Using Differentiated Instruction To Improve Mathematics Achievement Of Seventh Grade Students

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Using Differentiated Instruction

To Improve Mathematics Achievement

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ABSTRACT

Differentiated Instruction was recognized to be a compilation of many theories and practices related to effective teaching and the link to student achievement. Differentiated Instruction required a departure from traditional methods of teaching and the belief that learners vary according to readiness, ability, motivation, and interest. While numerous testimonials, examples of differentiation in practice, and for-profit tools abound in the literature, little empirical research existed warranting future research on the effectiveness of Differentiated Instruction as measured by student achievement on assessments. The research paper provided a review of the literature including: the theoretical background of Differentiated Instruction; a rationale for the practice of differentiation; an explanation of Differentiated Instruction included ways to differentiate, elements and goals of the instructional approach,

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CHAPTER 1

Introduction

Background for the Project

Most states and districts in the 1990s adopted Outcomes Based Education in some form or another. A state would create a committee to adopt standards and a performance based assessment to assess students. At the start of the 1990s, "outcomes" tended to be nonacademic but towards the 2000s, the term "high standards" instead was adopted, often resulting in very difficult tests. In the 2000s, many states were slated to require Students to pass the state adopted tests in order to receive a diploma, compared to the earlier tradition that any student who obtained a D average or above and attended High School for 4 years would graduate with a diploma (Jorgensen, 2003).

Students enrolled in high poverty schools began school with lower skills, grew less academically during the school year and lost more skills over the summer than students with wealthier and European-American peers. According to the study by Northwest Evaluation Association there was no rate of change/growth in any minority group sufficiently strong enough to close or reduce the observed achievement gap between groups of students in any substantive way before the end of the student's K-12 career (McCall, Hauser, Cronin, Kingsbury,& Houser, 2006).

If a Title I school failed to make Adequate Yearly Progress, the school was put on a list of "failing schools" published in the local paper and parents were given the option to transfer students to another school. If the school did not meet AYP for a second year,

the school provided special tutoring for the economically disadvantaged students (www.k12.wa.us/communication/pressreleases2005/schDistrictImprovmentAug2005).

The school used in the research had low WASL scores and was on School Improvement for three years and six years later had not met Adequate Yearly Progress. Scores on the WASL have been low and the teacher wanted to find strategies that would raise mathematics test scores for the school.

Statement of the Problem

Any mainstream classroom had many types of learners at any given school. The two classes used in the research had a wide range of scores in mathematics extending from very low to high. The difference in ability was evident from the range of scores on the mathematics section of the Measures of Academic Progress assessment. Having many levels of learners in the same classroom made teaching difficult for the teacher and made the learning difficult for all students.

The students who scored at high, medium high and medium levels seemed to understand mathematic concepts more quickly than the students who received lower scores. The teacher spent time working one on one with the students who scored in the low range. Not all students comprehended the main concepts of the mathematic instruction, which left several students behind and some students never went anywhere because of the low achieving students taking the time of the teacher. If the teacher spent too much time with the low achieving students then the high achieving students didn't have the chance to grow and if the teacher spent all the time with the high achieving

students, then the low achieving students never had a chance to catch up to where the students needed to be. Teaching was difficult in order to reach every student using direct instruction. The teacher wanted to find a way to reach every learner at the same time while making achievement gains as shown on the results of the Measures of Academic Progress assessment.

Purpose of the Project

The purpose of the project was to identify strategies to facilitate learning in the classroom for all levels of students with various learning styles. The teacher wanted to assess the impact of Differentiated Instruction in the classroom and determine the effect of Differentiated Instruction on individual student achievement. The teacher taught the students using Differentiated Instruction in one class. Students moved around the classroom using tools that helped students answer the various mathematics problems that dealt with the unit being taught. The other class was taught using only the mathematic textbook, Connected Mathematics, and the tools involved with the curriculum.

Delimitations

The school used for this research was in a city in Eastern Washington. The city was considered a rural area with a variety of agricultural businesses. The city had a population of about 52,000 residents. There were 3 middle schools in the city and the research was done at one of the middle schools of this rural city in Eastern Washington.

The school had an enrollment of 804 students and 89.5% qualified for free and reduced lunch. The school had about an equal amount of males and females. Hispanics

made up 88.8% of the schools' population; of that number 36.6% were transitional bilingual while 16.3% were migrant. The teachers at the school had an average of 8.9 years of teaching experience and each teacher was highly qualified. (www.reportcard.ospi.k12.wa.us).

The two classes used were assigned heterogeneously. Classes of highly capable students were in the school but the two classes used for this project were split up after the highly capable students were placed in the highly capable classroom. The teacher wanted the students in the first block to use Differentiated Instruction because there was a set time the teacher had to quit teaching mathematics and began teaching science. The teacher had special education students that came to the classroom for science class.

The first class had 22 students, 10 of the students were females, 12 males. The second mathematics class had 23 students, 10 students were female and 13 were male. The students sat in groups of 3 or 4 in each of the two classes. The morning group moved around the classroom and had tools to help with the problems. The students worked on different problems spread out through the classroom. The teacher wanted the students to complete at least 2 of the tasks to be processed as a class. The other class was taught from the book using what, and only what, the textbook prescribed. The students stayed at the tables and worked with people at the table.

Assumptions

The teacher was highly qualified to teach mathematics to students and was trained in Connected Mathematics and Differentiated Instruction. All students were treated with the same positive reinforcement and appropriate materials.

Hypothesis

A 7th grade class of students using Differentiated Instruction strategies will make greater than expected growth in mathematics achievement than a seventh grade class of students not receiving Differentiated Instruction strategies as measured by a pre/post assessment.

Null Hypothesis

Seventh grade students receiving Differentiated Instruction strategies will not make greater than expected growth in mathematics achievement than a seventh grade class of students not receiving Differentiated Instruction strategies as measured by a pre/post assessment at the .05 level of significance.

Significance of the Project

The school had been on School Improvement for the last 6 years and an increase in scores would help the school make Annual Yearly Progress. The teacher was excited about Differentiated Instruction and the teacher wanted all teachers of the building to have the opportunity to be trained or see Differentiated Instruction in action. If the scores in mathematics increased the teacher would show the strategy of Differentiated Instruction as a valuable tool in the district. The teacher would allow other teachers of the district to use his classroom for observations. The need to increase mathematic scores was high because not meeting AYP for 6 years could result in the loss of jobs for teachers

in the school building. Differentiated Instruction was a researched program which increased student achievement. The teacher wanted to know if Differentiated Instruction worked well in mathematics.

