literature to affect student achievement were state and national standards, curriculum, best practices and instructional strategies, classroom management, assessment, and intervention.

State and National Standards

> In 1983, The National Commission on Excellence in Education reported: More and more young people emerge from high school ready neither for college nor for work. This predicament becomes more acute as the knowledge base continues its rapid expansion, the number of traditional jobs shrinks, and new jobs demand greater sophistication and preparation. (*Nation at Risk*, 1983, n.p.)

With this report, *A Nation at Risk*, Ronald Reagan ushered the United States into an era of education reform to meet the needs of a changing world.

Washington State responded in 1993 with legislation that led to the Commission on Student Learning (CSL). "The Legislature passed the Engrossed Substitute House Bill 1209 in 1993, noting that 'student achievement in Washington must be

improved to keep pace with societal changes, changes in the workplace, and an increasingly competitive international economy'" (Washington State OSPI c, 2007, n.p.). From 1995-1997, Washington State created the EALRs in eight content areas including math. Then the state-wide assessment, Washington Assessment of Student Learning (WASL), was created based upon the EALRs and first administered in grades 4, 7, and 10 in 1998. A commission was also created to hold Washington schools accountable for maintaining the new state standards based upon WASL data. Eventually, the EALRs were broken down further into Grade Level Expectations (GLEs) and the WASL was expanded to test students in grades 3-10; ninth grade was optional.

Mathematics was the first content area in which national standards were developed. The Mid-continental Research for Education and Learning reported in 1989:

> The National Council of Teachers of Mathematics (NCTM) ushered in a new era relative to the role of national organizations in the practice of schooling. Through the *Standards* document, NCTM helped to form a new perspective on how national subject-area groups can contribute to the improvement of education when it delineated, for three levels (K-4, 5-8, and 9-12), a consensus on what students should know and be able to do and how that might best be demonstrated in the classroom. (History of the Standards, 2007, p. 1)

In 2000, NCTM revised the standards and incorporated all previous documents in *Principles and Standards for School Mathematics* (History of the Standards, 2007, p. 1).

On Jan. 8, 2002, President Bush signed the *No Child Left Behind Act of 2001:*

> *No Child Left Behind* ensures accountability and flexibility as well as increased federal support for education. *No Child Left Behind* continues the legacy of the *Brown v. Board* decision by creating an education system that is more inclusive, responsive, and fair. (Education Commission of the States, 2007, n.p.)

NCLB held all schools accountable for growth and progress of all students based on the individual state's standards and assessments. In Washington State, schools were held accountable for teaching the EALRs and GLEs measured by the WASL.

Curriculum

According to the Washington State Office of Superintendent of Public Instruction website, "More than at any other time in history, society is placing demands on citizens to interpret and use mathematics to make sense of information and complex situations" (Washington State OSPI c, 2007, n.p.). The OSPI has evaluated the effectiveness of numerous curricula and endorsed several for use in Washington State.

The district adopted *Connected Math Project* as the middle school math curriculum. According to What Works Clearinghouse, "*Connected Math Project (CMP)* is a problem-centered mathematics curriculum designed for all students in grades 6-8…The program seeks to make connections with mathematics, between mathematics and other subject areas, and to the real world" (What Works Clearinghouse, 2007). The Washington State Instructional Materials Report, January 2006, showed CMP was 63% strongly aligned with the state GLEs for the entire middle school level. CMP was also 15% adequately aligned, 16% partially aligned, leaving only 6% of the curriculum not aligned with the state GLEs (p. 21). However after reviewing research from 22 studies, "the WWC found the program to have mixed effect on math achievement" (What Works Clearinghouse, 2007).

