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Mastery Learning Approach with Formative Assessment Process to Encourage Student Success in Mathematics Classroom

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Mastery Learning Approach with Formative Assessment Process to Encourage Student Success in Mathematics Classroom

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Abstract

The mastery learning approach in education focuses on frequent check ins throughout learning to provide feedback. This feedback helps inform the teacher of how the students are doing and how to adjust lesson plans and activities. This feedback also informs the students of how they are doing in the class and provides the students with the opportunity to practice and learn from mistakes. This research study is an investigation of how the mastery learning approach in the mathematics classroom encourages students by utilizing frequent formative assessment and feedback. The purpose of this research was to determine whether mastery learning using frequent formative assessment and feedback increases student learning in mathematics. The main research question that the study was focused on was "how does the mastery learning approach with the formative assessment process encourage student success in the mathematics classroom?". To accomplish the objectives of the research study, a quantitative research design was used. A convenience sample was utilized since the participants are students in the mathematics classroom. The participants of the research study were given a pre-test and a post-test to measure growth in one unit of Algebra 1. Throughout the unit, participants were given feedback on their assignments and were able to correct and resubmit their assignments for points back. At the end of the unit, participants were given a survey to determine how they felt about the mastery learning and formative assessment process throughout the unit.

Dedication

This project is dedicated to my husband Parker who has encouraged me to pursue my master's degree in education while raising two young children. You have been a constant support in my life and throughout my graduate classes. I also dedicate this project to my two daughters, Addison and Shae. May you always follow your dreams and strive to keep learning throughout your entire life.

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Chapter 1

Introduction

Introduction

One of the daily struggles of a high school math teacher is determining what to do when students do not understand what is being taught. According to Guskey, (2010) "if teachers could provide the necessary time and appropriate learning conditions, nearly all students could reach a high level of achievement" (p. 53). The traditional approach to teaching includes an assessment at the end of a unit to check students' understanding of the material. But often this is too late for teachers to adjust daily teaching and for students to learn from one's mistakes (Curry et al., 2016).

A different approach, mastery learning, focuses on including frequent checks throughout the unit to provide feedback to the students and opportunities to practice and learn from mistakes. This approach identifies "precisely what students have learned well and where they still need additional work" (Guskey, 2010, p. 53). These frequent checks inform students on what they must work on towards the goal of mastering content while informing teachers on how to adjust learning in the classroom. Key elements of the mastery learning process include a pre-assessment, multifaceted instruction, regular formative assessment, corrective instruction, more formative assessment, and enrichment or extension activities. Formative assessment occurs multiple times to reinforce precisely what students are "expected to learn, identify what they learned, and describe what they need to learn better" (Guskey, 2010, p. 55).

Brief Literature Review (Background of the problem)

Cundiff et al. (2020) recognized that mastery learning has positive effects on student achievement. Mastery learning helps students learn the material and appreciate having multiple attempts to understand a concept. Students recognized that learning with a mastery learning approach wasn't just for memorization for a test and that they were actually learning the concepts. The positive impact of being able to "fix their mistakes and prove that they are both trying to grow and studying" (Cundiff et al., 2020, p. 115) and the regular feedback on their learning increased student motivation.

Formative assessment occurs throughout the teaching and learning process in the mastery learning approach. According to Wafubwa and Ochieng (2021), formative assessment is associated with benefits such as making learning visible and providing strong feedback to teachers and to students. A study also revealed that "students who see assessment as making them responsible learners have increased learning outcomes" (Wafubwa & Ochieng, 2021, p. 123) and that feedback is valued by students.

Frequent formative assessment with feedback is valued by students and has positive effects on students' achievement (Wafubwa & Ochieng, 2021). Feedback is a key part of the formative assessment process and is considered central to effective teaching (Burns, et al., 2021). Studies show that if teachers give informative feedback and students take action after receiving the feedback, student achievement increases. If students perceive the teacher feedback as clear guidance on how to improve their learning, it plays a positive role in students mathematics motivation and achievement (Burns, et al., 2021).

Statement of the Problem

In mathematics if students do not comprehend a certain topic in mathematics, they usually tend to not be successful in other topics. This contributes to low performances in the subject (Adeniji et al., 2018). Mastery learning holds teachers and students to the standard that all students need to learn each topic before moving on. The mastery learning approach includes teacher feedback on formative assessments and remedial activities for students to have more practice. A classroom with mastery learning as opposed to the traditional approach can "reduce the gaps of performance between learners of different degrees of academic abilities" (Adeniji et al., 2018, p. 3).

Purpose of the Study

The main purpose of this study is to determine whether mastery learning using frequent formative assessment and feedback increases student learning through a unit of mathematics. The mastery learning approach believes that nearly all students can master the content when provided the right learning conditions with formative assessment and feedback (Guskey, 2010).

Research Question(s)

The goal of this action research study is to answer the following question:

How does the mastery learning approach with the formative assessment process encourage student success in the mathematics classroom?

Definition of Variables. The following are the variables of study:

Variable: Mastery Learning is a theory developed by Benjamin Bloom in 1968 that concludes that all students have the potential to learn if given enough time and qualified

instruction is given. Key elements of mastery learning include pre-assessment, high-quality instruction, and frequent formative assessment paired with teacher feedback (Guskey, 2010).

Variable: Formative Assessment is defined as an assessment activity that provides information about student learning to be used by teachers and by students as feedback. Its purpose is to gather information about students' thinking and learning progress in order to modify teacher and learning activities (Park et al., 2020).

Variable: Feedback is defined as information provided to a student from a teacher to inform them on what needs to be improved and how to do so.

Significance of the Study

This study is important to teachers and to students to develop a deeper understanding of how the mastery learning approach with the formative assessment process encourages student success in the mathematics classroom. It allows students to receive feedback on their learning, understand their mistakes and where they are at in their learning. In addition, it allows students the opportunity to grow in their learning towards the summative assessment. This study is also important because it could influence other teachers to incorporate mastery learning in their classroom.

When compared with students in traditional classes, students in "well-implemented mastery learning classes consistently reach higher levels of achievement and develop greater confidence in their ability to learn and in themselves as learners" (Guskey, 2010, p. 54). Formative assessment gives teachers the data to make decisions on what's best for students and to make adjustments as necessary to improve student learning (Curry et al., 2016). Teaching becomes more effective and directed to students' needs.