Procedure

The Measures of Academic Progress assessment was given to 2 seventh grade mathematics classes in the fall and used as a pre test. The class that received Differentiated Instruction took the test at 8:00 a.m. and the second class taught entirely from the book took the test at 10:00 a.m. After the pre assessment the teacher used a *t* test to make sure the two classes did not differ in ability. The first class of students started at 7:50 a.m. and the second class started at 10:00 a.m. The second class was taught mathematic lessons with Connected Math books using direct instruction while the first class used the Connected Mathematics book using Differentiated Instruction and menu items from the Mathematics Education Collaboration.

Educators used the growth and achievement data from Measures of Academic Progress assessment to develop targeted instructional strategies and to plan school improvement. The data helped the teacher in developing lessons for the students. The teacher was able to group some students together because the students were struggling in the same mathematical concepts. Some of the strategies used in the classroom for differentiating instruction according to student readiness, interest, and learning profile included:

Readiness – used tiered product assignments, lead mini-workshops at varying levels, and developed benchmarks for success on grade-level expectations and individual needs,

Interest – allowed students to use a range of media, and provided opportunities for students to develop independent inquiries, and

Learning: profile – provided visual, auditory, and kinesthetic product options, and taught students how to use a wide range of product formats

The menu items were mathematical problems based on the concept being taught at the time. Menu items were mathematical problems students worked on in the classroom. The problems ranged from easy to more difficult. The problems were placed throughout the classroom. The idea was for the students to pick any problem the students wanted to start with and completed the problem. The students worked at a pace that was appropriate for the student and used any tools that would have helped with the problem. The teacher gave students a limited number of days to work and solve as many problems as possible in the limited number of days. Also the teacher would tell the students ahead of time what problems would be processed as a class. The teacher chose the two or three problems to be processed. The students were to make sure the problems to be processed were completed by the end of the predetermined number of days set forth by the teacher. At the end of the time limit the teacher would call on students to share the thinking behind the students' answers to the problems (R. Parker).

At the end of the spring semester the two classes were given the Measures of Academic Progress assessment as a post test. This test was given to see if Differentiated Instruction using Connected Mathematics had any significance on the students achievement.

Definition of Terms

Connected Mathematics. Connected Mathematics was a comprehensive, problem-centered curriculum designed for all students in grades 6-8 based on the National Council of Teachers of Mathematics standards.

Differentiated Instruction. Diffeentiated Instruction provided students with different avenues to acquiring content; to processing, constructing, or making sense of ideas; and to developing teaching products so that all students within a classroom could learn effectively, regardless of differences in ability.

Measures of Academic Progress. Measures of Academic Progress was a program that provided educators with the information the educator needed to improve teaching and learning. The assessment was given building wide.

DesCartes. The DesCartes continuum of learning ordered specific reading, language usage, mathematics, and science skills and concepts by achievement level. For reading, language usage, and mathematics, the skills and concepts aligned to the goal structures and content of state standards. Each individual student's achievement was unique and no single test yielded a complete profile of a student's overall achievement.

Acronyms

AYP - Adequate Yearly Progress

MAP -Measurement of Academic Progress

MEC- Mathematics Education Collaboration

OSPI -Office of the Superintendent of Public Instruction.

WASL-Washington Assessment of Student Learning

NCTM- National Council of Teachers of Mathematics

NWEA- Northwest Evaluation Association

RIT- Rasch Item response Theory

ZPD- Zone of Proximal Development

CHAPTER 2

Review of Selected Literature

Introduction

Federal legislation such as No Child Left Behind put an increasing stress on school systems, teachers, and, especially, on students. According to (Bravmann) No Child Left Behind focused on "all children" instead of on "each child" which was particularly problematic as No Child Left Behind invited educators to concentrate the efforts of teaching to the group – and thus the content taught – rather than on the needs of individual learners. And yet the principles of equity required that each student was central to the learning process and educated in ways that addressed the student's needs and abilities appropriately (2004)

To learn in a different way than the normal old fashioned way of sit in rows and in desks. Mathematic scores in the state have been low and teachers and school districts had been finding ways to help all students achieve in mathematics in order to pass the Washington Assessment of Student Learning. Different strategies had come and gone. Curriculum had been developed that helped students with low-test scores. In order for the teacher to raise test scores in mathematics the teacher researched strategies that benefited students in mathematics.

Differentiated Instruction

The research as it pertained to Differentiated Instruction had been varied and although much of the theoretical concepts have found strong support in the literature the practical application of a differentiated model had met with mixed results at best.

Differentiated Instruction was recognized to be a compilation of many theories and practices. According to the proponents of differentiation, the principles and guidelines were rooted in years of educational theory and research. For example, Differentiated Instruction adopted the concept of "readiness". Readiness meant the difficulty of skills being taught was slightly in advance of the child's current level of mastery. (Vygotsky, 1978). The term readiness was grounded in the work of Lev Vygotsky (1978), and so was the zone of proximal development (ZPD), the range at which learning took place. Research evidence indicated students were more successful in school and more engaged if the students were taught in ways that were responsive to the students readiness levels the interests and the learning profiles (Vygotsky, 1986). Researchers found in classrooms where individuals were performing at a level of about 80% accuracy, students learned more and felt better about the subject area under study (Hall, 2002).

Differentiation specifically responded to progress on the learning continuum and helped bridge what students already knew with what the students needed to learn (Heacox, 2002). Differentiated instruction was also related in research to cognition and the brain (Jensen, 1998) as well as multiple intelligences (verbal/linguistic, logical/mathematical, visual/spatial, bodily/kinesthetic, musical, interpersonal, intrapersonal, and naturalist) (Gardner, 1993), firmly grounded multiple intelligences in

an understanding of how people learn. According to Clark (2002), children learned more quickly when instruction was made relevant. The brain changed physically and chemically when challenged and, without challenge, neurons ceased to fire and the brain didn't increase in capacity. The idea of student choice was based on brain research conducted by Deci (1995) and Jensen(1998) who said students were intrinsically motivated if students had choices. Along similar lines, Bloom's (1994) Six Levels of Higher Thinking (knowledge, comprehension, application, analysis, evaluation, and synthesis) were also embedded to ideas of Differentiating Instruction as the teachers encouraged greater rigor for some students and variability among all.

According to Slavin (1993), slow learners were rarely more successful when placed in homogeneous groupings. Differentiated Instruction supported a community of learners rather than groups of students labeled as slow and fast (Corley, 2005).

Learning was the construction of understanding and application which required that individuals made own meaning (Corley, 2005). Differentiation was founded on the notion of student empowerment and was connected to the writings of critical thinkers such as Hooks (1994) who advocated for dialogical and constructivist teaching methods. Education was the practice of freedom and required student participation. Differentiated instruction required the building of community, recognized and validated the experiences and strengths of all, and allowed students to integrate "new" knowledge into the students unique perspectives and personal backgrounds (Corley, 2005)

Differentiated Instruction according to Tomlinson (2003) was the efforts of teachers to respond to the difference among learners in the classroom. Whenever the teacher reached out to an individual or small group to vary the teaching, the aim was to

create the best learning experience possible. The design and development of Differentiated Instruction as a model began in the general education classroom and the first application of Differentiated Instruction had first came to practice for students considered to be too smart or gifted and were not challenged by the content in the general education classroom. Classrooms have become more diverse with the introduction of inclusion of students with disabilities and the reality of diversity in public schools which is why Differentiated Instruction is important (Tomlinson, 2003).