To meet the needs of Tier 2 and 3 students in the Response to Intervention (RTI) model, the district purchased *Accelerated Math* for the intervention classes. *Accelerated Math* was one of the math intervention programs reviewed by the state of Washington. *The K-12 Mathematics Diagnostic-Intervention Program Review Report*, released in 2007, identified the objective:

> The purpose of this review is to provide assistance to local educational agencies when selecting mathematics diagnostic-intervention programs designed for grades K–12 that ensure with high probability, when used with fidelity, acceleration for students whose mathematics learning is

> significantly below their current grade level standards. (Washington State OSPI a, 2007, p. 1)

The results by program table indicated that *Accelerated Math* at the sixth grade level had adequate alignment for intervention in all areas except algebraic sense where *Accelerated Math* was only partially aligned with state standards (p. 61). The district did not provide professional development training for *Accelerated Math* until the third quarter, therefore the educator was unable to use *Accelerated Math* for measurement intervention.

Instructional Strategies

Instruction was described as "focused and connected teaching" (English, 2000, p. 18). Instruction was the method used by the educator to deliver the curriculum. One common thread throughout the research showed math instructors used two different instructional models; explicit or teacher-directed instruction and constructivist or student-centered instruction. Lynne Fuchs (2006), PhD and Professor at Vanderbilt University, stated, "Each approach, a constructivist and an explicit instruction approach, has its value. For certain kinds of learners, constructivism works very nicely. But clearly, a large group of learners needs more explicit instruction, especially students with learning disabilities" (p. 7).

With struggling math students, research showed, "Consistently strong effects were found for systematic, explicit instruction. We define explicit

instruction as instruction that involves a teacher demonstrating a specific plan (strategy) for solving the problem types and students using this plan to think their way through a solution" (William, 2007, p. 2). During the project, the intervention educator provided explicit instruction in computation, problem-solving, and measurement formulas.

However, other strategies were also recognized as effective when coupled with explicit instruction. In 2007, Russell Gersten and Benjamin S. Clarke reviewed meta-research from over fifty studies. The findings showed, "For low-achieving students, the use of peer-assisted learning activities, along with systematic and explicit instruction and formative data furnished both to the teacher and the students, appears to be the most important" (p. 3). Other strategies found effective were visual and graphic depictions of problems, student think-alouds, peer-assisted learning activities, and formative assessment data (Gersten & Clarke, 2007, p. 1-2).

GLAD strategies incorporated both visual and graphic representations of information and student think-alouds. Input Charts were graphic representations created by the teacher in front of the students to promote brain imprinting of the visual and auditory information that was presented. Input Charts included detailed, labeled diagrams of content information or detailed steps of a process such as multiplication or problem solving. GLAD also included chants and poetry that promoted students to learn complex processes in math and science

through repetition and rhyme. Students used the auditory and visual memory cues to independently retrieve information and solve problems. Input Charts also provided educators with the opportunity to model how to do mathematical processes. Stephanie Harvey and Anne Goudvis (2000) stated, "For too many years in education we have been telling students what to do without showing them how" (p. 12). GLAD provided the opportunity for students to see and interact with mathematical processes.

Peer-assisted learning strategies (PALS) allowed educators to "address a challenging mathematics curriculum and simultaneously attend to a wide diversity of math skills in the classroom" (Kroeger & Kouche, 2006, p. 1). In an action research project Stephen D. Kroeger and Beth Kouche adapted the PALS process for middle school students. The program was originally created for elementary and high school by Fuchs and Fuchs in 2001. "The overall structure of the PALS program creates a climate of reduced anxiety. By providing a safe and supportive environment where peer assistance is immediately available to the student, fear responses are minimalized" (Kroeger & Kouche, 2006, p.2). Students, trained to be peer coaches, were taught skills necessary to support the learning of student players. As Kouche reflected on PALS, "She saw confidence levels rise in many of her lower ability students" (p. 5).

Intervention

Research of special instruction clearly revealed two models. The first was remedial instruction for students qualifying for special education, often diagnosed with learning disabilities. The second model was timely intervention for all struggling students based upon student performance on assessments.

In 2001, G. Reid Lyon and Jack M. Fletcher reported that the number of students with learning disabilities had more than doubled from 1.8 percent in 1977 to 5.2 percent (p. 23). According to Lyon and Fletcher, "The term learning disability traditionally refers to unexpected underachievement in adequate educational settings, usually measured as discrepancy between IQ and achievement" (p. 26). The process of qualifying students for special instruction was considered, "time-consuming and often meant that a student must 'wait to fail' before receiving additional instructional support" (Brown-Chidsey, 2007, p. 42).

