Mastery Learning: Does it make a difference?

A Special Project

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Mastery Learning: Does it make a difference?

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ABSTRACT

This is an action research project that primarily uses a quantitative methodology. The researcher was interested in the relationship between mastery learning and student achievement as defined by Measures of Academic Progress (MAP) scores. These scores were used to predict the success rate for the End-of-Course (EOC) Exam. The researcher found a relatively strong positive correlation between the spring MAP scores and EOC Exam but the Pearson r score was not strong enough to make individual predictions. Based on this correlation, the researcher found that about 83% of students were predicted to pass the 2013 EOC Exam. The researcher also found that there was statistically significant relationship between mastery learning and student achievement for $p < 0.05$. Teachers also had positive comments regarding more time to show mastery.

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CHAPTER 1

Introduction

Background for the Project

Many schools with over 90% of students on free and reduced priced lunches struggle to meet state expectations on high stakes tests. Schools with low-test scores are under pressure from the government to quickly improve. Bloom (1984) said after giving students corrective assignments and a parallel assessment, many were able to improve to at least an 80% on the test. Mastery learning has been around for many years and is one-option teachers turn to when wanting to improve student retention and help improve their school's test scores.

According to the Office of Superintendent of Public Instruction (OSPI, 2012), Washington State students that graduate in 2015 must pass state tests in reading, writing, two End-of-Course (EOC) math exams, and one biology EOC exam to graduate from high school. The math EOC exams include algebra and geometry exams. Some high schools with low social economic status populations struggle to get their students to pass the Algebra EOC Exam. Social economic status is often correlated to passing rates. These schools face significant and often different challenges than more affluent school sites. (There is not enough information at this point to determine passing rates for the Geometry EOC.) Middle schools are trying to better prepare their students for success in these exams at the high school

level. However, these feeder middle schools are also struggling to get their students to pass the state Measure of Student Progress (MSP) exam.

Statement of the Problem

Many re-teaching and re-testing techniques take time and time is very limited in the school year. Is this time spent wisely? Are corrective activities and parallel assessments making a difference in student achievement in middle school Algebra classes? Time is precious when in a high stakes environment. For example, students in this particular district receive 56 minutes of math a day. That is 10,080 minutes a school year (168 hours) to accomplish state requirements and participate in state required assessments. Washington State requires Algebra students to learn 40 standards in these 168 hours. That is approximately 12 chapters in a textbook with about six sections in each chapter. Schools also have limited time to improve test scores year to year. This study looks at the relationship between mastery learning techniques and student achievement in middle school Algebra classes at a school with over 90% of students on free and reduced lunches.

Purpose of the Project

The purpose of this study was to determine whether the mastery learning techniques being used at this middle school with over 90% of students on free and reduced priced lunches are efficacious. Common assessments and Rausch Interval

Unit (RIT) scores from the Measures of Academic Progress (MAP) test were used to measure the effectiveness of these techniques.

Delimitations

Seven classes were involved in this study: three eighth grade Algebra and four seventh grade Algebra. Although all three teachers used direct instruction for the basis of each lesson and used TI-nspire calculators for entry tasks and investigation activities, they each have slightly different teaching styles and methods. Grading differences on tests were also a factor. The three teachers involved discussed ways of scoring tests during Professional Learning Community (PLT) meetings but there are always slight differences in scoring. Each teacher re-taught the material in a slightly different way and sometimes at different times. The seventh grade teacher tested at different times than the eighth grade teachers due to different schedules for seventh and eighth grade.

This study was conducted during the 2012-2013 school year. MAP assessments were given in October and March of the school year. Spring MAP assessments were given the week before spring break. Common assessments were collected during the month of January. EOC scores for the 2011 and 2012 assessments were also collected along with fall and spring MAP assessments for the same students.

Assumptions

Some students at this particular middle school transfer in the middle of the year or return to Mexico for a month. These students miss units of study with the three teachers involved in this study and their scores may not reflect the work being done at this middle school. Sixteen students from this particular study do not have either fall or spring MAP scores due to transferring during the school year or absences before spring break. Thirty-three students achieved mastery (100%) on common assessments on their first attempt and therefore did not take the parallel assessment. All three teachers are fairly new to teaching and therefore may not be implementing mastery learning techniques in the most effective way.

Hypothesis or Research Question

The use of mastery learning techniques will have a statistically significant positive effect on students' assessments measured by MAP. MAP is a proxy for the state assessment because it is highly correlated to the State MSP assessment.

Null Hypothesis

The use of mastery learning techniques will yield no statistically significant positive effect on students' assessment measured by MAP.

Significance of the Project

This school was identified as a failing school several years ago. Ever since, administrators have been pushing to increase rigor in math. One way of doing so is to provide summer school for advanced and "bubble" students to increase

numbers in middle school Algebra and Geometry classes. Part of their reasoning is to help the high school. The high school connected to this particular middle school has been struggling to get students to pass the Algebra EOC. This school believes they can help them out by passing as many kids as they can while in middle school. This will free up more classes at the high school for those students needing to retake algebra.

It is important to identify whether re-teaching and re-testing is working at this middle school because it takes a lot of time away from other learning activities. Because teachers are re-teaching material they are also moving at a slower pace than years past and have eliminated some sections of their textbook in order to focus on more important standards.

If this practice proves to be successful in this study, these three teachers will be able to continue to work on improving their mastery learning strategies. Participating teachers can also use this study to show evidence to fellow teachers that re-teaching and re-testing is an effective strategy for the population of students at this school.

If the results show their strategies are unsuccessful, these three teachers will have to reevaluate their teaching strategies. They will also have to present the data to their administrators who originally asked them to use mastery learning in their classrooms. Although it would be disappointing, the results would inform the

school that they need to improve their mastery learning strategies or discuss other means of helping these students be successful on the EOC.