Research Ethics

Permission and IRB Approval. In order to conduct this study, the researcher will seek MSUM's Institutional Review Board (IRB) approval to ensure the ethical conduct of research involving human subjects (Mills & Gay, 2019). Likewise, authorization to conduct this study will be sought from the school district where the research project will be taking place.

Informed Consent. Protection of human subjects participating in research will be assured. Participant minors will be informed of the purpose of the study via the Method of Assent that the researcher will read to participants before the beginning of the study. Participants will be aware that this study is conducted as part of the researcher's Master Degree Program and that it will benefit her teaching practice. Informed consent means that the parents of participants have been fully informed of the purpose and procedures of the study for which consent is sought and that parents understand and agree, in writing, to their child participating in the study (Rothstein & Johnson, 2014). Confidentiality will be protected through the use of pseudonyms (e.g., Student 1) without the utilization of any identifying information. The choice to participate or withdraw at any time will be outlined both, verbally and in writing.

Limitations. A few limitations in this study would be that not all students will make corrections towards mastery. Another limitation is that it will take more instructional time for some students to learn content towards mastery (Adeniji et al., 2018).

Conclusions

Mathematics classes build on each other and if students are not successful in one topic, they may not succeed in another. The mastery learning approach holds teachers and students accountable and provides opportunities for students to succeed. This study will focus on how the

mastery learning approach with the formative assessment process encourages student success in the mathematics classroom. The next chapter will review research on mastery learning, formative assessment, and the importance of teacher feedback.

Chapter 2

Literature Review

Introduction

One of the daily struggles of a high school math teacher is determining what to do when students do not understand what is being taught. Questions arise, such as, are students to move to the next lesson after assessments? What does a teacher do when students do not understand mathematical concepts? The traditional approach to teaching mathematics is dominated by timed tests and teacher-centered ideas, where the teacher has all knowledge that must be provided to the students. The traditional method of teaching has shown to be largely ineffective (Cundiff et al., 2020). Students typically do not receive feedback until after some sort of assessment, which is oftentimes too late for students to modify their learning. This raises a serious concern "regarding the efficacy of the traditional teaching styles many of us are trained to imitate" (Cundiff et al., 2020, p. 108).

A more student-centered approach to teaching mathematics shifts the focus on the teachers being facilitators of learning and emphasizes the use of formative assessment to improve student learning by giving effective feedback and involving students through self- or peer-assessments (Dayal, 2021). These different beliefs on teaching and assessment can influence how students learn and how well they learn. These views will also impact teachers' classroom practices related to formative assessment and mastery learning.

Mastery Learning

Mastery learning is a theory developed by Benjamin Bloom in 1968 that concludes that all students have the potential to learn if given enough time and quality instruction is given. According to a theory by John B. Carroll that initiated a fundamental change in teaching,

students need different amounts of time to learn and concluded a student's willingness and opportunities to learn affect the learning rate of a student (Goksoy, 2018). Quality instruction from a teacher includes active involvement and feedback during the student's learning process.

If students do not comprehend a certain topic in mathematics, they usually tend to not be successful in other topics. This contributes to low performances in the subject (Adeniji et al., 2018). Mastery learning holds teachers and students to the standard that all students need to learn each topic before moving on. Teachers break down course material into manageable units and create formative assessments to assess students on topics within the unit. Since there are many topics covered in one mathematics class, formative assessment needs to be occurring daily to allow teachers to understand where each individually student is at as well as feedback to students needs to happen daily as well too so that students know where they are at with each topic.

Mastery learning shifts the focus on the student and "prioritizes deep, conceptual understanding and regular feedback" (Cundiff et al., 2020, p. 108). It is a powerful strategy that improves student learning by providing numerous opportunities to practice concepts, receive feedback, and practice concepts again. Students are able to assess multiple times on a topic until mastery is proven. There is enough time to learn each concept while receiving quick, regular feedback through each unit (Cundiff et al., 2020). Formative assessment with descriptive feedback

is an important part of this process. Students in mastery learning classrooms like the opportunity to learn from one's mistakes and reassess on material not mastered. They also note that the pressure to perform the first time is lessened since they are able to always fix their mistakes and study more (Cundiff et al., 2020).

Most studies of mastery learning assess student achievement and find "positive effects in regard to student achievement, most often measured as student scores on unit and course exams or letter grades attained by student" (Cundiff et al., 2020, p. 109). According to Adeniji et al. (2018) in a specific research study, there was a significant difference in the performance of students taught circle geometry using master learning approach than those taught conventionally. There was also a significant difference in the posttests scores and their retention scores.

Students in a mastery classroom "felt motivated by the goal of mastery and appreciated the invitation to make mistakes and learn from them" and "saw mastery as a chance to focus on learning in a low-stress, yet active, environment" (Cundiff et al., 2020, p. 116). Formative assessments throughout the mastery learning approach made an impact on student understanding.

Formative Assessment

Formative assessment is an assessment activity that provides information about student learning (Park et al., 2020). It is to be utilized by teachers to modify teaching and learning activities. Formative assessment also provides information to students so that students can monitor their progress and improve their achievement. The purpose of formative assessment is to gather information about students' thinking and learning (Park et al., 2020). There are many types of formative assessment such as classroom discussions, teacher observation, entrance and exit slips, etc. that provide feedback and move students forward with their learning. A popular formative assessment, such as an exit ticket, ask specific questions to students at the end of class to find evidence of student understanding and help the teacher plan adjustments for the next lesson (Baron, 2016). Classroom discussions that are effective result in feedback either from peers, the teacher, or the student him or herself upon self-evaluation and reflection (Dayal, 2021). This feedback is critical in the process of mastery learning.

Studies have shown that the use of formative assessment in the classroom has positive effects on student achievement and promotes student learning (Wafubwa & Ochieng, 2021). The central idea behind formative assessment is that evidence of student learning is used to adjust instruction to better meet students' learning needs and to inform students where they are at. Whereas summative assessment is used as a measurement tool, formative assessment is designed to support teaching and learning continuously (Wafubwa & Ochieng, 2021). A study by Wafuba and Ochieng (2020) concluded that there is a need for teachers to make use of formative assessment strategies so that students can develop skills to regulate their learning.