However, in response to IDEA 2004, Washington's updated Special Education Policy and Procedure stated, "…states may not require districts to use only a severe discrepancy to determine whether a student has a specific learning disability. Districts are now allowed to use a student's response to research-based interventions or procedures." (Washington State School Directors' Association, 2008, p. 1). This revision allowed a more preventative approach as schools could, "provide intervention to students not succeeding in the general education program

before considering them for special education placement" (Brown-Chidsey, 2007, p. 42).

In 2007-2008, the Richland School District implemented the preventative RTI model in both reading and math. RTI consisted of three tiers. According to Lynn Fuchs, PhD (2006):

> What you're talking about is constant assessment as a means of identifying academic problems early on, hand-in-hand with intensive intervention to prevent later failure, and embedding all of that into a multi-tiered system. Then formulating sound judgments about which students learned adequately (i.e. responded) and those who did not. (p. 7)

Following the model, all Richland students received math instruction and assessment at grade level, considered Tier 1. Based upon assessments, students lacking in one or more areas were provided supplementary instruction, at Tier 2. Students significantly behind, therefore needing intense intervention or specialized instruction, were placed at Tier 3. "Only at Tier 3 does the school take steps to determine whether a student has a disability that requires special education" (Brown-Chidsey, 2007, p. 41).

Assessment

The educator employed formative and summative assessment information from state, district, and classroom levels during the intervention period. Washington State began developing a comprehensive math assessment in the mid

1990s in response to measure student progress in relationship to the newly created Essential Academic Learning Requirements. The WASL included multiple choice as well as open-ended short response and extended response questions in each content and process strand of mathematics. According to the OSPI website (2007), Washington State used the format because, "Washington teachers specifically said they didn't want another multiple-choice test. They wanted a test that showed not only what an individual student *knew* but also what that student could *do* – that is, they wanted students to be able to apply concepts, solve problems and write clearly" (Washington State OSPI c, 2007, n.p.). First introduced to fourth graders in 1997, the WASL was conducted annually and was expanded to test students in grades 3-10; ninth grade was optional. The test was administered in the spring of each year and scores were provided to the schools and parents in the fall of the following academic year. The OSPI website (2007) stated that, "The WASL tells us whether an individual student is gaining the skills and knowledge set out in our state learning standards" (http://www.k12.wa.us/assessment/WASL/default.aspx). The website also noted, "The WASL is not a diagnostic test – that is, its purpose isn't to pinpoint where an individual student is struggling and what kind of help is needed. Teachers use a variety of diagnostic, classroom-based assessments to tailor instruction to students' needs" (p. 2). The fifth grade WASL was used as a formative assessment when placing students in sixth grade math classes and planning

intervention classes. The sixth grade WASL was used as summative assessment in measuring student progress over the sixth grade year, not related to the research project.

The Richland School District adopted the Measure of Academic Process created by the Northwest Evaluation Association to monitor student progress in a timely manner and provide immediate feedback on specific areas of strength and weakness. The educator used the MAP as the pre- and post-test to measure student growth in measurement. The MAP measured student achievement in all five content areas of math. According to the Reliability and Validity estimates reported by NWEA (2004), the MAP had high reliability at the sixth grade level because data collected from 1999-2002 showed that the level of the Pearson correlation coefficient remained between .89 and .95 (p. 5-6). The data also indicated that the MAP was valid at the sixth grade level because the Pearson correlation coefficient comparing the MAP to other standardized tests maintained a level of .87 to .89 (p. 7-9). The MAP was used as formative assessment because fall scores were used to determine student needs. However, for the research project, MAP data was the summative assessment used to measure growth.

In the classroom, the educator used formative assessment to improve instruction and student learning. The unit objectives were aligned with the state GLEs for sixth grade. The educator used anecdotal notes, observations, and teacher/student created quizzes to assess student understanding and adjust lessons

on a daily basis. According to Dylan William (2007), "The available research evidence suggests that considerable enhancements in student achievement are possible when teachers use assessment, minute-by-minute and day-by-day, to adjust their instruction to meet their students' learning needs" (p. 4).