What Differentiation Instruction did not do was give the same assignment to all students and did not make the questions harder (or less difficult) for some of the students; neither did Differentiated Instruction entail grading that was curved, adapted, or otherwise dependent upon student ability. Differentiation did not provide enrichment activities for the students who finished the work before the students still working on the assignment. On the other hand, Differentiated Instruction did not mean that the students that didn't accomplish at the level of some pre-set standard were excluded from the more enriching aspects of the curriculum (Bravmann, 2004).

In order to achieve truly differential education for students, teachers had to modify standard classroom offerings in several areas such as but were not limited to pacing and sophistication, depth, complexity, and personalization. The speed with which students progressed through the curriculum had to be accelerated or decelerated according to student need. Students were encouraged to delve as deeply into content as the content was challenging for the students and then tried to delve even more deeply. Learning activities must have allowed the students to have student choice at levels of complexity that was most appropriate; in other words,

assignments had to be tiered to take into account different ways to meet the same goal. Finally, students were provided with reality-based opportunities to interpret and express what the students were learning in ways that were personally relevant and meaningful (Bravmann, 2004).

Psychologists such as Vygotsky said that a student learned only when a task was a little too hard for that student. When a student did do work with little effort, and virtually independently, that student was not learning, but rather rehearsing the known. When a student found a task beyond the reach of that students frustration, not learning, was the result. Only when a task was a bit beyond the student's comfort level and the student found a support system to bridge the gap, did learning occur. Teachers were unlikely to consistently be able to develop one-size-fits-all learning experiences in the zones of proximal development of all students in a particular class (pp. 153-4).

When tasks were too easy for learners, the learners didn't show thoughtful brain activity, but rather displayed patterns that looked more like the early stages of sleep. Only when tasks were moderately challenging for an individual did the brain "think" in a way that prompted learning. Once again, teachers found the task difficult to consistently find single tasks moderately challenging for all learners in a class that included a range of readiness and experiential levels (Tomlinson, 2003).

Culture had an important bearing on how individuals learned. Where varied cultural groups were represented, a single approach to teaching and learning was unlikely to serve all students well. In fact, because students in any cultural group also varied, even

classrooms that were more culturally homogeneous would have benefited from multiple approaches to teaching and learning (Tomlinson, 2003).

Student motivation and task persistence increased when students did the work with topics that were of personal interest. Modifying instruction to draw on student interests was likely to result in greater student engagement, higher levels of motivation, higher student productivity, greater student autonomy, increased achievement, and an improved sense of self-competence. Encouraging students to link required learning to that which was personally interesting to the student seemed an important modification for teachers in most classrooms (Tomlinson, 2003).

Differentiated Instruction gave an opportunity for students to learn in ways that made learning more efficient and was also likely to make learning more effective. Attention to a student's preferred mode of learning or thinking promoted improved achievement (Tomlinson, 2003).

According to (Tomlinson, 2003) the four classroom elements needed to Differentiate Instruction were: (1) Content was what the student needed to learn or how the student was able to access the information. (2) Process was the activities where the students were engaged in order to make sense of, or master, the content. (3) Products were the culminating projects that asked the student to rehearse, apply, and extend what the learner had learned in a unit. (4) Learning environment was the way the classroom worked and felt like when working (Bravmann, 2004).

The teacher made sure the curriculum was of high thinking skills and quality along with the instruction. Teachers made sure the curriculum was clearly focused on the information and understandings that were most valued by the expert in the specific

discipline. The lessons, activities, and products were designed to ensure that the students grappled with, used, and came to understand the mathematical concepts or essentials of the lesson. The teacher wanted to make sure the learning was active and there was joy and satisfaction in learning from each student (Tomlinson, 2001).

The teacher clarified key concepts and generalizations that ensured all learners gained powerful understandings that served as the foundation for future learning. Teachers were encouraged to identify the essential concepts and instructional strategies that ensured all learners comprehended. The teacher used assessments as a teaching tool that extended the measure of the instruction. The assessments occurred before, during, and following the instructional episode, and helped pose questions regarding student's mathematical needs and learning (Tomlinson, 2001).

Several recent studies have shown positive outcomes from the use of Differentiated Instruction. Johnsen (2003) conducted a study using undergraduate teachers differentiating instruction to suit different ability levels. Student teachers in this context were encouraged to differentiate content and process, used learning centers, different reading materials and different strategies. The study revealed that the use of differentiated techniques proved to be engaging, stimulated student interest and provided a gratifying experience for the undergraduate teachers. While the undergraduate teachers appeared to benefit from a rewarding experience, (Johnsen,) pointed out that students with exceptional needs continued to receive individual specialist support through other services.

Connor, Morrison, and Katch (2004) observed first grade instruction in 42 classrooms, measured 108 target children, and linked teachers' instructional practices to

growth in student achievement. Instruction was described as either explicit (when children's attention was focused on strategies) or implicit (when skills were allowed to develop more naturally) and coded as either teacher-managed or child-managed (i.e., independent learning, freedom of choice). Change in the above dimensions was measured to investigate whether teachers adapted the routines over the course of the year as children's skills changed. Findings indicated that students achieved more growth when the instruction was matched to the students needs. For example, for students who began the year with weak decoding and vocabulary skills, growth was experienced with explicit teaching. For students who began the year with strong skills, growth was experienced more with implicit instruction. Connor, Morrison, and Petrella (2004) employed a similar design for third grade children (explicit/implicit; teacher-managed/child-mangaged; word-level/higher order; and time) and measured for reading comprehension. Findings again indicated that growth was maximized when children were provided instruction to match the students needs.

Stager (2007) examined the effectiveness of Differentiated Instruction, specifically tiered activities, in increasing student knowledge in regard to fractions. Students were grouped according to ability, instructed by the teacher, and asked to complete activities at the appropriate level in student groups. While all students made significant gains in the mean test scores, not all achieved mastery. Though forming homogeneous groups allowed students to attain the same knowledge and to meet measurable success, further study was warranted to deepen understanding of how Differentiated Instruction could support mastery by all.