Procedure

The researcher began this project by discussing the procedure with administration to get approval for the project. Once the project was approved, the teachers sent home permission slips to parents getting permission to use student data. MAP and EOC scores were collected for students that took the 2011 and 2012 EOC at this particular school. The researcher found the correlation between MAP and EOC scores using this data and the Pearson r test. Fall and spring MAP scores were collected for current algebra students and the researcher ran the T-test to determine if the difference in scores was statistically significant. Spring MAP scores were also used to predict the percent of students likely to pass the 2013 EOC Exam. Common assessments created by the participating teachers were collected to determine if there was a statistically significant improvement in scores. The researcher interviewed participating teachers using a semi-structured interview to further understand the data.

Acronyms

EOC. End-of-Course Exam

IEP. Individualized Education Plan

MAP. Measures of Academic Progress

MSP. Measurement of Student Progress

NWEA. Northwest Evaluation Association

OSPI. Office of Superintendent of Public Instruction

PLT. Professional Learning Community

RIT. Rausch Interval Unit

CHAPTER 2

Review of Selected Literature

Introduction

Benjamin S. Bloom (1968) suggested the idea of mastery learning. Bloom's process for mastery learning involved clear planning on the part of the teacher. He suggested several components for mastery learning to be successful. The teacher organizes units of study into 1-2 week sessions followed by a formative assessment. After grading these assessments, the teacher provides feedback to the students. Students that have yet to reach mastery on the formative assessments are provided with corrective activities while students that already reached mastery are given an enrichment activity. After one to two days, a parallel assessment is given to inform whether students have improved. (Guskey, 2007; Guskey, 2010; Guskey, n.d.).

The focus of mastery classrooms are to improve understanding and to master skills. In mastery classrooms teachers evaluate student progress and provide multiple opportunities to improve skills. Mistakes along the way are treated as learning opportunities (Cauley & McMullian, 2010).

Guskey (n.d.) stated that corrective activities are "just-in time correction" to prevent small misunderstandings from becoming major learning difficulties (Guskey, n.d., para. 10). Corrective activities have many different forms.

Teachers can re-teach information that most students did not initially understand or students can work in small groups where they use textbooks to find information needed for improvement (Bloom, 1984). Block (1980) includes workbooks, audiovisual materials, academic games, and puzzles. Peer tutoring, cooperative learning groups, paraprofessional instruction, and small group instruction are also used as corrective activities. Assigning corrective activities that are different from the teaching strategy allows students a second chance to learn the material (Guskey, 2010).

While some students work on corrective activities, others that have already shown mastery work on enrichment activities. These activities should not be busy work or harder problems but should allow students to "… gain valuable learning experiences without necessarily moving ahead in the instructional sequence" (Guskey, 2010, p. 56). Enrichment activities include special projects, reports, games, or problem-solving tasks that should be self-selected by students (Guskey, 2007).

Student Achievement

To find the effectiveness of mastery learning, Bloom (1984) investigated three types of classes: conventional, mastery learning, and tutoring.

> "Using the standard deviation (sigma) of the control (conventional) class, it was typically found that the average student under tutoring

> was about two standard deviations above the average of the control class (the average tutored student was above 98% of the students in the control class). The average student under mastery learning was about one standard deviation above the average of the control class (the average mastery learning student was above 84% of the students in the control class)" (Bloom, 1984, p. 4).

Bloom found that students who received tutoring outperformed those that were in a mastery learning setting and those that were in a conventional classroom. Although students in a mastery learning setting did not outperform students being tutored, they did outperform those in conventional classrooms. The average student in a mastery learning setting is about "… 1 sigma (84 percentile) above the average student in the control class" (Bloom, 1984, p. 7). Students in the mastery learning classroom received an 80% after taking the parallel assessment.

After looking through various studies, Kulik, Kulik, and Bangert-Drowns (1990) found the average mastery learning program raised assessment scores by 0.5 standard deviation (50^{th} percentile to 70^{th}). Students in mastery learning classrooms also learn more effectively and efficiently than conventionally taught students (Block, 1980). Guskey and Gates (1986) found that mastery learning had a mean effect size for junior high students of 0.93 and a mean effect size of mathematics of 0.81. Hattie and Jaeger (1998) found an effect size of 0.50. The

higher the effect size then the more effective the strategy. According to Gay, Mills, and Airasian (2009) an effect size of .80 or higher suggests a very strong treatment.

Postlethwaite and Haggarty (1998) found that students in a mastery learning classroom retained their learning longer than those in a conventional classroom. Black and William (1998) said that mastery learning could raise student achievement on teacher prepared tests in a teacher-paced program. They also found that mastery learning is more effective with younger students.

Attitude

"Teachers who engage in mastery-oriented *instructional practices* tend to create learning environments where all students can feel successful and feel a sense of task mastery and improvement" (Anderman, Eccles, Yoon, Roeser, Wigfield, & Blumenfeld, 2001, p. 78). Cauley and McMullian (2010) add that students in mastery learning classrooms are more persistent when working on challenging tasks. Researchers have in fact found that students involved in a mastery learning classroom begin to develop a more positive attitude including a more confident outlook on their ability to learn (Bloom 1984; Guskey, 2007; Guskey & Gates, 1986). Student attitude toward the subject and toward the instruction they receive from teachers is more positive with mastery learning

students than those in a conventional classroom setting (Kulik, Kulik, & Bangert-Drowns, 1990 and 1991; Block, 1980; Postlethwaite & Haggarty, 1998).