One type of formative assessment is an informal conversation with a student called an assessment conversation, where "teachers pose questions purposefully not only to assess student thinking, but also to advance their reasoning and sense making about important mathematical ideas and relationships" (Park et al., 2020, p. 3). Previous studies on assessment conversations found that teachers often use questions that check students' factual understanding, affirm students' answer, and clarify information. These most likely guide students to correct answers rather than explore their reasoning processes. Although these types of conversations have a purpose of their own, follow-up questions are encouraged to offer students the opportunity to "refine and make explicit their explanations or initial thinking." These "follow-up questions should be deliberately phrased to reveal student ideas and thinking" (Park et al., 2020, p. 10).

According to Wafubwa and Ochieng (2021), formative assessment is a tool to empower students to be involved in the teaching and learning process. Learning becomes visible to students and teachers, and the feedback provided helps students build skills and develop learning strategies while providing teachers information on student understanding. Baron (2020) explains that paying attention to students' reflections and feedback shows that the teacher values the

students' thinking and feedback. This can lead to increased motivation for some students and may increase trust in the classroom.

Teacher Feedback

Feedback is a core component of formative assessment. It provides "information to learners that would translate into them taking action to understand whatever they could not previously understand. It is different from simply telling the correct answer to the learner" (Dayal, 2021, p. 12). Feedback can build student's self-confidence about his or her level of understanding.

Teacher feedback has been identified as a key factor in improve students' achievement. Effective feedback is thought to include corrective and improvement-oriented guidance in order to provide students with clear strategies for how to improve their learning (Burns et al., 2021). It is to "convey to students the gap between their current and desired or potential performance and to provide guidance about how to reduce the gap" (Burns et al., 2021, p. 828). Teacher feedback has significant positive effects on students' motivation and performance. According to Yildirim and Yildirim (2019), teachers use feedback effectively, they engage more with students and students then realize that their teacher as being supportive. Research "focused on mathematics learning indicates that teachers' feedback may provide opportunities for students to correct their mistakes in mathematics, and may positively affect students' motivational beliefs or achievement" (Yildirim & Yildirim, 2019, p. 72).

Burns (2021) and Barana (2021) both describe a three question model for constructing effective feedback between teachers and students. The first question ('where am I going?') reminds students of the learning goal. The second question ('how am I going') provides

information on the students' progress and identifies strengths and weaknesses. The third question ('where to next?') provides specific strategies to progress learning towards the learning goal.

One concern about feedback is that students often do not go through feedback. If students do not process the feedback, then improvements will not be made. There needs to be a way to encourage students to process the feedback and use the information. Much literature discusses the difference between elaborated feedback and corrective feedback (saying the answer is correct or not). In mathematics, elaborated feedback can be in the form of a worked-out example where students can compare and contrast their work. Elaborated feedback can also include an explanation of the correct solution and suggestions to the student on where to improve. This is more effective than just correctness. Good feedback causes thinking for the student and motivate students to take action with it. Feedback should be an interactive process that involves the teacher and the student. Feedback needs to be in a timely manner. Teacher feedback is an "ongoing process that is central to effective teaching" (Burns et al., 2021, p. 828).

Formative assessment can also occur digitally. The use of digital formative assessments provides an instant collection of data about student learning and also provides immediate feedback to students and teachers, which can be used to adjust lesson plans and help students understand how they are doing on a particular topic (Barana et al., 2021).

Throughout the ongoing use of the formative assessment process, teachers can "evaluate student understanding of concepts and procedures and monitor student progress over time. Teachers can identify where students need help and focus additional instruction on those students who need it most". (Accardo & Kuder, 2017, p. 358).

Theoretical Framework

There have been numerous studies done on mastery learning and formative assessment. One theory that supports my research is the theory of formative assessment. According to Clark (2013),

> The theory of formative assessment holds that (1) thinking and learning processes are supported when students are given information and feedback regarding the learning criteria and standards by which they are assessed: and (2) when there is subsequent use of that feedback by students and teachers as they plan the next steps of the learning process together. (p. 2)

Sharing feedback from formative assessment to students engages them in their own learning and increases their participation in the process. This active participation requires students to "take direction from and provide leadership to their peers, so they develop a sense of agency" in their learning" (Clark, 2013, p.5). This differs from summative assessment, where the data is used to evaluate learning at the end of a unit or a period of time. Formative assessment supports student learning and their growth towards their summative assessment. It shows students what they need to improve on before the summative assessment (such as a unit test or standardized assessment).

Research Question(s)

The goal of this action research study is to answer the following question:

How does the mastery learning approach with the formative assessment process encourage student success in the mathematics classroom?

Conclusions

This chapter reviewed literature about the mastery learning process, formative assessment, and teacher feedback. Mastery learning is a powerful strategy that can improve student learning while using formative assessment and effective feedback (Cundiff et al 2020). In the next chapter, we will discuss the methods of my action research.

Chapter 3

Methods

Introduction

This action research study will be conducted to see if the mastery learning approach paired with frequent formative assessment and feedback encourages success in a mathematics classroom. Previous studies have shown that the mastery learning approach produces positive results in student achievement (Cundiff et al., 2020) as well as increased student motivation (Burns, et al, 2021). Frequent formative assessment provides students and teachers information on what students have learned and what they still need to work on (Guskey, 2010). The traditional approach to teaching focuses on the summative assessment at the end of the unit to provide feedback for the teacher, but often this is too late for students to make a change and learn from their mistakes. Mastery learning shifts the focus on frequent formative assessment and feedback through a unit to improve student learning and provide multiple opportunities to practice concepts. There is enough time to learn before taking a summative assessment.

Research Question(s)

The goal of this action research study is to answer the following question:

How does the mastery learning approach with the formative assessment process encourage student success in the mathematics classroom?

Research Design

The research design selected is a quantitative action research study. In this study, a pre-test and post-test will be given to students to measure growth in one unit of Algebra 1.