In planning the measurement unit, the educator followed the assessment for learning progression outlined by Rick Stiggins (2005) in *On Common Ground*:

1. Start by clearly understanding the standard to be mastered.
2. Deconstruct it into the enabling classroom achievement targets that form the foundations of learning leading up to the standard.
3. Create a student-friendly version of those targets to share with students from the beginning of learning.
4. Create high-quality assessments of those classroom targets.
5. Use those assessments in collaboration with students to track progress over time. (p.76)

Summary

The educator reviewed research regarding the history of math reform related to *A Nation at Risk* and *No Child Left Behind*. This reform led to national math standards and the creation of the Washington State math standards for both content and process strands. The educator also discussed the curricula used to deliver instruction, CMP, in the district and CMP's alignment with state standards. The district's adopted intervention curriculum, *Accelerated Math*, was

not available for the project, but the educator researched its alignment with state standards as well.

The educator researched teacher-directed (explicit) and student-centered (constructivist) instruction and found the later was often recommended for remedial or struggling students. The educator also incorporated the research-based strategies of the GLAD program into the intervention classes.

To investigate intervention practices, the educator researched learning disabilities and learned that the number of students labeled as learning disabled was on the rise until the IDEA of 2004 and the updated definition of learning disability. The research showed that historically students waited to fail before receiving remedial instruction due to a reactive response. The update of IDEA opened the door to new intervention approaches for struggling students in the form of the preventative Response to Intervention model.

Finally, the educator researched the assessments required within the state and district which were the WASL and MAP testing. The educator also investigated formative assessment, validating the educator's direct impact on student achievement based on the daily observations and adjustments to instruction.

CHAPTER 3

Methodology and Treatment of Data

Introduction

In the second quarter of the 2007/2008 school year, the educator conducted two experimental studies on a group of struggling sixth grade measurement students to determine if math intervention focused on measurement would improve student achievement in measurement. The students were considered low in measurement based on the Fall 2007 MAP. The educator conducted two experimental studies to determine if intervention would result in higher than expected gains and if students who received intervention would show greater growth than students who did not receive intervention.

Methodology

The educator used a quantitative approach to determine if intervention improved student achievement in measurement. In the first study, the educator used a non-independent *t* test with pre and post MAP scores to determine if students who received intervention showed greater than expected gains. The educator used the independent chi square with pre and post MAP scores for the second study to determine if struggling sixth grade measurement students who received intervention showed more growth than struggling sixth grade

measurement students who did not receive measurement intervention. The students were pre-tested in the fall of 2007 and post-tested in the winter of 2008.

Participants

The project included 25 sixth grade students from the middle school. Thirteen struggling measurement students received intervention in Math Plus or the math/science block class. Twelve struggling measurement students did not receive intervention. The students were identified as struggling through the Measure of Academic Progress.

Instruments

The educator used student scores from the MAP taken in the fall and winter. The MAP was a computer-based test, therefore students used computers for testing purposes. Per testing guidelines, students were also allowed to use paper and pencils to solve computation problems on the test. The educator used measurement unit goals created using the Washington State GLEs for sixth grade as well as a variety of research-based supplemental teaching strategies and materials.

Design

In the first study, the educator used a non-independent *t* test to determine if students who received intervention showed greater than expected gains. The educator used the two-dimensional chi square in the second study to determine if struggling sixth grade measurement students who received intervention showed

more growth than struggling sixth grade measurement students who did not receive measurement intervention.

Procedure

In the fall of 2007, sixth grade students at the middle school took the MAP as a pre-test. Twenty five students scored low in the measurement strand. Thirteen struggling measurement students received intervention in Math Plus or the math/science block class. Twelve struggling measurement students did not receive intervention.