Anderman et al. (2001) found in a study including 570 3rd, 4th, and 6th graders from 12 schools that "… self-concept of ability was found to be related positively to gains in the valuing of both mathematics and reading" (p. 89). They also stated in their research that maintaining a positive self-image helps students keep a positive attitude toward a subject. When performance-oriented instructional strategies versus mastery learning strategies were emphasized, student attitudes of the subject declined. Ogbuehi and Fraser (2007) suggest that teachers can increase student enjoyment in math by developing environments that "… emphasize personal relevance, student control, involvement and task orientation" (p.112)

Postlethwaite and Haggarty (1998) found that teachers had higher expectations for their students and were able to focus their goals for students. Guskey and Gates (1986) saw more positive attitudes after teachers used mastery learning in their classrooms for 3 weeks. The effect size for their attitude change was 1.67. Teachers began changing their expectations for students and stressed a "… far greater importance to teaching practices and behaviors (effect size = 1.13)" (Guskey, Gates, 1986, p.78).

> "… Guskey (1984) found that teachers who use mastery learning and see improvement in student learning outcomes begin to feel much better about teaching and their roles as teachers (effect size = .61), accept far greater personal responsibility for their students' learning successes and failures (effect size = 1.25), but express somewhat less confidence in their teaching abilities (effect size = .59)" (Guskey, Gates, 1986, p. 78).

Usher (2009) recognized three ways students' self-efficacy beliefs can change: when students alter emotions and thoughts, teachers have an effective classroom structure, and when students improve their behavior. He also described four sources of self-efficacy: mastery experience, vicarious experience, social persuasions, and emotional and physiological states. Usher (2009) found that boys have higher mastery experiences and lower anxiety in math than girls. In his study, Usher (2009) interviewed eight middle school students about their self-efficacy in math. He found that their confidence increased when they showed strong academic performance. Two of the boys interviewed got their confidence from their "inborn capacity for math" whereas one of the girls got her confidence from her effort (Usher, 2009, p. 291). Another student said her confidence came from her teacher's ability to teach her and often worried that if she moved to another class or school her skills would decline. This teacher often gave her

student messages that she was capable of being successful. Usher (2009) found that persuasive messages were beneficial to those with high self-efficacy but those with low self-efficacy rarely heard such messages. Four students expressed that encouragement from their teacher helped them feel more confident in math and two said their teacher was a vital aspect to their success. One student said her teacher helped her to change her negative outlook on math and one expressed that he was frustrated when his teacher didn't understand his needs.

Usher (2009) also found that all eight students interviewed measured their math ability based on their peers' performances and what others told them about their abilities. Those students with high self-efficacy took this information and became competitive but those with low self-efficacy were convinced of their lack of ability in math.

Usher (2009) concluded that teachers should provide students with many opportunities for mastery experiences to occur because when students feel they have mastered a skill, they develop more positive beliefs in their personal efficacy. He found that those with high self-efficacy had high levels of achievement while those with low self-efficacy had poor performance and struggled in math.

Students with a fixed mind-set lose the desire to learn because they are trying to find "tasks that will prove their intelligence and avoiding ones that might

not" because they fear making mistakes (Dweck, 2007, p. 34). Dweck (2007) said that when these students make a mistake, they hide them. Effort scares students with fixed mind-set because it "makes them feel dumb" and when " hit with a setback in school, they *decrease* their efforts and consider cheating" (Dweck, 2007, p. 35). Students with a growth mind-set believe they can develop their intellectual ability with their effort and education. Because these students don't focus on how smart they are, they will accept a challenging task and are more likely to stick to it. When they make a mistake, their effort increases until they correct it. Dweck (2007) also said that the key to outstanding achievement is when students are dedicated and persistent when facing challenging tasks.

Dweck (2007) found that when students were given intelligence praise, their confidence and motivation decreases when given a challenging task. These students did worse than they had initially performed and even lied about their scores. On the other hand, students that were praised for their effort showed continuous improvement and performance. "… effort or 'process' praise (praise for engagement, perseverance, strategies, improvement, and the like) fosters hardy motivation. It tells students what they've done to be successful and what they need to do to be successful again in the future" (Dweck, 2007, p. 36).

Formative assessment is "…one of the most powerful ways to enhance student motivation and achievement" (Cauley & McMullian, 2010, p. 1). Stiggens

and DuFour (2009) said formative assessment, when done correctly, can help students see their individual progress toward learning goals and in the process motivate them by building confidence as learners. Cauley and McMullian (2010) stated that there is a positive relationship between this form of assessment and student motivation and achievement on high stakes tests. They also noted that positive effects on student motivation and learning occur when the teacher establishes a supportive and trusting classroom environment. "Formative assessment, then, is a planned process to the extent that the teacher consciously and constantly absorbs evidence of student motivation and engagement" (Cauley & McMullian, 2010, p. 2).

According to Cauley and McMullian (2010), teachers can help students build hope, positive expectations for themselves, interest, and commitment by providing feedback about their progress that is task-specific. Simply providing a grade as feedback can lower student expectations for success. By assessing and providing feedback for learning helps students to be optimistic and eager to keep trying. If students understand their success comes from their effort, they will have more motivation and persistence than those that believe their success came from luck or chance.

Feedback

"Effective teachers continually attempt to learn about their students' thinking and understanding" (National Research Council, 2000, p. 140). A large part of mastery learning is providing students with feedback before giving corrective or enrichment activities. While Hattie and Jaeger (1998) found mastery learning has an effect size of 0.5, they also investigated effect sizes of many forms of feedback. They found effect sizes for positive forms of feedback including "…reinforcement (1.13), corrective feedback (0.84), remediation and feedback (0.65), diagnoses and feedback (0.52)…" (Hattie and Jaeger, 1998, p. 114).