Throughout the unit, the researcher will be leaving feedback on assignments through an online learning platform where the assignments are turned in. The assignments will be graded on a rubric. Assignments will be given a grade of 0, 5, 7, or 10 out of 10 points. Students will be able to read through the feedback, correct and resubmit their assignments, and earn points back. The assignments will serve as formative assessment for students to learn from mistakes and grow in their learning. Data will be collected on how many students correct their assignments, how many students earn points back on their assignments, and how many students complete their assignments. Students can turn in assignments throughout the unit anytime without late penalty. All assignments will be due by the day of the test. A zero may be put in the gradebook for assignments that are not turned in by the "suggested due date", but students are able to turn in assignments for full credit until the time they take the unit test. At the end of the unit, students will be given a survey asking questions about how they felt about the process.

A quantitative approach was chosen because the research wanted to measure growth and understand how students felt about the mastery learning approach, feedback on formative assessment, and the opportunity to learn from their mistakes and earn points back on their assignments. The researcher wanted to gauge if students felt like this process helped them learn and prepare better for the summative unit test (post-test). With a Likert Scale on the survey, the researcher is able to measure positive and negative experiences.

Setting

The study will be conducted in a town in southeastern North Dakota in a larger school district. The school in which the research will be conducted has students in grades 9-12 in which there are 1441 total students: 328 9^{th} graders, 360 10^{th} graders, 356 11^{th} graders, and 397 12^{th} graders. Out of the total 1441 students, 72.5% are Caucasian, 17.9% are African American, 3.5%

are Asian, 3.3% are Hispanic, and 2.6% are Native American. 49% of students are male and 51% are female. 11% of students are served by special education and 27% of students are on 504 plans. The population of town is about 40,000 where the school is located. The school has some students that also live in rural areas surrounding the town. The town is known for small town atmosphere in one of the fastest growing communities with great sports teams and many activities in the school and the community. The town and surrounding areas are known for its technology, manufacturing, healthcare, and education industries.

Participants

Participants in this study will be students in two Algebra 1 classes during 2nd semester taught by the same researcher. There will be a total of 24 students, 14 in one class and 10 in the other class. Of those 24 students, there are 11 females and 13 males. There are 18 ninth graders, 4 tenth graders, one eleventh grader, and 1 twelfth grader. There are 3 students on Individualized Education Plans (IEPs) and 2 students on 504 plans. There are 2 students on Individualized Language Plans (ILPs).

Sampling. A convenience sample will be used in this study. The researcher has easy access to this sample since the participants are students in the researcher's classroom. The results will not represent an entire population but will focus on the researcher's own teaching.

Instrumentation

There are a few instruments used in this study. Two instruments are the pre-test and the post-test of the unit. The post-test was a unit test made by the Algebra 1 Professional Learning Community (PLC) in the school and was based on North Dakota math standards. The pre-test was made by the researcher and had similar questions to the post-test. Other instruments include

the daily assignments used for formative assessment throughout the unit. These daily assignments were worksheets made by the researcher based on the North Dakota math standards. The last instrument used is the survey administered to the students after the unit.

Data Collection. Data will be collected through scores on a pre-test and a post-test from one unit of Algebra 1. Data will also be collected on assignments grades throughout that unit. The researcher can keep track of how many students were given corrections on their assignments, how many students chose to correct their assignments, and how many students completed each assignment. Assignments are turned in on a learning platform and scores are store on the learning platform. The researcher will then keep track of each score and if the assignment was corrected or not.

Data will also be collected through a survey based on a Likert scale. This data can be quantitative, but also can provide descriptive feedback to whether students felt positively or negatively about the mastery learning approach, feedback on formative assessment, and the opportunity to learn from their mistakes and earn points back on their assignments.

Data Analysis. After gathering the data from the methods above, the average of the pre-test score and post-test score will be calculated. These scores can be compared to summarize growth in learning from the beginning to the end of the unit. The data from the assignments (formative assessments) can be used to determine how many students were given corrections, how many students corrected their assignments, and how many students completed their assignments. The percentage of students that corrected each assignment can be calculated to determine if students utilized the opportunity.

The data from the survey will indicate whether students felt positively or negatively about the mastery learning approach, feedback on formative assessment, and the opportunity to learn from their mistakes and earn points back on their assignments.

Research Question and System Alignment. The table below (Table 3.1) provides a description of the alignment between the study research question and the methods used in this study to ensure that all variables of the study have been accounted for adequately.

Table 3.1.

Research Question Alignment

Research Question	Variables	Design	Instrument	Validity & Reliability	Technique (e.g., interview)	Source
How does the mastery learning approach with the formative assessment process encourage student success in the mathematics classroom?	Formative Assessment Feedback Pre-test and Post-test scores, assignment scores Mastery Learning Approach	Quantitative Action Research	Pre-test and Post-test Daily assignments Survey	The average of the pre-tests and post-tests will be calculated. The average number of students who correct assignments, who turn in assignments, and the average score on assignments will be calculated.	Pre-test, Post-test, Feedback on daily assignments, survey	Total of 48 students in 9th-12th grade in two different Algebra 1 classes.

Procedures

This study will take place during a three-week unit in quarter 3 in Algebra 1. Students have been exposed already to the researcher's classroom routines and feedback style. Students will take a pre-test at the beginning of the unit before any lessons have been taught. After each lesson throughout the unit, students will be given an assignment. Each assignment will have a suggested due date which is when the researcher starts to grade and give feedback on the assignment. The assignments are turned in through an online learning platform. The researcher will make comments on the assignment through the online learning platform and grade the assignment. Once a comment is made, the students are notified and are able to read the feedback on their assignment. Then students are strongly encouraged to correct assignments to earn back points and learn from their mistakes. If an assignment is not turned in by the suggested due date, a 0 will be entered in for the grade. Students are able to turn in assignments for full credit throughout the entire unit. At the end of the unit, students will take a post-test. At this time any missing assignments cannot receive any credit. After the unit post-test, a survey will be administered to students asking questions about how students felt about the mastery learning approach, feedback on assignments, and the opportunity to learn from this mistakes and earn points back on their assignments.

Ethical Considerations

To protect individuals in this action research study, an informed consent form will be sent home with each student and returned with signatures from their parents/guardians. All students who will participate in this study will be kept anonymous by replacing names with Student 1, Student 2, and so on. The results of this data will only be used for the purpose of this study and will be kept safely on the researcher's computer which is password protected. No risk or harm is

intended in this study. All activities conducted are a part of the regular classroom activities that take place on a daily basis.