The intervention educator used a variety of research-based best practices and instructional strategies to deliver content and vocabulary in Math Plus and the math/science block class. The educator gathered materials from a variety of sources or created and formatted materials to fit highly-effective teaching strategies and *Guided Language Acquisition Design* organizers and posters. To provide appropriate computation practice, the educator used flashcards, games, and student-created materials. At the end of the second quarter, the students took the MAP as a post-test.

Treatment of the Data

In the first study, the educator used a non-independent *t* test with pre and post MAP scores to determine if students who received intervention showed greater than expected gains. The educator used a 2-dimensional chi square with pre and post MAP scores for the second study to determine if struggling sixth

grade measurement students who received intervention showed more growth than struggling sixth grade measurement students who did not receive measurement intervention.

Summary

The educator used experimental research to determine if intervention improved the achievement of struggling measurement students. The data collected were fall and winter MAP scores. The data was analyzed using a two-dimensional chi square test and a non-independent *t* test.

CHAPTER 4

Analysis of the Data

Introduction

The educator used a quantitative approach to determine if intervention improved student achievement in measurement. In the first study, the educator used a non-independent *t* test with pre and post MAP scores to determine if students who received intervention showed greater than expected gains. The educator used the independent chi square with pre and post MAP scores for the second study to determine if struggling sixth grade measurement students who received intervention showed more growth than struggling sixth grade measurement students who did not receive measurement intervention. The students were pre-tested in the fall of 2007 and post-tested in the winter of 2008.

Description of the Environment

The project included 25 sixth grade students from the middle school. Thirteen struggling measurement students received intervention in Math Plus or the math/science block class. The intervention class sizes varied from 13-18 students throughout the study. Students worked independently and in groups.

Twelve struggling measurement students did not receive intervention. The twelve students attended typical sixth grade math classes containing 28-30 students. Students worked independently and in groups.

The students were assessed in the fall and winter of sixth grade. The time period was from September 2007 to January 2008. All 25 struggling measurement students took the MAP assessment in the school computer lab. Students took the test independently and were monitored by a teacher or administrator.

Hypothesis

A population of struggling measurement students who received intervention would show greater than expected gains as measured by the Measure of Academic Progress. The hypothesis was rejected, as the population of struggling measurement students who received intervention did not show greater than expected gains as measured by the Measure of Academic Progress. A nonindependent *t* test showed the results of the pre and post MAP scores were significant >.10 probability.

Also, a population of struggling measurement students who received intervention would show greater gains than a population of struggling measurement students who did not receive intervention. The hypothesis was rejected, as the population of struggling measurement students who received intervention did not show greater gains than a population of struggling measurement students who did not receive intervention as measured by the Measure of Academic Progress.

Null Hypothesis

A population of struggling measurement students who received intervention would not show greater than expected gains as measured by the Measure of Academic Progress. The null hypothesis was accepted. A non-independent *t* test with pre and post MAP scores showed the level of growth was significant >.10 probability.

Also, a population of struggling measurement students who received intervention would not show greater gains than a population of struggling measurement students who did not receive intervention as measured by the Measure of Academic Progress. The null hypothesis was accepted. A two-dimensional x^2 with the post-test levels indicated that the level of significance was >.10 probability.

Results of the Study

A non-independent *t* test with pre and post MAP scores proved the null hypothesis. A population of struggling measurement students who received intervention did not show greater than expected gains as measured by the Measure of Academic Progress. Table 1 showed the results of the pre and post MAP scores were significant >.10 probability. The students' scores increased, but the increase was not statistically significant.

Table 1.

t test of Pre-Post Test Results for Struggling Intervention Students

Test	N	Mean	Standard Deviation
Pre	12	204.33	6.42
Post	12	208.75	11.47
df = 11		*t* = 1.64	p>.10

The mean RIT score of the struggling intervention students was 204.33 on the fall MAP and increased to 208.75 on the winter MAP. The educator found the *t* score to be 1.64 and the degrees of freedom to be eleven. The value of significance was only p>.10. The mean average RIT growth for the group of twelve students was 4.42. The standard deviation increased from 6.42 in the fall to 11.47 in the winter. The standard deviation was 6.42 in the fall and 11.47 in the winter.