Feedback is usually seen in the form of a summative assessment where students receive a grade and then move on to another topic. This, however, is not the most effective way to use assessments as feedback. According to the National Research Council (2000), feedback is most effective when students are given the opportunity to revise their thinking after receiving the feedback. Formative assessments are appropriate sources of feedback when it is used to improve teaching and learning. The National Research Council stated these assessments need to be focused around student understanding rather than memorizing procedures and facts and should occur continuously. Adding opportunities for students to receive feedback through formative assessments will increase students' learning and transfer. Students will also begin to appreciate the

opportunity to refine their thinking. “Stiggins (2005) noted that students use available information to decide if learning is worth the effort. If students believe learning is important, they will exert greater effort. Students who believe learning is not worth the effort tend to give up” Cauley & McMullian, 2010, p. 2).

Hattie and Timperley (2007) recognized four levels of feedback: when it’s to correct a task, about the process to complete a task, about self-regulation, and about the self. Feedback is most effective when it gives details of the correct answer and corrects a student’s faulty interpretations rather than a lack of understanding and least effective when it is about the self (Hattie & Timperley, 2007; Black & William, 1998). Hattie and Timperley (2007) reported effect sizes for feedback about a task of 1.13, 0.82, and 0.74. This type of feedback should be simple such as giving comments rather than a grade. Feedback on the processing of a task is most effective when enhancing deeper learning. Feedback on self-regulation is most effective when students believe their answer is correct when they are actually wrong. Because of this feedback, students will put effort toward correcting their misunderstanding.

Formative assessments provide teachers with information they can use as feedback to modify their teaching and student learning. For formative assessments and feedback to be successful, Black and William (1998) believed students needed to see the gap in their understanding and then take action to close the gap.

They also noted that some students may not see the feedback as helpful because they believe they are receiving it because of their low ability.

Stiggens and Dufour (2009) stated that formative assessments should be used continuously during the learning process to show teachers where their students are currently located in their learning. If these assessments are used correctly, they can provide feedback to both the teacher and student as to their progress toward meeting learning standards. "Over time, the student masters progressive levels of prerequisite learning that accumulate to mastery of the standard" (Stiggins & DuFour, 2009, p. 641).

Summary

Although mastery learning is not as effective as tutoring when it comes to student achievement, it is more effective than conventional classrooms with effect sizes ranging from .50 to .93 (Bloom, 1984; Guskey & Gates, 1986; Hattie & Jaeger, 1998). According to Kulik, Kulik, and Bangert-Drowns (1990), mastery learning moved students from the 50^{th} percentile to the 70^{th} percentile. Students within mastery learning classrooms tend to have a more positive attitude toward their learning, are more persistent with challenging tasks, and are more confident in their abilities (Bloom, 1984; Cauley & McMullian, 2010; Guskey, 2007; Guskey & Gates, 1986; Usher, 2009). Helping students keep a positive self-image will also help improve student attitude (Anderman et al., 2001). The constant

feedback from formative assessments in a mastery learning classroom helped with student confidence (Stiggens & DuFour, 2009). This feedback, however, was most effective when it corrected students' misinterpretations, the student saw the gap in their understanding, and was continuous (Black & William, 1998; Hattie & Timperley, 2007; Stiggens & Dufour, 2009).

CHAPTER 3

Methodology and Treatment of Data

Introduction

This research project examines the correlation between mastery learning and student achievement in algebra classes within a middle school with over 90% of students on free and reduced price lunch. This particular school based their teaching strategies on Bloom's (1968) idea of mastery learning. However, the algebra teachers have not fully implemented mastery learning in the way Bloom intended. These teachers teach a unit, test, and within a week conduct a review day within the classroom. The following day students take a parallel assessment (same questions but different numbers). Students only take sections of the test they did not receive 100% originally on; mastery is assumed on the first assessment at 100% achievement. Thirty-three students received 100% on the initial assessment and still participated in re-teaching activities. These students did not participate in the parallel assessment and this may be a limitation in the data.

Student achievement was assessed through common assessments created by the three participating algebra teachers as well as fall and spring Measures of Academic Progress (MAP) Rausch Interval Unit (RIT) scores. The researcher analyzed End-of-Course (EOC) Exam data from previous algebra students at this

middle school to see if there was a correlation between spring MAP and EOC scores. Ultimately, the teacher-researcher was interested in having a better understanding whether a relationship between mastery learning and student achievement exists.

Methodology

This was an action research project using a primarily quantitative methodology because the researcher was interested in student achievement using assessment scores (Gay, Mills, and Airasian, 2009). The researcher analyzed the correlation of mastery learning and student achievement using fall and spring MAP scores, common assessments created by the participating teachers, and EOC data. For the purpose of this research, student achievement will be defined as observed growth on the MAP assessment for the given school year (2012-2013) as compared to typical growth. The researcher used spring and fall MAP scores to see if there was a statistically significant increase is student achievement in this given school year. Common assessments were analyzed to see if there was statistically significant improvement from the original assessments to the parallel assessment. EOC data and spring MAP scores from the previous two years were analyzed to help predict success on the current year's students on the EOC.

This researcher also interviewed the teachers involved in a semi-structured interview setting to get a better understanding of the data.

Participants

Participants for analyzing the correlation between mastery learning and student achievement included 83 8th grade and 122 7th grade algebra students from a high poverty school. Student data was collected from the previous year for 7th grade fall and spring MAP tests as well as spring EOC scores. The same data was collected for the previous two years for 8th grade.