Conclusions

This chapter looked at how the researcher collected and analyzed data. The data was collected to see if the mastery learning approach paired with frequent formative assessment and feedback encourages success in a mathematics classroom. The data was collected through a quantitative action research study. The next chapter will include the results of the study.

Chapter 4

Results

Introduction

The purpose of this study was to see if the mastery learning approach with frequent formative assessment and feedback encouraged success in an Algebra 1 classroom throughout one unit of study. Students took a pre- and post-test to measure growth through one unit in Algebra 1. Throughout the unit, the researcher left feedback on each assignment. Students were able to correct their assignments, learn from their mistakes, and earn points back. After the post-test, students took a survey that asked questions on their thoughts of the mastery learning approach, the opportunity to correct their mistakes, seeing the feedback, and how they liked the entire process.

Data Collection

The researcher sent out and gathered letters of consent from students over two weeks. Then data was collected from 24 students in two Algebra 1 classes throughout a three-week unit. The pre-test at the beginning of the unit gave the researcher a baseline of data. The post-test at the end of the unit showed student academic growth. Throughout the unit, the researcher provided feedback on students' assignments and encouraged them to make corrections on their assignments. The researcher collected data on each assignment: how many students were given corrections and how many students decided to correct their assignments. At the end of the unit, students were given a survey to determine how they felt about the mastery learning process, the feedback they were given, and the opportunity to correct their assignments. The data from the

survey provided the researcher with descriptive feedback and whether the students had a positive or negative thoughts with the mastery learning process.

Results

Individual pre-test scores and post-test scores along with growth are shown below in Table 1. All students had positive growth from their pre-test to their post-test. The average of the pre-test for the 24 students was 20.75% and the average of the post-test was 83.125%. This data along with the average growth in points in shown in Table 2 below.

Table 1

Pre-Test versus Post-Test Scores with Growth

	Pre-Test Score	Post-Test Score	Growth
Student 1	22	97	75
Student 2	17	90	73
Student 3	0	74	74
Student 4	28	99	71
Student 5	9	85	76
Student 6	52	86	34
Student 7	17	71	54
Student 8	0	88	88
Student 9	26	100	74
Student 10	65	96	31
Student 11	30	100	70
Student 12	26	63	37
Student 13	9	68	59
Student 14	22	75	53
Student 15	9	85	76
Student 16	30	96	66
Student 17	13	92	79
Student 18	30	100	70
Student 19	7	86	79
Student 20	30	72	42
Student 21	22	86	64

Student 22	0	39	39
Student 23	30	97	67
Student 24	4	50	46

Table 2

Average Pre-Test Score, Post-Test Score, and Growth

Average Pre-Test	Average Post-Test	Average Growth
20.75	83.125	62.375

There were 5 main assignments given throughout the unit. Table 1 shows how many students were given corrections on each assignment and how many students corrected their assignment. Out of 40 assignments that were given corrections throughout the unit, 26 assignments were corrected. This means that 65% of the time the assignments were corrected during this unit.

Table 3

Assignment Correction

	Number of Assignments Given Corrections	Number of Students That Corrected Their Assignment	Percent of Students Who Corrected Their Assignment
Assignment 1	10	8	80%
Assignment 2	9	4	44.44%
Assignment 3	4	4	100%
Assignment 4	10	6	60%
Assignment 5	7	4	57.14%
Total	40	26	65%

Students were given a 12-question survey after their post test on how they felt about the mastery learning approach, the feedback they were given, and the opportunity to correct their mistakes. Results from questions 4 and 5 are shown below in Figure 1. In response to question 4

(I read through the feedback on my assignments), 7 students responded “always”, 8 students responded “often”, 4 students responded “about half the time”, 2 students responded “sometimes”, and 1 student responded “never”. Question 5 responses to “I implement changes on my assignments after receiving feedback” were similar to question 4. Most students responded with “often”.