A case study of one middle school's experience with Differentiated Instruction by Tomlinson (1995) revealed initial teacher opposition toward modifying instruction to suit learner variance. Added to this, administrative barriers included teacher dissention about being instructed to implement differentiated strategies by district officials, impacted on the teacher's sense of self efficacy. Other barriers included teachers perceiving Differentiated Instruction as a fad that would pass, concerns over time allocated to prepare for differentiated lesson, unease over student assessments and preparation for testing, disquiet regarding classroom management and perceived teacher insecurity over a change in the teachers role. Observations of the teachers in the study, who adopted the use of differentiated techniques demonstrated that age was not a factor that determined acceptance of the new exemplar. However, the teacher's attitude towards change proved a more decisive factor, with teachers who embraced change showing a greater inclination to adopt differentiation. Teachers who experienced early successes with differentiation were more likely to persist. Tomlinson concluded that there was a need to investigate teacher resistance to new models catering for academic diversity, as well as considering teachers' perception of classroom management in the light of Differentiated Instructional changes. Classroom management appeared to arise as a disquieting factor when changes were implemented – this phenomenon required greater research since proponents of the Differentiated Instruction model believed classroom management issues would decrease if teachers implemented the model efficiently, yet there remained disquiet about a loss of control among teachers.

McAdamis (2001) reported significant improvement in the test scores of low scoring students in the Rockwood School District (Missouri), following the use of

Differentiated Instruction. Apart from the impact of the differentiated model, teachers in the Rockwood School District (Missouri), study indicated that the students were more motivated and enthusiastic about learning. The study further reflected the whole-school change which Differentiated Instruction necessitated – efforts included professional development, mentoring and intensive planning. Teachers were initially resistant to the change; however strategies like peer coaching, action research, study groups and workshops offered on-going support and feedback. Teachers were eventually convinced of the benefits of differentiation and were keen to try other differentiated lessons in the year following (McAdamis, 2001). The Rockwood School District (Missouri) study was worth pointing out that training sessions, mentoring and professional development in the Rockwood School District (Missouri) study were implemented over a five year period, and required a concerted response from all stakeholders including school principals, teachers, district trainers and school authorities (McAdamis, 2001). The Rockwood School District (Missouri) study confirmed the need for whole-school and whole district change – without the essential support structures and the cooperation of all participants; it was unlikely that any differentiated program would endure. Further to this, it was clear that the results of a differentiated program would only be seen over a few years, with the initial stages being utilized to overcome teacher resistance and a sustained effort.

An investigation of Differentiated Instruction strategies utilized by teachers in a study conducted by Affholder (2003) concluded teachers who used differentiated instructional strategies more intensively showed improved individual perception and adopted greater responsibility for student growth. In addition, the (Affholder) study revealed that teachers employing higher levels of differentiated techniques experienced

increased feelings of self-efficacy and demonstrated greater willingness to try new instructional approaches. The study further appeared that Differentiated Instruction was favored by more experienced teachers who were familiar with the curriculum than the teachers who had taught and received extensive training prior to implementing the Differentiated Instruction methods in the classroom (Affholder,2003). In the light of (Affholder) findings, the study would be reasonable to investigate why differentiation proved more popular with experienced teachers rather than the younger counterparts.

Aspects that still required investigation included the impact of Differentiated Instruction on teacher efficacy, the teacher's response to adopting a new model, the differences between differentiation and tracking, the impact of teaching experience on the teacher's ability to differentiate instruction, how time and resources were utilized during differentiation and, the challenges and strengths that teachers' perceived during the implementation of differentiated techniques.

Connected Mathematics

The Connected Mathematics Project was funded by the National Science Foundation between 1991 and 1997 to develop a complete middle school mathematics curriculum. The result was Connected Mathematics, a curriculum built around mathematical problems that helped students develop understanding of important concepts and skills in numbers.

The overarching goal of Connected Mathematics was to help students and teachers develop mathematical knowledge, understanding, and skill, as well as an awareness and appreciation of the rich connections among mathematical strands and

between mathematics and other disciplines. As the CMP materials were developed, the authors synthesized multiple mathematical goals into a single standard (www.connectedmath, 2006).

The mathematics in the Connected Mathematics curriculum was carefully selected and sequenced to develop a coherent, connected curriculum. Important mathematical concepts were embedded in interesting problems that promoted deeper engagement and learning for students. Students developed deep understanding of key mathematical ideas, related skills, and ways of reasoning as the students explored the problems individually, in a group, or with the class. The name of the curriculum pointed to the importance of students making connections among mathematical ideas. Rather than seeing mathematics as a series of unrelated experiences, students learned to recognize how ideas were connected and developed a disposition to look for connections in the mathematics the students studied (www.connectedmath2006)

With funding from the National Science Foundation in 1991-1996, and in 2000-2006, the Connected Mathematics Project developed a complete mathematics curriculum for middle school teachers and students. Connected Mathematics helped students and teachers develop understanding of important mathematical concepts, skills, procedures, and ways of thinking and reasoning in number, geometry, measurement, algebra, probability and statistics. Connected Mathematics was based on research, and was field-tested in diverse sites across the country with approximately 45,000 students and 390 teachers. Each unit, in both 1991-1996 and 2000-2006 development periods, went through at least 3 cycles of field testing. A growing body of research and evaluation reports indicated that CMP outperformed non-CMP curricula on tests of problem-solving

ability, equaled or outperformed non-CMP curricula on skills tests, and promoted long term retention (Connected Math 2006).

Validation Reports demonstrated that an increasing number of students were meeting and passing state mathematics expectations in districts that have adopted CMP. Data was gathered for CMP districts to document growth from pre- to post-CMP implementation as evidenced by performance on state mathematic assessments. Full district demographics were also reported. The CMP data provided widespread proof of CMP success across diverse demographics and regions.

In a study at Eastmont school district, Eastmont began using Prentice Hall's Connected Math Project (CMP) in the fall of 2002. Seventh graders have continued to improve the math performance on the WASL test over the six years of *CMP* program usage. At the end of the sixth year, 53 percent of seventh graders met the state math standard.

Measures of Academic Progress

The Northwest Evaluation Association was a non-profit organization engaged in ongoing, supportive relationships with partnering school districts and education agencies throughout the United States. Northwest Evaluation Association provided products and services that measured and promoted academic student growth and school improvement. The services included accurate assessments, timely reporting, practical classroom resources, and ongoing professional development (http://www.nwea.org/about/index.asp).

The assessment used by the teacher was the Measures of Academic Progress. The assessment was developed by Northwest Evaluation Association. In the school studied, the MAP tests were administered in the fall and spring. The test was an electronically administered and scored achievement assessment designed to measure growth for individual students, classrooms, schools, and the district. Educators were provided information needed to improve teaching and learning from the results of the mathematic section of the Measures of Academic Progress assessment. Teachers used the data from the test and developed targeted instructional strategies, and planned school improvement. The Measures of Academic Progress test could be given four times a year, with that many times a year the test was given, the teachers were able to see the growth and were able to make better plans for the students specific needs. The mathematic part of the assessment helped teachers make student-focused, data-driven decisions. Measures of Academic Progress tests were given in four subject areas: mathematics, reading, language usage, and science. The MAP assessment was used as an indicator for the preparedness for the state assessments and allowed educators an opportunity to make timely instructional adjustments to the learning.