Instruments

Fall and spring MAP scores were collected for all participating students. Common assessments across 7th and 8th grade algebra classes were also collected for current participating students in this school and have face validity. Previous MAP and EOC scores were collected for all students who have taken the EOC at this particular school. MAP, according to Northwest Evaluation Association (NWEA) is reliable (NWEA, 2013b). NWEA (2013a) reported the MAP assessment is also valid. The Educational Testing Service (2012) and Educational Testing Service (2013) reported that the EOC Exams were valid and reliable.

Design

Fall MAP RIT scores were used as a pre-tests for participating students and spring MAP RIT scores were used as a post-tests for the academic year. Common assessment data and parallel common assessment data were collected for all 7th and 8th grade algebra students. These assessments were collected second semester

of the school year for the units being taught at that time. Each teacher gave the same assessment at roughly the same time. The seventh grade classes took their parallel assessments for chapter 7 later than the eighth grade classes due to scheduling differences. MAP and EOC scores were collected for the previous two years to show the correlation between the two assessments and predict current student scores.

According to NWEA (2013), the average beginning of the year mean MAP score for 7^{th} grade is 225.6 and 230.2 for 8^{th} grade. The end of year mean MAP score for 7^{th} grade is 230.5 and 234.5 for 8^{th} grade. Thus, to achieve the typical growth, 7^{th} grade must gain 4.9 RIT points and 8^{th} grade must gain 4.3 RIT points.

Researcher bias was controlled by randomly assigning student numbers to eliminate any identifiable information. The structured interview questions were worded to eliminate questions that would lead participants to a biased answer. The researcher was involved in the study and was not involved in answering the interview questions. Only answers from the remaining two teachers were used to eliminate researcher bias.

Although the same content was being taught within several days in each classroom, each teacher had different teaching styles and techniques. All three teachers used direct instruction and math notebooks in their classrooms as well as TI-nspire calculators. The eighth grade teachers gave different entry tasks than the

seventh grade teacher. Therefore, it was the opinion of the researcher that the classes were similar. Even though these teachers discussed how each assessment was to be graded, there were slight differences in how scores were assigned to particular students. For example, a student with an Individualized Education Plan (IEP) could have been graded differently than those without. Also, when the teachers involved in the study re-taught material to prepare students for the parallel assessment, each teacher re-taught using different techniques (white boards versus TI-nspire calculators).

Procedure

EOC and MAP data from the past two years were collected via the district's testing coordinator who organized fall and spring MAP scores and EOC scores by student. All students were assigned a random number to eliminate any identifiable information by the district's testing coordinator. The researcher created scatter plots comparing Fall MAP to EOC scores and Spring MAP to EOC scores. The correlation was calculated using the Pearson r test. The researcher then inserted lines to show passing scores for both MAP and EOC to predict estimated passing rates for the current year.

All three algebra teachers administered the same common assessment to their classes within a week of each other. The teachers met after school due to different PLC times for 7^{th} and 8^{th} grade to determine how to grade each test and each

teacher graded her own class's assessments and created an excel sheet that included all scores for each test. Each teacher found the mean and median score for each class. Sections that students had not achieved 100% on were re-taught. Student that received 100% on the initial assessment participated in re-teaching activities. Teachers administered a parallel assessment to all students who had not yet achieved mastery. Students only retook the sections of the parallel assessment they did not receive 100% on the initial assessment because receiving 100% is assuming mastery. The teachers inputted the new test scores onto the same excel sheet with the original test scores, calculated the mean score, and calculated the median score. Although teachers gave the students their highest score for their class grade, this study compare all initial assessment scores to all parallel assessment scores. If students achieved mastery on the initial assessment then their score was also transferred to the parallel assessment. This data was compiled by the researcher in an Excel sheet and assigned each student a random number. Mean scores for each teacher were calculated as well as the difference between initial assessment and parallel assessment scores. The researcher conducted the T-test to determine if the difference was statistically significant.

MAP scores were collected for all algebra students in October as well as the last week of March of the same school year. The researcher analyzed the data by creating a scatter plot, finding the difference in student scores, and using the T-

test to determine if there was a statistically significant gain in student achievement for that particular year. The correlation between spring MAP scores and EOC scores was used to predict student achievement for the 2013 EOC.

Summary

The researcher used a primarily quantitative methodology while conducting her action research project to better understand whether there was a relationship between mastery learning and student achievement. Participants included 7th and 8th grade Algebra students at a school with over 90% of students on free and reduced price lunches. Common assessments created by the teachers, MAP scores, and EOC scores were used to conduct Pearson r and T-tests. The researcher looked for a correlation between MAP scores and EOC scores. She also looked for a statistically significant difference in student scores for this particular school year (2012-2013).

CHAPTER 4

Analysis of the Data

Introduction

The item of interest for the research question was whether the mastery learning techniques at a school with over 90% of students on free and reduced price lunches has statistically significant affects on student achievement. Student achievement was defined by Measures of Academic Progress (MAP) scores. Students at this particular school were in 7^{th} and 8^{th} grade algebra classes and must pass the Algebra End-of-Course (EOC) Exam to graduate high school. Their spring MAP scores helped predict their success on the EOC.

Description of the Environment

This project looked at student achievement in four seventh grade classrooms and three eighth grade classrooms throughout the 2012-2013 school year. These classes were in a school with over 90% free and reduced price lunches and participants were generally considered highly capable students. These algebra classes were advanced placement classes for that particular year. The same material, for the most part, was taught in each classroom. However, each teacher had her own teaching style and strategies used within the three classrooms varied.

Common assessments were written by the participating teachers and given within a week of each other in each class due to differences in schedules from

seventh and eighth grade. These common assessments have face validity. The MAP assessment was used to assess student achievement for the given year. MAP and EOC scores from the two preceding years were used to predict EOC scores for participating students for the 2013 test.