Figure 1

Survey Questions 4 and 5 on Feedback

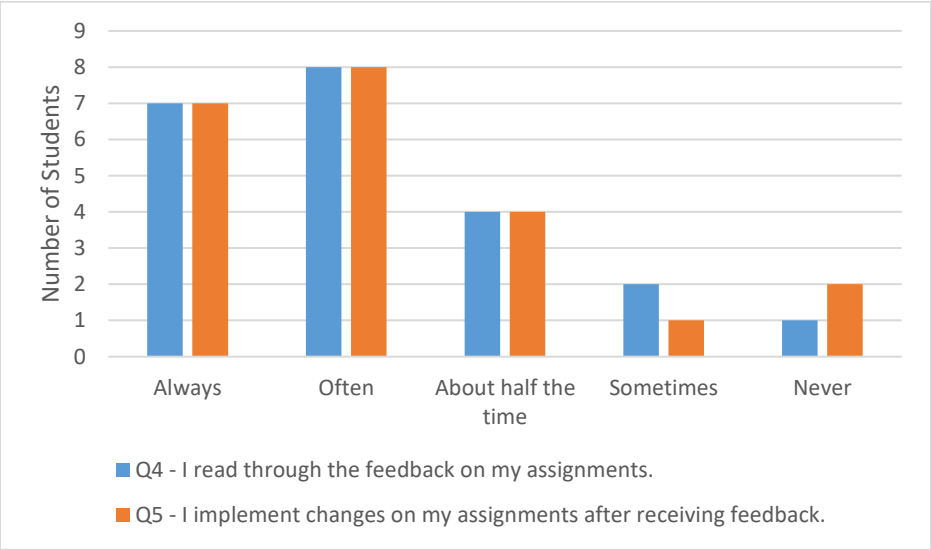
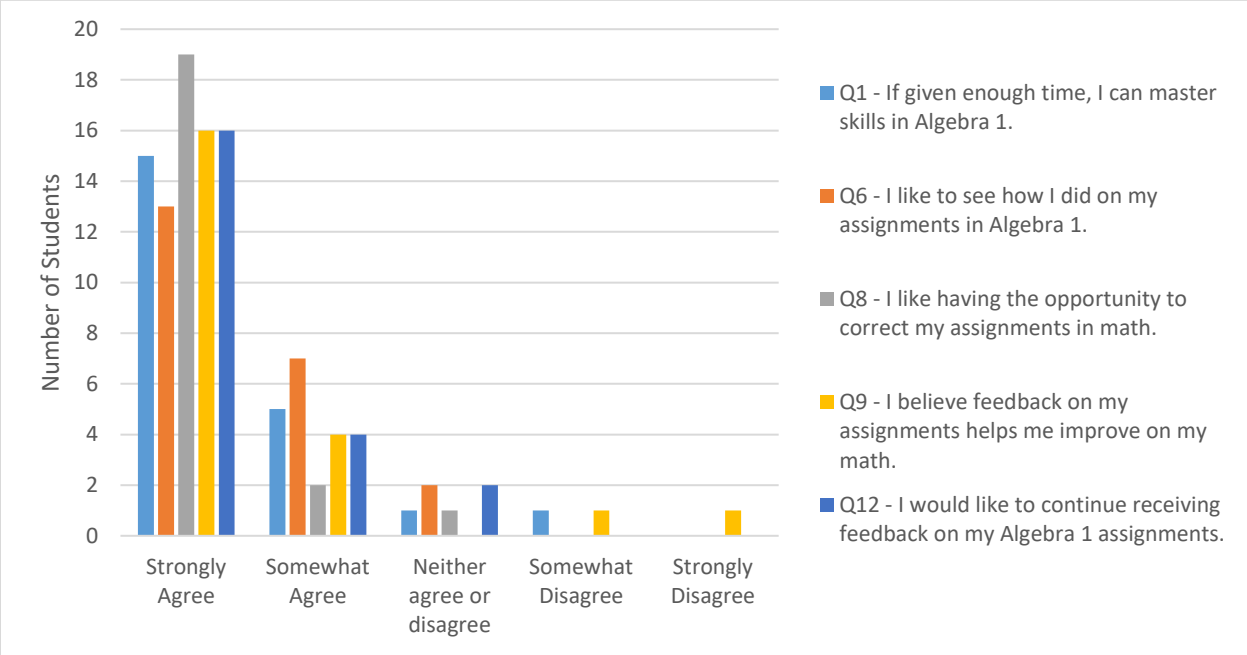


Figure 2 shows results of questions 8, 9, and 12. Students were asked in question 8 whether they liked having the opportunity to correct their assignments. Out of 22 students who responded to the survey, 19 students strongly agreed that they liked being able to make corrections and 0 students disagreed. In question 9, students were asked if they believed that feedback on their assignments helped them improve in math. 16 students strongly believed the feedback helped them and 1 student strongly disagreed. Question 12 asked students if they would like to continue to receive feedback on their assignments. 16 students strongly agreed while 2 students neither agreed or disagreed.

Figure 2

Survey Questions 1, 6, 8, 9, and 12 on Feedback



Data Analysis

The data shown in Table 2 shows that the average pre-test score was 20.75% and the average post-test score was 83.125%. The average growth was 62.375 points. This indicates that there was a positive impact on student success in this unit with the mastery learning approach, feedback, and formative assessment. When looking at individual scores on the pre-test and post-test in Table 1, every student increased their score between the pre-test and post-test, so student understanding increased throughout the unit.

The data shown in Table 3 shows the breakdown of how many students were given corrections on each assignment and how many students corrected their assignments. Assignment 1 and Assignment 2 had 80% and 100% of students who were given feedback that corrected their

assignments, while Assignment 2, 4, and 5 were lower with only 44.44%, 60%, and 57.14%, respectively. This brings the average of students who are given feedback that correct their assignments to 65%. This shows that students are not always correcting their assignments when given feedback.

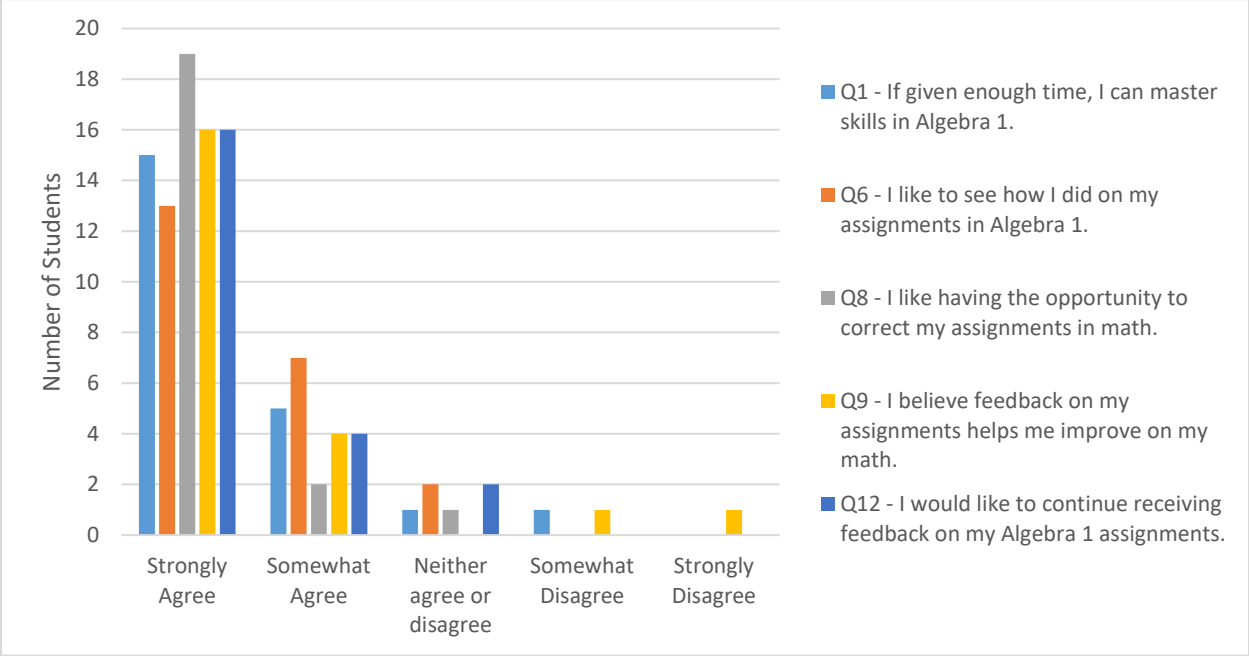
The first question on the survey asked students how strongly they believed in the statement "If given enough time, I can master skills in Algebra 1". In Figure 2, the data shows that 15 students strongly agree, 5 students somewhat agree, 1 student neither agreed or disagreed, and 1 student somewhat disagreed. When looking at the data in Figure 1, 7 students said they always read through their feedback on their assignments and 8 students said they often read through their feedback. This is 15 students out of 22 total students who took the survey, which is 68%. This percentage matches closely 65% of assignments that were corrected during the unit (in Table 2).