Measures of Academic Progress drew from a bank of more than 15,000 items that created tests for mathematics, reading, language usage, and science. Each year hundreds of new items were added to the item bank. Teachers who received thorough training in item-writing processes developed most of the items. Each potential item had to pass a rigorous bias and content review, which was followed by field-testing with a minimum of 300 students. Only those items that passed the bias review, field-testing, and the subsequent strict statistical screening procedures were calibrated for difficulty and

assigned the appropriate value on the RIT scale. The items that passed the review became part of the continually expanded item bank. The NWEA had a variety of meaningful resources that helped teachers understand and use the test data. The resources helped organize materials, programs, and staff to meet the needs of individual students, create flexible groups for instruction based on students' performance in specific goal areas, recognize the skills and concepts that challenged the students, select appropriate curriculum to ensure academic growth for all students, engage students in setting academic goals and tracking the progress, oversee growth when compared to state standards, and share academic needs with parents (NWEA, 2008).

After three days of the completion of the tests, principals accessed a range of reports to guide decision-making at the school level. The reports provided growth and instructional information at grade, school, and district levels were shared with parents. Educators accessed reports within 72 hours and began planning assignments that met the needs of the students.

Reliability and validity were two of the words most commonly associated with tests. Reliability was an index of a test's consistency. The consistency refers to performance of the test across time, across forms, or across the assessments items. The answer to reliability was found using a Pearson product-moment correlation coefficient. The minimum acceptable correlation was considered to be .80 with 1.00 being a perfect correlation. During the study, the researchers found the reliability only dipped slightly below .80 twice, both at the grade two level. Most coefficients were in the mid. .80's to the low .90's. Validity spoke to the idea of the test testing appropriate content. If the test was valid, then teachers had the ability to draw accurate inferences and the ability to

make generalizations about a population. Content validity of NWEA tests was assured by carefully mapping existing content strands from a district or a state into a test blueprint. Test items were selected for a specific test as to assure a match to the content standards as well as difficulty level. Also, efforts were made within a strand to select items with a uniform distribution of difficulties. Most of the documented validity evidence fro NWEA tests came in the form of a Pearson correlation coefficient. A strong relationship was indicated when the correlations were in the mid .80's. (Northwest Evaluation Association, 2004).

The Northwest Evaluation Associaton used a specific model conceived by Danish mathematician, Georg Rasch, (1901-1980). Rasch was best known for his contributions to psychometrics, and his model was used extensively in assessment in education, particularly for skill attainment and cognitive assessments (NWEA, 2008).

The RIT scores were very accurate estimates of where the students were in the learning at the time the students tested. Students could correctly answer about 50% of the question in their RIT range. One RIT range lower, students could correctly answer about 80% of the questions. One RIT range higher the students could answer about 20% of the questions correctly.

Mathematics Education Collaborative

Mathematics Education Collaborative vision was for every student and teacher to be powerful users of mathematics. The mission of Mathematics Education Collaborative

was to work with educational communities in support of quality mathematics in schools. Mathematic Education Collaborative, was a Washington-based non-profit company, that worked in partnership with school districts and mathematics leaders to secure a well-informed public committed to making sound decisions about mathematics education in local schools, and committed to improving mathematics education for every student and teacher (http://www.mec-math.org/About-MEC/mission).

To accomplish the mission, MEC offered a series of community math nights and courses for teachers, administrators, and the public-at-large. The components of the MEC Community Engagement model provided all the necessary elements needed to establish a common base of dialogue, knowledge and understanding to achieve high quality mathematics in K-12 schools.

In order to secure a knowledgeable public and well-prepared teachers, all members of the community, including educators, needed ongoing opportunities to learn mathematics in ways that modeled optimal classroom pedagogical and assessment practice. Mathematics Education Collaborative provided such opportunities.

Dr. Ruth Parker made visits to different schools throughout the United States. During the school or community visits all parents and students were invited to the schools selected as host schools and worked with Dr. Parker on mathematical concepts. All of the games Dr. Parker mentioned were done at home with the family. Dr. Parker also gave parents strategies on multiplication to use at home with the students.

The work of Mathematics Education Collaborative was based on the belief that knowledgeable public and well-prepared teachers made responsible decisions for children's mathematics education. In order to secure knowledgeable public and well-

prepared teachers, all members of an educational community needed ongoing opportunities to learn. Although today's students were held to higher mathematics standards, some mathematics teachers taught the way the teachers were taught. To reach high standards for students, teachers had needed to learn mathematics in ways that modeled optimal classroom pedagogical and assessment practices. Mathematics Education Collaborative provided such opportunities through a series of mathematics content courses and school-year follow-up workshops for K-12 teachers. (R. Parker, 2008).

The researcher of this paper had been involved in the 5 year course available through (MEC) for the past year. During that year the program had showed ways of student learning in variables and patterns and lots of discussion that involved student learning. The teachers in the program worked the same problems that were given to the students during the school year. The idea was to work the problems and used the tools to help with the problems and the instructor did not give any answers as the teachers worked on the problems. After a certain time the teachers would come back together and discussed their learning and how the teachers solved the problems.

The teachers took the problems back to the classroom and had the students work and discuss the answers as a class. The students were given a certain amount of days to work the problems before the whole class discussion. During the school year the teachers met every other month to discuss with the other teachers about the students and the discussions that had been going on in the classroom. In the following summer the researcher will be in year 2 of MEC. During year 2 the researcher will learn different ways to teach number sense.

Mathematics Education Collaborative Community Engagement Model brought communities together, in collaborative ways, to improve mathematics education for each student. Mathematics Education Collaborative offered math nights for parents, educators and the public. Mathematics Education Collaborative provided in-service and leadership development during a five-year implementation of the model that included in-depth work with educators, parents and other community members.

DesCartes

DesCartes was a dynamic tool that provided the information educators needed to meet the academic needs of each student. DesCartes defined flexible grouping for instruction based on students' performance in specific goal areas; identified the skills and concepts that provided the most appropriate academic challenged; and guided the selection of materials that were appropriately challenging to ensure sustained academic growth for all students. The teacher engaged the students in setting academic goals and tracked the students' progress made. Teachers and parents monitored academic growth in relationship to content standards and shared academic needs with parents (www.slideshare.net).

The teacher used DesCartes to help set goals for each student in every class and kept it on file. The teacher used the students achievement score or RIT score and identified the portion of the DesCartes that represented the students instructional level. The students had concepts below the RIT score that had to be reinforced to maintain the concepts. This is where the menu items were helpful for the students of the classrooms. The concepts above the students RIT score were concepts that had to be introduced appropriately.