Hypothesis/Research Question

The use of mastery learning techniques will have a statistically significant positive effect on students' assessments as measured by MAP. MAP is a proxy for the state assessment because it is correlated to the State Measurement of Student Progress (MSP) assessment with a Pearson r score of 0.845 (Northwest Evaluation Association, 2011).

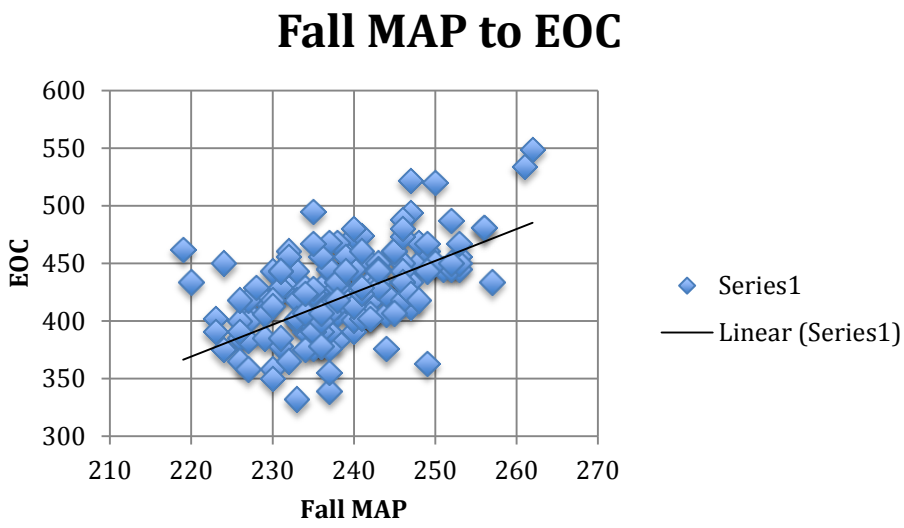
Null Hypothesis

The use of mastery learning techniques will yield no statistically significant positive effect on students' assessment measured by MAP.

Results of the Study

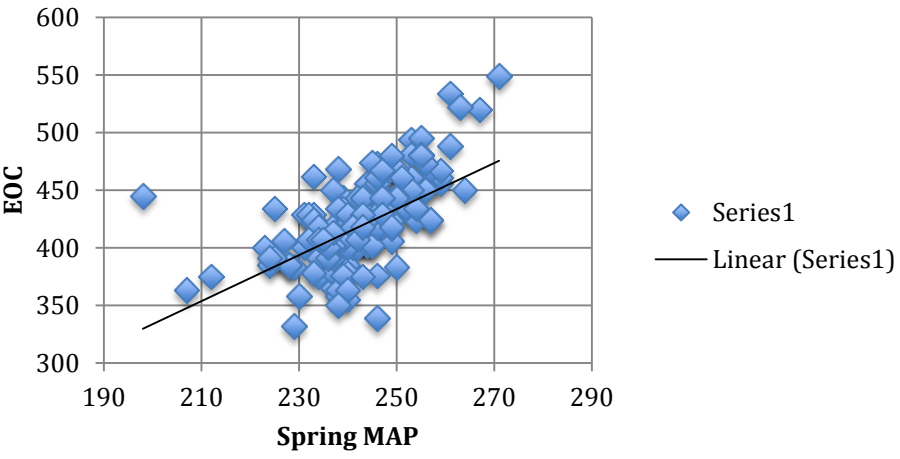
The researcher first studied the correlation between the MAP and EOC assessments using data from the algebra classes in the school years 2010-2011 and 2011-2012. Both fall and spring MAP assessments were positively correlated to the EOC assessment as shown in Figure 1 and Figure 2. The fall MAP assessment and EOC Exam had a Pearson r score of 0.525, which is considered a fairly strong positive correlation.

Figure 1 Fall MAP and EOC Correlation



The spring MAP assessment and EOC assessment had a Pearson r score of 0.622 and is consider a stronger positive correlation than that between fall MAP and EOC assessments. This correlation was still not strong enough to make individual predictions.

Figure 2 Spring MAP and EOC Correlation



Since spring MAP scores had a higher correlation with the EOC, researcher used spring MAP scores to predict success on the EOC for the 2012-2013 class of algebra students at this particular school. The passing score for the EOC is a 400. Based on this correlation, the researcher found that students will need a 233 or higher on the spring MAP assessment to pass the 2013 EOC. The RIT range for the MAP is plus or minus 3 RIT points. This means that students ranging from 230 or higher can be predicted to pass the EOC. The researcher then found that about 83% of the Algebra students were predicted to pass the 2013 EOC as seen in Figure 3.