Even though not 100% of students are correcting their assignments, Figure 2 shows that 19 out of 22 students strongly agreed with the statement "I like having the opportunity to correct my assignments in math". This is 86.36% of the students that took the survey. No students said they do not like having the opportunity to correct their assignments. Figure 2 also shows that 13 students strongly agree with the statement "I like to see how I did on my assignments in Algebra 1" and 7 somewhat agree with that statement. This means that approximately 91% of students liked seeing how they did on their assignments.

Figure 2 shows how many students believe that feedback helps them improve on their math. While 19 students strongly agreed with liking the opportunity to correct their assignments, 16 students strongly agreed it helps them improve on their math. One student said they strongly

disagreed that feedback helps them improve on their feedback, even though no one said they did not like seeing feedback on their assignments.

The data from question 12 in Figure 2 shows that 16 students strongly agree with the statement "I would like to continue receiving feedback on my Algebra 1 assignments", 4 students somewhat agreed, and 2 students neither agreed or disagreed. This shows that around 91% of students want to continue receiving feedback on their Algebra 1 assignments.



Conclusions

Based on the results from this study, the mastery learning approach with formative assessment and feedback had a positive impact on student success in the mathematics classroom. Students had a positive experience with receiving feedback and liked seeing how they did on their assignments and how they can improve. Even though not all students corrected every

assignment, students would like to continue to see feedback on their assignments and how they are doing on their mathematics.

Chapter 5

Implications for Practice

Action Plan

Based on the results of the study, the researcher believes that the mastery learning approach increases student success in mathematics. The researcher believes students like to see feedback on their work and know how they are doing with mathematical concepts. The results of this study also show that even though most students viewed their feedback, not all students corrected their mistakes. The researcher may adjust this process in the future to somehow keep providing feedback on student work, but not on all assignments. Specific assignments may be chosen in each unit to provide feedback on.

Moving forward, the researcher has more ideas on how to keep implementing formative assessments throughout the unit such as exit tickets, small quizzes, or conferencing with students. These are other great opportunities for the researcher to provide feedback to students on how they are doing. Overall, the researcher strongly believes that feedback to students increases students' knowledge of how they are doing in mathematics and what they need to do to improve. This feedback also provides the researcher with information on how the students are doing and helps adjust daily lesson plans throughout the unit.

Plans for Sharing

These results will be shared with teacher colleagues at the researcher's school. The results will be discussed with the Algebra 1 professional learning community (PLC) and collaboration group as the research and colleagues move forward with finding the best way to provide feedback to students in an impactful way. The researcher's school is planning on moving

towards a block schedule which provides more in-class opportunities for feedback. The researcher expects that there will be more in-class practice and opportunities for feedback and less focus on homework and out of class practice and feedback.

These results will also further show the researcher and teacher colleagues that students benefit from opportunities to learn from their mistakes. Students enjoy having mastery learning in the mathematics classroom and seeing feedback on their work.

Personal Perspective

As a teacher, I truly believe in the mastery learning approach. I believe that students need to learn from their mistakes and be aware of common mistakes in mathematics. I also believe that students should strive for mastery and not just learn something to get through the class. Throughout this action research process, I have truly defined my classroom philosophy and mindset. I want my students to check in with me and see how they are doing.

Moving forward, my school is going towards a block schedule. I plan to incorporate feedback into my classroom in a different way. The block schedule will provide 90 minutes for each class. This is a lot of in-class time to practice and give feedback within the class period. I do not plan on comment on assignments because I plan to not really give homework with the block schedule. We will practice math for 90 minutes and build in the opportunity to get feedback and learn from mistakes within the block class.

This has been a great opportunity to research a topic I believe in strongly. I hope to keep improving as a teacher for myself and my students. I want to find the best way to run my block class while providing as much feedback to my students as possible. It might take some time to

figure out how I want to run my class in the block format, but I am excited that I know what I believe in and want to continue to keep researching best practices in mastery learning.

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Appendix A

Unit 8 Pre-Test **Name: _____**

Solve the following equations. When appropriate write your answer in simplest radical form.

1.) $2x(5x - 10)(x + 3) = 0$

2.) $x^2 + 8x + 15 = 0$

3.) $x^2 + 6x = 0$

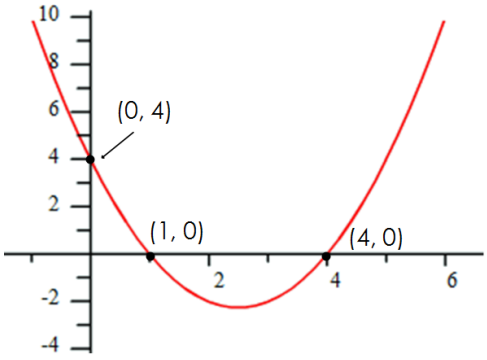
4.) $x^2 - 25 = 0$

5.) $2x^2 - 4 = 38$

6.) Write the equation for the following graph:

X-Intercepts: _____

Opens: UP or DOWN



7.) Consider the graph of the parabola $y = -2(x - 3)(x + 6)$

Create one equation of a parabola that:

- Opens in the opposite direction
- Has exactly one root in common with the given quadratic
- Is wider

8.) Consider the function $f(x) = -(x + 4)(x - 7)$. Will the vertex of this function be a MAXIMUM or MINIMUM value of the function? Explain how you know.

Appendix B

Algebra I **Name: _____**

Unit Eight: Quadratic Equations (Factored Form)

Solve. When appropriate write your answer in simplest radical form. Box your answer.

