Practicing Multiple-Choice Assessments: The Effects on Student Achievement

A Capstone Project
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Abstract

Multiple-choice and open-response are two common formats used to assess student knowledge. Multiple-choice formatted questions were incorporated into current mathematical assessments to determine if practicing the format would help students excel on high-stakes tests. Results were collected from the recent NWEA test and compared to the students’ scores from previous years. Students were given a survey to determine their comfort level about multiple-choice assessments before and after the intervention. When data were collected and analyzed none of the results were found to be statistically significant. Therefore, no firm conclusions can be drawn from this study regarding the inclusion of multiple-choice tests into a math curriculum for the purpose of standardized test improvement.
Acknowledgements

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I would also like to recognize my friends and family for the support and words of encouragement throughout this process.
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Chapter One

Introduction

A cycle takes place in education regardless of the subject matter. State standards are given to teachers as guidelines for the concepts students should learn. Teachers take the standards, write objectives, and instruct the students on topics that need to be covered. The students are then assessed on their knowledge of the material. Assessment in the classroom can be any format the teacher wants, but when it comes to mathematics and high-stakes testing, the format is usually multiple-choice. Assessment format was the main topic of this research paper. This study examined the effects of incorporating multiple-choice questions into classroom assessments. Chapter One includes discussion about the motivation for doing this project, the background information, and the problem and purpose of this research.

Motivation for the Project

Many times a student’s future relies heavily on his/her ability to perform well on a high-stakes test. These performances could include passing an exit exam to graduate or earning a scholarship by doing well on the American College Testing (ACT) test. Schools also put pressure on students to do well on state assessments in order to meet Adequate Yearly Progress (AYP). With the pressure faced on high-stakes tests, teachers need to help students be as prepared as possible for these situations.
I came to the realization that all of my assessments had open-response questions in which the students were allowed to gain partial credit. If students are tested in a multiple-choice format on high-stakes tests, then maybe teachers should explore incorporating multiple-choice questions into their assessments.

**Background on the Problem**

The No Child Left Behind Act (NCLB) of 2001 required students to be tested on the knowledge they have acquired. The majority of the questions in the mathematics section of the North Dakota state test are in the multiple-choice format. In some mathematics classrooms, students receive partial credit for showing their work and having proper labels. The situation some mathematics teachers face is all of the tests given in their classrooms have open-response questions, which is a different format than high-stakes tests. It has become apparent that students need to possess skills to help them succeed on high-stakes tests. They are not only being evaluated on their knowledge but also on their ability to choose the best answer. If “practice makes perfect,” then students should be practicing multiple-choice questions.

This study and the problem it addressed are important; if the results showed students’ scores on high-stakes tests did in fact improve when multiple-choice problems were included on in-class tests, then teachers could plan to incorporate multiple-choice questions into their assessments for the benefit of their students. Besides improvement in student achievement, I wanted to examine
the comfort levels students had on multiple-choice testing both before and after implementation.

**Statement of the Problem**

This study addressed the format of mathematics assessments. The type of assessment commonly used was in the open-response format, where students were allowed to receive partial credit for having appropriate work shown. High-stakes tests like the ACT, State Assessment, and part of the Praxis II, are all in a multiple-choice format. If students are tested in a multiple-choice format on high-stakes tests, shouldn’t teachers design their tests in the classroom in a similar fashion? On open-response assessments students are not totally dependent on getting the correct answer, they earn partial credit for showing the proper work, which they do not receive on most multiple-choice tests. Where is the line between giving students credit for attempting to get the correct answer and requiring them to find the best answer? Can teachers change their testing formats to better prepare students for high-stakes testing?

**Statement of Purpose**

The purpose of this study was to determine whether implementing multiple-choice questions into current Algebra I assessments would improve student achievement on high-stakes tests. The main goal of changing assessments was to determine whether student achievement improved with practice of a particular format. The study implemented multiple-choice questions into current
assessment formats. I expected practicing multiple-choice assessments during the third nine weeks of the school year would improve student mathematics achievement, as measured by the Northwest Evaluation Association (NWEA) test, and show greater growth in achievement than in previous years. Question format is an important part of an assessment, and teachers should be doing what they can to help students excel on high-stakes tests. It not only can help the school meet AYP, but it can also prepare students for exit exams, ACT tests, and other standardized tests they may encounter in the future.