Figure 3 Percent Predicted to Pass the EOC

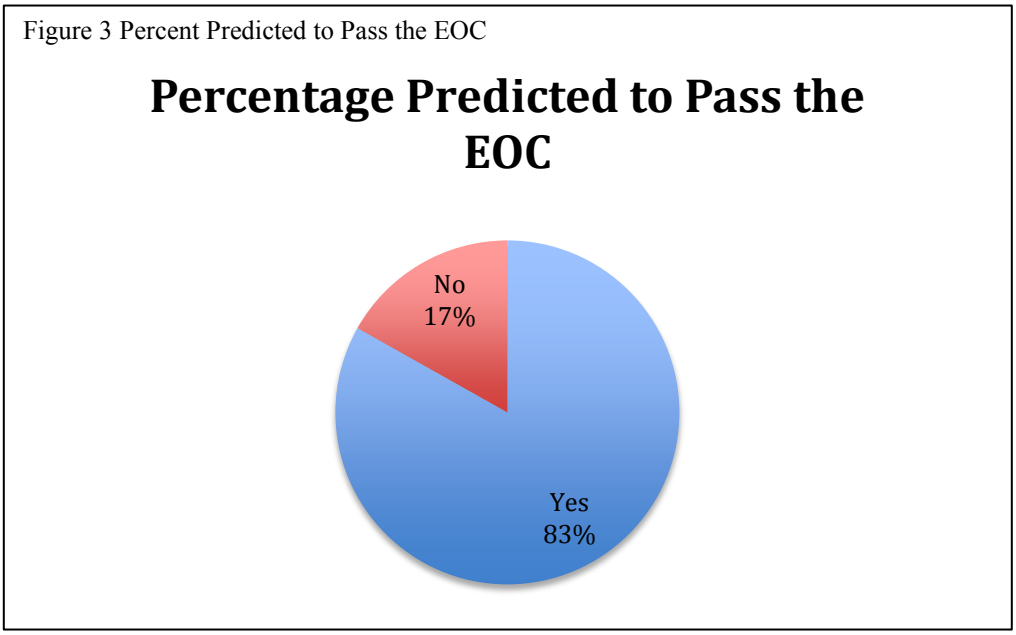


Table 1 shows the average score for each common assessment by teacher and grade. Seventh grade classes had higher average scores than 8th grade classes on the initial common assessments.

Table 1 Mean Initial Assessment Scores

Teacher	Assessment 1	Assessment 2	Assessment 3	Assessment 4
1 8th Grade	1.73	1.54	1.60	2.16
2 8th Grade	1.84	0.68	0.48	1.20
3 7th Grade	2.64	2.21	2.08	3.68
Total Possible Points	**3**	**3**	**3**	**5**

Common assessment data for the parallel assessments are shown in Table 2. Seventh grade classes, again, had higher average scores than eighth grade classes on the parallel assessments.

Table 2 Mean Parallel Assessment Scores

Teacher	Assessment 1	Assessment 2	Assessment 3	Assessment 4
1 8th Grade	2.03	2.16	1.96	3.18
2 8th Grade	2.07	2.05	2.26	3.33
3 7th Grade	2.69	2.54	2.45	4.24
Total Possible	**3**	**3**	**3**	**5**

The difference in scores from initial assessments to parallel assessments is shown in Table 3. Although seventh grader classes had higher scores on both assessments, they did not improve as much as eighth grade classes on the parallel assessment. Eighth grade classes made greater gains than seventh grade classes.

Table 3 Changes from Initial to Parallel Assessment

Teacher	Assessment 1	Assessment 2	Assessment 3	Assessment 4
1 8th Grade	+0.30	+0.62	+0.36	+1.02
2 8th Grade	+0.23	+1.37	+1.78	+2.13
3 7th Grade	+0.05	+0.33	+0.37	+0.56

The T-test was run for overall common assessment scores for seventh and eighth grade combined because the researcher was ultimately interested in the overall effect on student achievement. The researcher calculated a t Stat score of 4.42 with a P-value of $1.29x10^{-5}$.

Table 4 shows mean fall and spring MAP scores. The table also shows the difference in those scores. T Stat scores and P-values in relation to MAP scores are also shown in Table 5. T-tests provided statistically significant evidence for $p < 0.05$.

Table 4 MAP Data by Grade

Grade	Fall MAP Mean	Spring MAP Mean	Difference in Mean	t Stat	P-value
8^{th} Grade	233.14	235.73	2.59	1.83	0.07
7^{th} Grade	235.49	240.69	5.20	3.86	$1.50x10^{-4}$
Overall	234.52	238.67	4.14	4.11	$4.78x10^{-5}$

Participating teachers were interviewed to better understand the data being presented in this chapter. Teachers were first asked if they believed mastery learning improved student achievement in their classroom. One teacher stated, "It is no longer the students take a test and it's done. They have to move on whether they understood it or not. My students now have multiple opportunities to show their understanding and if they didn't get it on the test the first time, they are still responsible for that information and can show me they understand it later. I believe it has pushed the students to become more responsible for their own learning and understanding as well as improve the general feeling of success in the classroom." This teacher was also asked if she would make any changes to the mastery learning strategies used in her classroom. She said, "I would implement more small group instruction in class or after school from the beginning of the year to prevent any student from falling behind to the point where they are failing. In mastery learning we need to meet the needs of every student so that all

[students] can be successful rather than letting a few fall through the cracks. Also, I want to implement a new system for retests so we have more of a routine on how we review and retest."

Both teachers were asked what they believed to be the best strategy their team implemented this year. One teacher responded by saying, "I think the best strategy that we are using this year is common assessments. This allows us to discuss how concepts were taught and compare the differences between our scores to see which way of teaching worked and which way didn't." Another teacher said, "The best strategy we are using this year is repetition. We are making sure the students see the information many times before they are asked to assess on it."

In regards to some of the eighth grade MAP scores decreasing; an eighth grade teacher responded with, "I think the main reason for this is because my students took the spring MAP test on the Friday before [spring] break. They were not able to focus on their exam with spring break in their minds."

Findings

The spring MAP assessment and the EOC Exam had a positive correlation. About 83% of Algebra students at this particular school were predicted to pass the 2013 EOC Exam according to this correlation. The null hypothesis was rejected

according to the t Stat values produced by the T-test with statistically significant evidence for $p < 0.05$.