The two-dimensional chi square with post MAP scores for the second study disproved the hypothesis. Struggling sixth grade measurement students who received intervention did not show greater gains than struggling sixth grade students who did not receive intervention. In the fall, 12 struggling measurement students received intervention. After intervention, 10 students were still below level on the winter Measure of Academic Progress. In the fall, 12 struggling

measurement students did not receive intervention. On the winter Measure of Academic Progress, only 7 of the students were still below level.

Table 2.

x^2 test of Post MAP Scores for Measurement Strand

Group of Students	Below Level in Fall	Below Level in Winter
Intervention	12	10
Non-Intervention	12	7

df = 1	$x^2 = .5214$	p >.10

Findings

A population of struggling measurement students who received intervention did not show greater than expected gains as measured by the Measure of Academic Progress. However, the population of students did show growth. The mean RIT score of the struggling intervention students was 204.33 on the fall MAP and increased to 208.75 on the winter MAP. The mean average RIT growth for the group of twelve students was 4.42. Typical growth for a sixth grader was 3.0 points from fall to winter. The group mean was 1.42 points above typical growth.

Seven of the twelve struggling intervention students' scores increased more than five points, above typical growth. Two students' scores increased two

points and the remaining three students' scores went down. Although the growth was not statistically significant, 58% of the intervention students showed typical or higher growth than expected. Unfortunately, 16.67% of the students showed growth that was less than typical and 16.67% of the students showed negative growth.

The standard deviation increased by 5.05 points from 6.42 in the fall to 10.98. The increase in standard deviation reflected the increase in variance of student scores from the fall to the winter. In the fall, student scores ranged from 191 to 217, a range of 26 points. However, as students achieved growth at different rates from fall to winter, the range of winter scores increased from 194 to 233, a range of 39 points.

A population of struggling measurement students who received intervention did not show greater gains than a population of struggling measurement students who did not receive intervention as measured by the Measure of Academic Progress. Each population began with twelve students performing below grade level in measurement as measured by the Measure of Academic Progress in the fall. At the end of the study, ten of the students who received intervention were still below level, while only seven of the students who did not receive intervention were still below level as measured by the Measure of Academic Progress in the winter. Two struggling measurement students who received intervention showed gains in measurement and five struggling

measurement students who did not receive intervention showed gains in measurement as measured by the winter Measure of Academic Progress.

Discussion

As previously discussed, measurement was a critical component of both math and science education. Students needed to be successful in measurement to be successful in math and science at the secondary level and into college. The educator realized that intervention was a possible method of improving student achievement in measurement.

The data showed a population of struggling measurement students who received intervention did not show greater than expected gains as measured by the Measure of Academic Progress. The data reflected student growth though the growth was not at a statistically significant level. The data also showed that a population of struggling measurement students did not show greater gains than a population. In fact, the students that did not receive intervention showed greater gains on the winter Measure of Academic Progress than the students who received intervention.

Summary

The educator performed a research project to determine if measurement intervention improved achievement of struggling students. The students were identified and separated into two groups; students receiving intervention and

students not receiving intervention. Students were pre- and post-tested using the Measure of Academic Progress.

After conducting a *t* test, the educator knew that students who received intervention did not show greater than expected growth. The hypothesis was rejected, as the population of struggling measurement students who received intervention did not show greater than expected gains as measured by the Measure of Academic Progress. Most students showed growth, but the growth was not statistically significant.

After conducting a two-dimensional chi square test, the educator realized that the students who received intervention did not show greater gains than the students without intervention. The hypothesis was rejected. Only two students that received intervention showed gains in measurement, while five students that did not receive intervention showed gains in measurement.

CHAPTER 5

Summary, Conclusions and Recommendations

Introduction

The educator knew measurement was a critical component of both math and science education. Students needed to be successful in measurement to be successful in math and science at the secondary level and into college. The purpose of this project was to examine the effects of math intervention on student achievement in measurement. A middle school implemented a preventative multi-tier intervention model for struggling math students. The math intervention teacher used pre- and post- test results to measure the success of the math intervention.