This study used previous NWEA results to compare student improvement in mathematics from fall to spring. The achievement gap (AG) was calculated from fall to spring this year, after the implementation. If there was a statistically significant improvement from past years to this year it could be attributed in part to practicing or learning strategies for taking a multiple-choice test. After looking at the results, teachers can decide whether or not to incorporate multiple-choice questions into their assessments.

Research Questions/Hypotheses

The question this research attempted to answer was as follows: Does practicing multiple-choice formatted questions improve student achievement on high-stakes testing? This study not only looked at test scores but also surveyed the students’ comfort level and attitudes both before and after the implementation. The hypothesis was that by practicing multiple-choice questions and talking about
strategies when taking a multiple-choice exam, the students would see an increase in their scores and feel more comfortable taking a multiple-choice exam.

**Definitions**

*Northwest Evaluation Association* — A non-profit organization working alongside member school districts to create a culture that values and uses data to improve instruction and student learning (NWEA, 2011).

**Summary**

The focus of this study was to determine whether implementing multiple-choice questions into current assessments would improve student achievement on high-stakes tests. This study implemented multiple-choice questions into assessments during the third nine weeks of the school year. The students also learned general strategies to use when taking a multiple-choice test. Improvements in NWEA test scores were examined and compared. Student comfort levels were also considered when taking a multiple-choice exam both before and after the implementation. In the next chapter, literature about multiple-choice versus open-response formatted questions, high-stakes testing, and strategies used to help students be successful on multiple-choice assessments is summarized.
Chapter Two

Review of Literature

Mathematics assessments are usually given using a mixed format, multiple-choice and open-response questions, to measure student ability. This study could help mathematics teachers decide if incorporating different assessment formats better prepares students for high-stakes testing. In this chapter the present literature was reviewed to compare the effects multiple-choice and open-response questions had on students. The importance of testing and high-stakes tests that students encounter during their high school career were summarized. Finally, strategies to help students become more successful on multiple-choice exams were discussed.

Multiple-Choice vs. Open-Response

Multiple-choice and open-response are the two types of questions frequently used to assess student knowledge. In an open-response question, the test taker is required to come up with an answer without any clues or examples. A multiple-choice question calls for the student to select the best choice from a list of possible answers. According to Birenbaum and Feldman (1998), when students are given choices rather than having to come up with the answers on their own, they seem to be more at ease and experience less test anxiety. Students with high test anxiety think multiple-choice questions require less of their information processing abilities during testing situations. For these reasons open-response
questions provoke greater amounts of concern than do multiple-choice questions. O’Neil and Brown (1998) showed that, “given the tendency of the open-ended question format to generate more worry than multiple-choice format, we may see reduced performance as a function of increased worry among test takers in the open-ended condition” (p. 345). Another reason a student may prefer a multiple-choice test over open-response is because it is easier to recognize an answer than it is to recall it (Fair Test, 2007).

When looking at gender issues, research has shown that girls perform better than boys on open-response assessments. Boys, however, do better than girls on multiple-choice formatted assessments (DeMars, 2000). The reason for this, according to DeMars, is females are known to have superior language abilities and are able to express themselves better. They are likely to give a more complete explanation of the mathematical process, whereas males just document outcomes. Among the top ability students, females still scored higher on open-response questions, and males excelled on the multiple-choice items. As stated by Bolger and Kellaghan (as cited by Liu & Wilson, 2009), since most high-stakes tests are given in a multiple-choice format, this could lead to advantages for male students.

If an exam was given with an equal amount of multiple-choice and open-response questions, gender issues can be underestimated. Since each gender is favored for a particular format the difference may get cancelled out (Liu &
Wilson, 2009). For example, if a male does better on the multiple-choice section but gets a lower score in the open-response section, the overall score would be the average of the two.