1.) $3x(2x-5)(x+9)=0$

2.) $x^2-15x+36=0$

3.) $x^2+4x=0$

4.) $x^2-16=0$

5.) $3x^2-5=31$

Graph the following quadratic functio

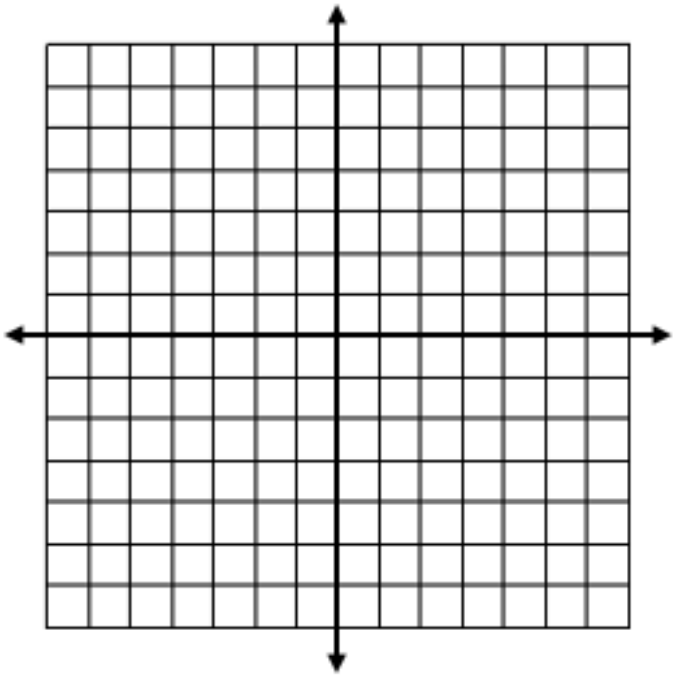
6.) $f(x) = \frac{1}{2}(x+2)(x+6)$

Roots:_____

Axis of Symmetry:_____

Vertex:_____

x	*y*



7.) $f(x) = -2(x+1)(x-3)$

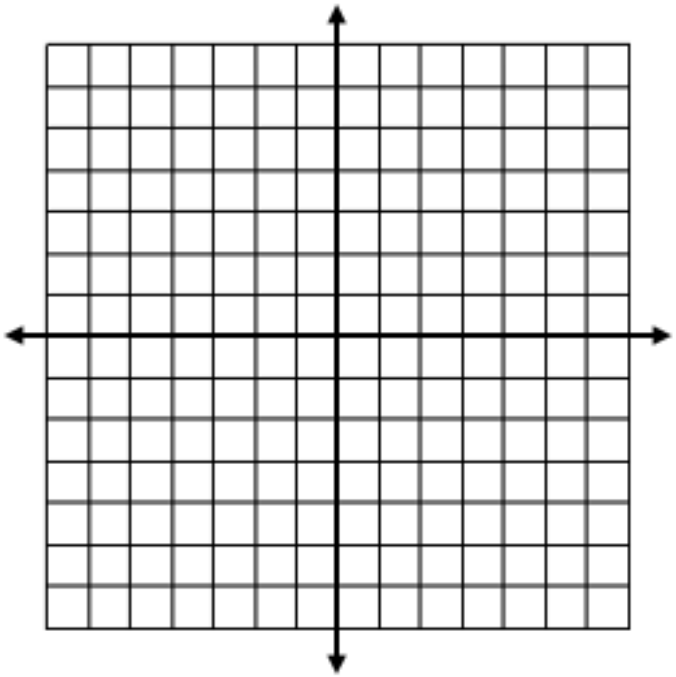
Zeros:_____

Axis of Symmetry:_____

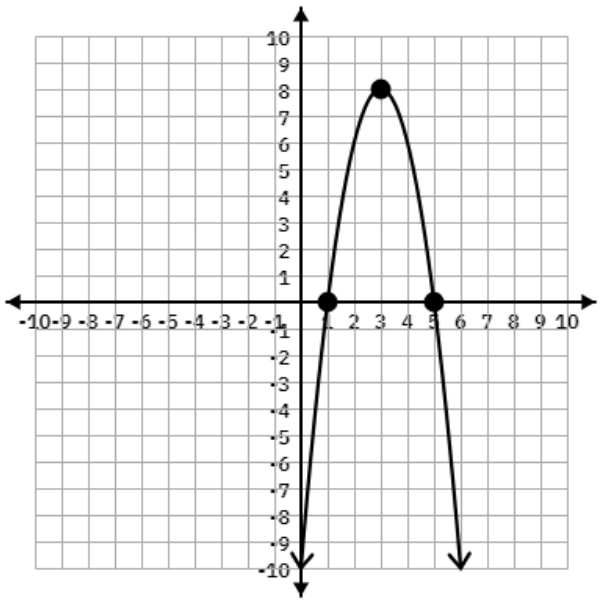
Vertex:_____

Ta

x	*y*



8.) Write the equation for the following graph:



Solutions: _____

Opens: _____

Equation: _____

9.) Consider the graph of the parabola $y = -3(x - 4)(x + 2)$

Create one equation of a parabola that:

- Opens in the opposite direction
- Has exactly one root in common with the given quadratic
- Is wider

10.) Consider the function $f(x) = -4(x + 2)(x - 1)$. Will the vertex of this function be a maximum or minimum value of the function? Explain how you know for full credit.

Appendix C

Question:	Strongly Agree Always	Agree Often	 Neutral	Disagree Sometimes	Strongly Disagree Never
If given enough time, I can master skills in Algebra 1.					
My grade in Algebra 1 is very important to me.					
Learning Algebra 1 is very important to me.					
I read through the feedback on my assignments.					
I implement changes on my assignments after receiving feedback.					
I like to see how I did on my assignments in Algebra 1.					
I value feedback on my assignments.					
I like having the opportunity to correct my assignments in math.					
I believe feedback on my assignments helps me improve on my math.					
I believe the feedback on my assignments and the corrections I make help prepare me for quizzes and tests.					
I believe the feedback on my assignments help me know where I need to improve in Algebra 1.					
I would like to continue receiving feedback on my Algebra 1 assignments.					