The teacher also developed learning plans that focused on the needs of each individual student using DesCartes. Teacher and student set specific learning goals that the student had to focus on for a set period of time. This was a great tool at conferences as well.

Summary

Empirical evidence is lacking for the practice of differentiating instruction. While literature on the application and implementation of differentiation was abundant, there was a marked gap in regard to its link to student achievement. Though differentiated instruction was grounded in what scholars and practitioners believe to be "best practice," little to no empirical studies have been conducted to support and validate the practice. Some qualitative research studies existed that report on challenges to implementation, leadership perspectives of implementation, and its connection to student motivation, but, to date, differentiated instruction has not been empirically linked to increases in student achievement to a significant extent. Thus, as schools and school districts dedicate significant resources toward the implementation of differentiation, research is warranted that substantiates its effectiveness.

Classrooms are becoming more diverse with wide ranges of learners and cultures. The ultimate goal was to provide a learning environment that would maximize the potential for student success. The important thing to remember was to hold on to the effective teaching strategies that had led students to positive learning outcomes and to make adjustments when necessary. Differentiated Instruction was about being flexible and open to change and also about taking risks and tiered teaching and learning strategies

that teachers would have otherwise ignored. Differentiated Instruction was about managing instructional time in a way that met the standards and also provided motivating, challenging, and meaningful experiences for school age students.

To reach high standards for students, teachers had needed to learn mathematics in ways that modeled optimal classroom pedagogical and assessment practices. Mathematics Education Collaborative provided such opportunities through a series of mathematics content courses and school-year follow-up workshops for K-12 teachers. If children are to become mathematically proficient, then how mathematics is taught is every bit as important as what mathematics is taught. A disposition to persist at solving new and complex problems is essential, as is a belief that one can be successful as a problem solver.

Using MAP is a great way to check what students know and what they need to know. The tool DesCartes is beneficial for the students and teacher as they set goals for the future learning and gives the students targets to hit.

CHAPTER 3

Methodology and Treatment of Data

Introduction

Student achievement was the cornerstone of public education. When underachievement was observed, educators were charged with identifying and implementing interventions that yielded effective solutions. Student achievement was accomplished when teachers had the appropriate resources and understood research-based strategies that assisted all learners in meeting specific academic goals (NCTM, 2000).

The purpose of the study on Differentiated Instruction was to research the best ways to reach every student of the classroom at the same time. The teacher had to adapt the curriculum to fit the needs of the students in the classroom. The class had a wide range of learners from low to high and everything in between.

Students were assessed using the MAP test. Students took the MAP test in the fall and again in the spring. During the time between the fall and spring, the teacher taught one block of students using Differentiated Instruction and the second block of students using the textbook and the directions from the textbook. The teacher wanted to know if Differentiated Instruction made a difference in making greater than expected gains on the MAP test.

Methodology

The teacher selected the students of the seventh grade mathematics classroom to be the participants in the research. The teacher controlled the conditions in the research setting by when the assessment would be given, what lessons would be taught, how long

each lesson was and the environment of the classroom. The researcher selected the Measurement of Academic Progress test as the way of assessment. The selection of participants was from two different classrooms of students who were given different methods of instruction and who had similar initial characteristics.

The teacher gave MAP the assessment to the students as a pre test in the fall. The 8 a.m. mathematic class was given Differentiated Instruction throughout the school and the 10 a.m. mathematics class was given instruction straight from Connected Mathematics textbook throughout the school year. At the end of the school year the teacher gave the students the MAP assessment as a posttest to see if Differentiated Instruction made a made a difference in student achievement.

Participants

The sample of students was 2 seventh grade mathematics classes in a large middle school in eastern Washington State. The students were from a low economic status consisting of mainly Hispanic culture. The first class had 25 students, 13 of the students were females, 12 males. The second math class had 25 students, 10 students were female and 15 were male. The students sat in groups of 3 or 4 in each of the two classes. The students entered the school year with a wide range of scores in mathematics and different learning styles. The 8 a.m. mathematics class was the experimental group because the teacher wanted the first class to have the Differentiated Instruction because the teacher allowed the students to get out of the seats more.

Design

The pre/post test group design was used for the two mathematics classes. Both of the classes were given a pre-test in the fall on the same day. The MAP assessment was used as the pre-test for each student. Each class was given different treatment or different strategies for teaching and learning. The first class or the 8:00 a.m. class was given Differentiated Instruction strategies using the Connected Mathematics textbook, while the 10:00 a.m. class was taught from the Connected Mathematics curriculum.

The students were given the MAP assessment as the posttest during the spring after each class was taught using the 2 methods. The posttest scores were compared between the two classes to determine the effectiveness of Differentiated Instruction in mathematics.

Procedure

The Measures of Academic Progress assessment was given to 2 seventh grade mathematics classes as a pre-test. The first class that received Differentiated Instruction took the test at 8:00 a.m. and the second class taught entirely from the book took the test at 10:00 a.m.

The first class of students started at 7:50 a.m. and the second class started at 10:00 a.m. The first class used the Connected Mathematics book using Differentiated Instruction, CMP and menu items that were developed by the teacher and other 7^{th} grade mathematics teachers of the school, while the second class was taught mathematic lessons with the Connected Mathematics using direct instruction.

The teacher used the growth and achievement data from the Measures of Academic Progress assessment to develop targeted instructional strategies for Differentiated Instruction. The data helped the teacher in developing lessons for the students. The teacher was able to group some students together because the students were struggling with the same concepts.

The first class used menu items which were mathematical problems based on the concept being taught at the time. Menu items were mathematical problems students worked on in the classroom. The problems ranged from easy to more difficult. The problems were placed throughout the classroom because the idea was for the students to pick any problem the student wanted to start with and work the problem. The students worked at a pace that was good for the student and used any tools that would have helped with the problem. The teacher gave students a limited number of days to work and solve as many problems as possible in the number of limited days, also the teacher would tell the students ahead of time what problems would be worked out as a class. The teacher chose the two or three problems to be processed or worked out as a class. The students were to make sure the problems to be processed were completed. At the end of the time limit the teacher would call on students to share the thinking behind the students' answers to the problems. Differentiated Instruction changed the way the teacher taught and met with students. Differentiated Instruction allowed the teacher to spend more time with students who were struggling with the mathematic concept. The students with higher thinking helped with the students who were struggling. The conversations that were in the classroom also helped with the instruction and learning of the students.

The second class used the Connected Mathematics textbook and direct instruction from the teacher. The students worked on problems from the textbook and used the guidance from the teacher to solve the problems. The teacher followed every instruction of the Connected Mathematics book and used any supplemental activities that were called for.

At the end of spring and before the end of the school year each class was given the MAP assessment again as the posttest. The posttest was used to determine if Differentiated Instruction was effective for the students. For Differentiated Instruction to be effective the students in the first block needed to make greater than expected gains on the MAP assessment compared to the second class.