In earlier studies, by Ben-Shakhar and Sinai (as cited by Liu & Wilson, 2009), when males were unsure of an answer they were more likely to guess than females, whom usually left questions blank. Even when students were instructed to answer all the questions, females still tended to omit answers to some questions. In a more recent study done by Liu and Wilson (2009), females seemed to have changed their guessing tendencies. Females were no longer leaving answers blank; this was accredited to test-taking strategies taught to capitalize on opportunities to achieve higher scores.

When measuring student achievement, open-response questions allow students to express their thinking and problem-solving strategies instead of selecting a correct answer from a set of alternatives. O’Neil and Brown (1998) stated, “Generally, students were more likely to use a trial-and-error or guessing approach for multiple-choice items, whereas for open-ended items, students much more frequently employed a mathematical line of reasoning” (p. 333). Even students noticed a difference in their responses. They expressed the importance of quality and depth in their answers when taking an open-response exam versus multiple-choice. According to Williams and Clark (2004), faculty and students
object to multiple-choice tests because they limit the students’ ability to apply their reasoning skills and only evaluate surface knowledge.

Mathematics exams are usually designed to have a particular answer with no ambiguity, which makes them a good candidate for a multiple-choice format. Since there is usually only one correct answer, there won’t be confusion as to which answer is the “best choice” (Steen, 2006). Although a student’s outlook is more positive toward multiple-choice assessments, open-response assessments ask for more effort from the student (Struyven, Dochy, & Janssens, 2005). Students think a multiple-choice examination is easier to prepare for because the answers are already written down; all they need to do is match the correct answer with the question. Also, some answers come from guessing, which gives the student a chance to answer the question correctly (e.g., four choices gives the student a 25% chance to guess the correct answer). Overall, these two question formats, multiple-choice and open-response, have different effects on student effort and anxiety which can affect their mathematical achievement on standardized tests.

**Testing**

Testing is an important part of the educational process. Students need to be held accountable for learning the material, and the public needs a way to see that accountability. Steen (2006) noted, “Especially when public money is involved – as it is in virtually every educational institution – public questions will
follow” (p. 12). Evidence of student learning between formal assessment programs and quality education is hard to find. When dealing with accountability, Steen also mentioned variance; he wondered if the lower students’ scores were close to average or if the higher students’ scores just cancelled out the difference. For example, if two students take the same test, one scores a 95% and the other scores a 65% the average would be 80%. Which means the school looks to be average even though some scores are much lower than others.

Many types of questions are associated with a multiple-choice exam, but according to Robert Blackey (2009), the two most popular types were traditional linear questions and complete the stem questions. For traditional linear questions the student must pick the best option to answer the question. When dealing with a complete the stem question, the student is given an incomplete sentence and is asked to pick the best option that accurately completes it.

Teachers need to make sure students are prepared to take high-stakes standardized tests. For example, when dealing with a spelling test it is unfair to call out words and have students spell them, then give them an exam in which the student picks the best spelling of a word out of a list. If a teacher uses good classroom testing practices which correspond to standardized tests, student test scores will improve (Simmons, 1998). According to Simmons, not every test has to be given in the multiple-choice format or timed like a standardized test, but students need to at least be familiar with this type of testing. If students do not do
well the first time on a standardized test, they are usually told they will do better next time since they know what to expect. It would make sense to prepare students before they take their first standardized test so they already know what to expect. On some high-stakes tests students only get one chance.

Learners should also have the opportunity to practice with an answer sheet. If a student fails to completely fill the bubbles or is accustomed to writing on the test copy, then teachers need to make the use of an answer sheet routine. In general, teachers should attempt to align classroom assessments with standardized tests. As Simmons (1998) put it, “The more alike the two become, the better students will perform” (p. 30).

**High-Stakes Testing**

Students are required to take high-stakes tests throughout their lives. In order to graduate from high school, 26 states have implemented or plan to implement a mandatory exit exam. Springer, Pugalee, and Algozzine (2007) acknowledged, “Another five states, although not requiring an exit exam, allow individual districts the option to implement such requirements” (p. 37). Students may take other high-stakes tests such as the ACT and SAT. Scores on these exams help students get accepted into college, earn scholarship money, and get placed into the appropriate classes at the college level. The variations in grading during high school require colleges to use a uniform assessment tool. According
to Dulan (2008), “The ACT is made up of four multiple-choice tests – English, Mathematics, Reading, and Science Reasoning – and one optional essay” (p. 1).