Discussion

Black and William (1998) said that student achievement would rise on teacher prepared tests in a mastery learning classroom. According to Table 3, all classrooms did improve from the initial assessment to the parallel assessment. T-tests showed that mastery learning did have a statistically significant effect on student achievement for these common assessments. Seventh and eighth grade students, on average, increased their MAP scores. According to NWEA (2013) seventh grade students should gain around 4.9 Rausch Interval Unit (RIT) points and eight grade should gain around 4.3 RIT points. Table 4 shows that eight grade students gained an average of 2.59 RIT points and seventh grade gained 5.20 RIT points. Therefore, eighth grade did not gain as much as NWEA said they should while seventh grade gained more than the average RIT points for their grade level. Many other factors besides mastery learning strategies may have contributed to the results of this. This particular middle school has a wide range of parent involvement from the parent that monitors homework to the parent that never asks. Timing of the test may have also affected the results of this study. All students took their MAP assessment the week before spring break. One particular class took the assessment the last school day before spring break. Several students

involved in the study also missed a large number of school days due to family vacations or emergencies. Teachers also did not follow the exact steps that researchers suggested in chapter 2. Bloom (1984) found that mastery learning was more effective than conventional teaching but not as effective as tutoring. The results of this study did reflect findings of researchers mentioned in chapter two.

Bloom (1984), Guskey (2007), and Guskey and Gates (1986) said that students in mastery learning classrooms developed more confidence in their abilities. The teachers involved in this study agreed. One teacher said, " I believe that by allowing mastery learning the students are more successful and confident about math."

The purpose for this project was to better understand how the mastery learning strategies the algebra teachers implement in their classrooms affected student achievement. Based on the interviews with participating teachers, mastery learning was allowing for more opportunities to learn material and show growth in learning. The teachers understood that there was room for improvement in their strategies but have already seen an improvement within their classrooms. According to the data mastery learning strategies used during the 2012-2013 school year supported the views of the teachers.

Summary

A stronger positive correlation was found between the spring MAP assessment and the EOC Exam than between the fall MAP assessment and the EOC Exam. The researcher used this correlation to find that about 83% of the algebra students were predicted to pass the 2013 EOC Exam. The researcher was able to reject the null hypothesis based on the statistically significant evidence for $p < 0.05$.

Teachers expressed positive opinions in regards to mastery learning in their classrooms and believed mastery learning helped their students be more responsible for their learning. They also expressed that they believed the additional opportunities to show student growth was beneficial. The results of the study did align with results discussed in chapter 2.

CHAPTER 5

Summary, Conclusions and Recommendations

Introduction

The purpose of this research project was to determine if the mastery learning techniques used in a middle school with over 90% of students on free or reduced-priced lunches had a statistically significant effect on student achievement. The particular school involved in the research study was identified as a failing school and must improve test scores. The school had been working to move more students into advanced math classes and the algebra teachers have adopted strategies from Bloom's (1968) mastery learning.

Summary

This was an action research project that primarily used quantitative data because the researcher was interested in better understanding the relationship between mastery learning and student achievement as defined by Measures of Academic Progress (MAP) scores. Participants included seventh and eighth grade algebra students from a middle school with over 90% of students on free or reduced priced lunches. These algebra students take the End-of-Course (EOC) Exam at the end of the school year. The researcher was interested in success rates for the EOC and used the correlation between previous MAP and EOC scores to predict success rates for the current year's (2012-2013) students.

A positive correlation was found between spring MAP and EOC scores with a Pearson r score of 0.622, which suggests a relatively strong correlation. This correlation was not strong enough to make individual predictions but was used to estimate an overall percentage of passing students. The researcher found that about 83% of students are predicted to pass the 2013 EOC Exam.

Seventh and eighth grade classes showed improvement from original common assessments to the parallel assessments created by the teachers. T-test scores were calculated for common assessments and there was statistically significant effect on common assessment scores for $p < 0.05$. The T-test was also calculated for MAP assessments and there was statistically significant effect for $p < 0.05$.

Many factors contributed to the results of this study. Teachers did re-teach and re-test the material but they did not follow the exact recommendations and strategies researchers in Chapter 2 suggested. Also, students miss school for various reasons and MAP assessments were given the week before spring break. These factors play a role in student assessment scores.

Conclusions

According to Guskey and Gates (1986), mastery learning had a mean effect size of 0.93 for junior high students and a mean effect size of 0.81 for mathematics. Overall the Review of Selected Literature in chapter 2 showed a positive relationship between mastery learning and student achievement. There also seems to be a positive effect on student and teacher attitudes. Table 3 in,

chapter 4, shows growth in common assessment and MAP scores for each grade level. Mastery learning strategies that participating teachers showed statistically significant effect on student achievement for $p < 0.05$. There are many other factors that may have contributed to these results.

For the purpose of this study student achievement was defined by Spring MAP Rausch Interval Unit (RIT) scores. Students, on average, improved from fall to spring MAP assessments. Some student scores decreased. This may have been due to the timing of the test. Mastery learning had a statistically significant effect on the difference in fall to spring MAP scores for $p < 0.05$. Therefore, the mastery learning strategies as implemented by these teachers were affective. Teachers, however, did not use Bloom's (1968) mastery learning outline and the timing of the spring MAP assessment was right before spring break. These factors may have affected the results of the study.

Recommendations

Based on the data collected, the researcher suggested that the teachers continue to improve their mastery learning strategies within their classroom. Researchers in chapter 2 like Bloom (1984) received positive results because they implemented the strategies as he suggests. Since the teachers saw improvement in their students' attitudes and assessment scores, the researcher suggested further researching Bloom's (1968) strategies and implementing them as he suggested.

With further implementation of mastery learning strategies, further data collection should also be continued.

Future research around mastery learning is also recommended. This particular study was conducted in a middle school where 90% of students are on free or reduced price lunches. It would be interesting to see if similar outcomes may be found in Algebra classes at the high school level. It would also be interesting study the results of general seventh and eighth grade math classes that use mastery learning as compared to the Algebra classes at the same grade level in this particular middle school.

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