Summary

The educator reviewed research regarding the history of math reform that led to national math standards and the creation of the Washington State math standards for both content and process strands. The educator also discussed the curricula used to deliver instruction as well as the district's adopted intervention curriculum, *Accelerated Math*. *Accelerated Math* was not available for the project, but the educator researched its alignment with state standards as well.

The educator researched teacher-directed (explicit) and student-centered (constructivist) instruction methods as well as research-based strategies of the

GLAD program for use in the intervention classes. To further investigate intervention practices, the educator researched learning disabilities and the Response to Intervention model. The educator researched the assessments required within the state and district which were the WASL and MAP testing. The educator also investigated formative assessment, validating the educator's direct impact on student achievement based on the daily observations and adjustments to instruction.

The educator used action research to determine if intervention improved the achievement of struggling measurement students. The students were identified and separated into two groups; students receiving intervention and students not receiving intervention. Students were pre- and post-tested using the Measure of Academic Progress. The data collected were fall and winter MAP scores. The data was analyzed using a two-dimensional chi square test and a non-independent *t* test.

After conducting a *t* test, the hypothesis was rejected and the educator knew that students who received intervention did not show greater than expected growth. Most students showed growth, but the growth was not statistically significant. After conducting the two-dimensional chi square test, the educator realized that the students who received intervention did not show greater gains than the students without intervention. The hypothesis was rejected. Only two

students that received intervention showed gains in measurement, while five students that did not receive intervention showed gains in measurement

Conclusions

The data collected indicated that intervention provided to struggling measurement students did not result in greater than expected gains. The Measure of Academic Progress scores showed gains for the students, but not at a statistically significant level. Table 1 indicated that the mean average RIT growth for the group of twelve students was 4.42. Typical growth for a sixth grader was 3.0 points from fall to winter. The group mean was 1.42 points above typical growth.

Continued analyzation of the data showed that struggling students who received intervention did not show greater gains than struggling students without intervention. Table 2 showed ten of the twelve students who received intervention were still below level after intervention, while only seven of the twelve students who did not receive intervention were still below level as measured by the Measure of Academic Progress. Also, two struggling measurement students who received intervention and five struggling measurement students who did not receive intervention showed gains in measurement as measured by the winter Measure of Academic Progress.

In conclusion, based on the Measure of Academic Progress pre- and post-tests, math intervention was not proven to have a statistically significant effect on

student achievement in measurement. Intervention students showed limited growth in measurement.

Recommendations

Based on the conclusions, the educator determined that limited growth occurred as a result of intervention. Several recommendations need to be made to further improve student achievement.

First, the educator would recommend continued investigation into instructional strategies. GLAD strategies were researched and implemented during intervention as a framework for classroom management and overall lesson planning. However, the educator came to realize that it can be difficult to find enough appropriate strategies to meet the needs of a diverse group of struggling students. Further research on instructional strategies, such as PALS, would allow the educator to more specifically target struggling students and deal with common mathematical misconceptions.

The educator would also recommend the district and/or building provide ample training for both the educator and the educational assistants that provide intervention for struggling students. Training all members that work with the students is critical at this level. Students struggle for a variety of reasons. The adults working with such a diverse group of students need a tool belt full of academic and behavioral strategies to promote student success.

The final recommendation is to begin the intervention program with a curriculum specifically designed for intervention. During the project, the educator was unable to use the district adopted intervention curriculum, *Accelerated Math*. Gathering and differentiating materials from a variety of sources was very time consuming. Even with the state and national math standards as a guide, the educator found it difficult to organize the collection of curriculum pieces in a way that was developmentally appropriate for struggling students. Beginning with an intervention curriculum would create a more focused learning environment.

The educator recommends the intervention program be continued with several modifications or improvements. Further research into instructional strategies would enable the educator to specifically target misconceptions and meet the diverse needs of learners. More training opportunities would provide both educators and educational assistants with better skills to handle academic and behavior situations that occur. Implementing an intervention curriculum as students begin to struggle would provide a more focused learning environment.

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