Treatment of the Data

The teacher used Stat Pak and ran a *T*-Test as way to calculate and compare scores from the 2 mathematic classes and to find if Differentiated Instruction had any significance. The pre test was given first to see if the classes were significantly different at the beginning. The classes were not significantly different which allowed the teacher to continue with the research. At the end of the school year the 2 classes were given a posttest to see if the classes were significantly different after the treatments.

CHAPTER 4

Analysis of the Data

Introduction

The school used in the research had low WASL scores and was on School Improvement for three years and six years later had still not met Adequate Yearly Progress. Scores on the WASL have been low and the teacher wanted to find strategies that would raise test scores for the school in mathematics.

Description of the Environment

The school used for this research was in a city in Eastern Washington. The city was considered a rural area with a variety of agricultural businesses. The city had a population of about 52,000 residents. There were 3 middle schools in the city and the research was done at one of the middle schools of this rural city in Eastern Washington.

The school had an enrollment of 804 students and 89.5% qualified for free and reduced lunch. The school had about an equal amount of males and females. Hispanics made up 88.8% of the schools' population; of that number 36.6% were transitional bilingual while 16.3% were migrant. The teachers at the school had an average of 8.9 years of teaching experience. (Office of the Superintendent of Public Instruction 2007)

The two classes used were assigned heterogeneously. There were classes of highly capable students in the school but the two classes for this project were split up after the highly capable students were placed. The teacher wanted the students in the first

block to use the Differentiated Instruction because there was a set time the teacher had to quit teaching mathematics and begin teaching science. The reason behind the teacher teaching science at specific time was because that was the students with special needs entered the room.

The first class had 22 students, 10 of the students were females, 12 males. The second math class had 23 students, 10 students were female and 13 were male. The students sat in groups of 3 or 4 in each of the two classes. The morning group moved around the classroom and had tools to help with the problems. The students worked on different problems spread out through the classroom, the teacher wanted the students to complete at least 2 of the tasks that were to be worked out together as a class. Students would share the ideas on solving the problems. The other class was taught from the book using what, and only what, the textbook prescribed. The students stayed at the tables and worked with people at the table.

Hypothesis

A 7^{th} grade class of students using Differentiated Instruction strategies will make greater than expected growth in mathematics achievement than a seventh grade class of students not receiving Differentiated Instruction strategies as measured by a pre/post assessment.

Null Hypothesis

Seventh grade students receiving Differentiated Instruction strategies will not make greater than expected growth in mathematics achievement than a seventh grade

class of students not receiving Differentiated Instruction strategies as measured by a pre/post assessment at the .05 level of significance.

Results of Study

Table 1.

T – Test of Pre – Post Results for Students Using Differentiated Instruction

MAP Assessment	N	Mean	Standard Deviation
Pre Test (Fall)	22	216	11.6
Post Test (Spring)	22	222	12.6
Df = 42		*t* = 1.62	p < 0.05

Since the probability of 1.62 was greater than the significance level, then the null hypothesis was accepted. The data showed that the standard deviation also increased which means the sample went from a medium variability to a high variability.

Table 2

T – Test of Pre – Post Results for Students NOT Using Differentiated Instruction

MAP Assessment	N	Mean	Standard Deviation
Pre Test (Fall)	23	216	9.99
Post Test (Spring)	23	219	11.0
Df = 44		*t* = .870	p < 0.05

Findings

To test the hypothesis of the study, the researcher used StatPak computer software. After inputting the data from the pretest and posttest group scores, the *t*-test value obtained was1.62. The *t*-tests used a significance level of 0.05, a standard level used in research as the criterion for rejecting the null hypothesis.

Discussion

With the call for higher accountability standards, federal, state, and district education personnel were developing action plans that attempted to increase student achievement. In the past decades, the field of education has undergone tremendous change in how students were taught, what strategies were considered best practices, and how best to teach diverse learners. The goal of this paper was to determine if students receiving Different Instructional strategies had differences in mathematics achievement over students receiving instruction from the textbook only. According to the NCTM (2000), in order for students to be successful, the student must have had multiple opportunities to study and learn mathematics. What this meant to the researcher was more than one instructional strategy would possibly offer support to teachers with a wide range of learners; therefore, the principles of Differentiated Instruction were selected.

Summary

The teacher found teaching the lessons was very difficult to provide instruction to learners that varied so significantly in mathematical skill. Students had difficulty multiplying and dividing while other students had problems adding and subtracting. The wide range of learners presented a major challenge for the researcher because not only did remedial skills need to be addressed but the actual seventh-grade mathematics

curriculum had to be addressed. The participants needed to make significant gains in mathematics to decrease previously identified deficiencies in mathematics.

CHAPTER 5

Summary/Conclusions/Recommendations

Summary

There were several encouraging things that the researcher observed while implementing Differentiated Instruction in the mathematics class. The first thing that stood out was that the students were excited when the time came for mathematics. The researcher saw that unmotivated students became motivated. The students seemed assured that the students would understand the lesson that was going to be taught. Next, test scores improved, especially with the students that tended to struggle academically. The researchers though that the students were really able to benefit from the small grouping with mixed abilities. Finally, the researcher was able to get a chance to challenge the high students. Without Differentiating Instruction teaching was really hard to make sure that the students stayed motivated. In the future, the researcher looked forward to differentiating other subject areas.

On the flip side, Differentiating Instruction does not come easy. Differentiated Instruction was very time consuming and the researcher often found that planning and implementing was time consuming and became overwhelmed. The researcher found that weekly planning took twice as long just to Differentiate Instruction in mathematics; the researcher could not imagine Differentiating Instruction for all subject areas. The researcher will continue to use Differentiated Instruction in the classroom in hopes that the practice and experience will make teaching to each individual student less of a challenge.

Conclusion

In conclusion, the researcher would like to continue to implement differentiation in the mathematics classrooms. With the varied abilities in today's classroom Differentiated Instruction is necessary to adapt teaching methods to meet different needs. Differentiated Instruction are strategies that cannot be implemented immediately and needs to be well thought out, planned, and gradually implemented. The researcher felt the frustrations of

planning time, time allotted for activities in the classroom, and changing teaching styles in the middle of the year. The researcher feels that the planning time frustrations can be alleviated through proper training and resources.

Recommendations

Differentiated Instruction was beneficial and should be implemented in every educational setting. Differentiated Instruction should be implemented in the best academic school in the state and the worst academic school in the state as every classroom has a wide range of learners. Differentiated Instruction should be implemented in schools with a high socioeconomic student population and schools with low socioeconomic student population.

Any school that decides to implement Differentiated Instruction needs to be mindful of the different parts that lead to the success of the program. Parents, teachers, curriculum, and the different environments can make all the difference in the success or failure of a student attaining a goal. Recommendations include introducing Differentiated Instructional strategies and practices to staff, students, and students' parents.

I think that by having student reflection and keeping parents updated would lead to even greater gains and even more success in mathematics. One of my top priorities as a teacher is to increase understanding in regards to mathematics. If the test scores go up and mathematical retention is occurring, then I am becoming a better and more successful teacher. I rate my ability as a teacher on student achievement.

References

Affholder, L. P. (2003). Differentiated Instruction in inclusive elementary classrooms. Unpublished EdD thesis. University of Kansas, Kansas.

Bender, W.N. (2005). *Differentiating math instruction strategies that work for the K-8 classrooms!* Thousand Oaks, California: Corwin Press.

Bravmann, Stephanie (December 2004). Two, four, six, eight, let's all differentiate. *New Horizons For Learning*, Retrieved January 18th 2009, from http://www.newhorizons.org/strategies/differentiated/bravmann.htm

Clark, B. (2002). *Growing up gifted: Developing the potential of children at home and at school* (6th ed.). Upper Saddle River, NJ: Prentice Hall.

Connected Mathematics research and evaluation summary. (2006). *Pearson Prentice Hall*, Retrieved 2-27-09, from http://connectedmath.msu.edu/rnd/2006res.pdf

Connor, C. M., Morrison, F. J., & Katch, L. E. (2004). Beyond the reading wars: Exploring the effect of child-instruction interactions on growth in early reading. *Scientific Studies of Reading, 8,* 305-336.

Connor, C. M., Morrison, F. J., & Petrella, J. N. (2004). Effective reading comprehension instruction: Examining child x instruction interactions. *Journal of Educational*

Corley, M. (2005). Differentiated Instruction: Adjusting to the needs of all learners. *Focus on Basics: Connecting Research and Practice, 7*(C), 13-16.

Deci, E. L. (1995). *Why we do what we do: Understanding self-motivation.* New York: Penguin Books.

Ellis, E. S. and Worthington, L. A. (1994). *Research synthesis on effective teaching principles and the design of quality tools for educators*. University of Oregon: Technical Report No. 5 National Center to Improve the Tools of Educators.

Gardner, H. (1993). *Frames of the mind: The theory of multiple intelligences*. New York: Basic Books.

Hall, T. (2002). *Differentiated Instruction.* Wakefield, MA: National Center on accessing the general curriculum. Retrieved January 18th 2009, from http://www.cast.org/publications/ncac/ncac_diffinstruc.html

Heacox, D. (2002). *Differentiating instruction in the regular classroom: How to reach and teach all learners, grades 3-12.* Minneapolis, MN: Free Spirit Publishing.

Hollas, B (2005). *Differentiating Instruction in a whole-group setting; Taking the easy first steps into Differentiation*. In (S. Smith, Ed). Peterborough, NH: Crystal Springs Books.

Hooks, B. (1994). *Teaching to transgress: Education as the practice of freedom.* Taylor and Francis.

Jensen, E. (1998). *Teaching with the brain in mind.* Alexandria, VA: Association for Supervision and Curriculum Development.

Johnsen, S. (2003). Adapting instruction with heterogeneous groups. *Gifted Child Today, 26*(3), 5-6.

Jorgensen, Ph.D., Margaret (2003). History of No Child Left Behind Act of 2001. Retrieved December 15, 2008, from www.pearsonasses.com Web site: http://www.pearsonasses.com

McAdamis, S. (2001). Teachers tailor their instruction to meet a variety of student needs. *Journal of Staff Development, 22*(2), 1-5.

McCall, M, Hauser, C, Cronin, J, Kingsbury, G, & Houser, R (November 2006). Achievement gaps: An examination of differences in student achievement and growth. *Northwest Evaluation Association*, Retrieved October 20, 2008,from http://www.nwea.org/research/gap.asp.

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics*. Reston, VA: Author.

Office of the Superintendent of Public Instruction .(2007). Retrieved Jan 5, 2009, from Office of the Superintendent of Public Instruction. Washington state report card Web site: http://reportcard.ospi.k12.wa.us/summary

http://www.nwea.org/about/index.asp

http://www.nwea.org/classroom/descartes.asp (2008)

Parker, R (2008). Mathematics Education Collaborative. Retrieved October 20, 2008, from http://mec-math.org

Parsons, C.V. & DeLucia, J.M. (September 2005). Decision making in the process of differentiation. *Learning & Learning with Technology*. *33*, 8-10.

Protheroe, N. (2001). Improving teaching and learning with data-based decisions: Asking the right questions and acting on the answers. Retrieved October 20, 2008, from Making a difference in our children's future Web site: http://www.ers.org/*spectrum*/sum01a.htm

Slavin, R. E. (1993). Ability grouping in the middle grades: Achievement effects and alternatives. *Elementary School Journal*, 93 (5), 535-552.

Stager, A. (2007). Differentiated instruction in mathematics. Master's thesis, Caldwell College. UMI: 1443733.

Sousa, D (2008). *How the brain learns mathematics*. Thousand Oaks, California: Corwin Press.

Tomlinson, C. A. (1995). Deciding to differentiate instruction in the middle school: One school's journey. *Gifted Child Quarterly, 39*(2), 77-114.

Tomlinson, C. (October 2003). Deciding to teach them all. *Educational Leadership*. *6*, 6-11.

Tomlinson, C. (2001). *How to Differentiate Instruction in mixed-ability classrooms* (2nd ed.). Association for Supervision & Curriculum Development

U.S. Department of Education. (2005). *Differentiated Instruction summer workshop*. Washington, DC: U.S. Department of Education. Retrieved January 29, 2009, From http://www.ed.gov/teachers/how/tools/initiative/summerworkshop/walker/index.html (www.k12.wa.us/communication/pressreleases2005/schDistrictImprovmentAug2005).

Appendixes

(Figure 1) 7th Grade Mathematics Class Differentiated Instruction

Seventh Grade Mathematics Pre-Post Test Scores Using Differentiated Instruction	
Pre Test	**Post Test**
193	197
198	204
202	211
202	199
206	213
206	217
211	217
211	230
213	220
213	221
215	221

218	221
219	221
220	219
221	232
223	213
224	237
224	234
225	231
229	233
229	240
242	243

The class that used Differentiated Instruction did not have any significance from the pre and post test as measured by the (MAP) assessment.

(Figure 2) 7th Grade Mathematics Direct Instruction From Connected Mathematics

Seventh Grade Mathematics Pre/Post Test Scores NOT Using Differentiated Instruction Pre/Post Test Scores	
Pre Test	Post Test
199	203
200	205
201	197
205	214
206	211
207	214
211	220
213	211
215	216
216	210
216	210
216	220
216	217
217	235
220	224
221	224
224	234
224	222
225	220
226	223
228	234
230	229
236	241