One of the major high-stakes tests students take during their high school career is the state assessment. The North Dakota constitution mandates that all citizens have an opportunity to receive a high-quality education. By administering an annual assessment to specific grade levels, officials are able to analyze overall student achievement. Public schools are required to test grades three, four, five, six, seven, eight, and 11 in reading and mathematics annually. They are also required to test science in grades four, eight, and 11. Since the North Dakota State Assessment uses a standardized scoring tool to measure each student’s achievement, officials can insure that all students are receiving a comparable education (Sanstead, 2006).

The Standards, Assessment, Learning, and Teaching (SALT) team is made up of local and state representatives whom assist with the development of the North Dakota State Assessment. The state assessment incorporates both multiple-choice and open-response formatted questions. The multiple-choice questions allow students to use problem-solving and reasoning skills whereas the open-response questions call for students to exhibit their writing ability (Sanstead, 2006).

After taking the test students are considered advanced, proficient, partially proficient, or novice. Advanced students surpass likely achievement levels;
proficient students meet likely achievement levels; partially proficient students seem to be striving towards meeting expected achievement levels; and novice students have an apparent lack of understanding (Sanstead, 2006). Using these student rankings, schools can identify subject areas or concepts that need improvement. Both the Elementary and Secondary Education Act (ESEA) and the No Child Left Behind Act (NCLB) of 2001 required North Dakota to use student performance to identify schools in need of improvement (Sanstead, 2006).

**Strategies for Multiple-Choice Assessments**

When taking multiple-choice assessments students can do a lot to prepare themselves. Of course, the first step would be to study. While reading a question, Blackey (2009) stated students should “underline the critical words in the stem. This helps them to focus precisely on what is being asked and thus reduce the chance of making careless mistakes with regard to the intent of the question” (p. 58). Another option students have is to cover up the choices to answer the question without looking at the list of possibilities. If students can come up with their own answers first, they can look for a matching answer from the choices listed (Blackey). The third option students have is to rewrite each option in their own words to try to make more sense of the selection (Blackey). The final strategy is to read the question with each statement listed and decide the truth value of each combination. If any of the options make the statement false, they should eliminate that option from the list of choices (Blackey). Students need to
be sure to read through all of the options before jumping to a conclusion as to which is the best answer. Students who give reasons for eliminating options and who read through all options do better on multiple-choice exams (Williams & Clark, 2004).

If students are unsure of the correct answer, they should then attempt to eliminate choices they know are wrong. Students need to make sure to cross out any options considered wrong in order to eliminate them for good. This way the student will not attempt to look back and change to a wrong answer. If given the option “all of the above,” look for two statements that seem to be true. If choices still remain, look for key words such as “always” and “never” as these options are usually less likely to be right. Look for clues grammatically, if a stem ends with “an” then the correct response probably starts with a vowel. Roell (2010) believed options with the most information are likely to be correct. Teachers usually put as much information as possible so the distracters do not lead the students astray. If all else fails, students should take an educated guess as long as there is no penalty for doing so.

A couple more things to remember when taking a multiple-choice exam are pacing and filling in the answer sheet correctly. Students should not get stuck on one question for too long. Students should learn to recognize problems that usually give them trouble and skip those problems immediately. As Dulan (2008) put it, “It is a much better use of your time and energy to pick up all the correct
answers that you can early on, and then go back and work on the tougher problems” (p. 6). Students should also know how much time is allotted for the test and divide it into quarters. This way, students will know which question they should be at periodically throughout the test.

Students should not be afraid to try to work the problems out or make notes to use when they check back over the test. When filling in the answer sheet, Dulan (2008) suggested students mark the correct answers in the test booklet then fill in the answer sheet at the end of the section. Precious time is wasted going back and forth between the test booklet and answer sheet after each question. There is also less of a chance of mismarking the answer sheet if it is filled in all at one time. Finally, students should not change any answers unless new information is noticed; if unsure, the first choice is usually correct. A few other things students should remember when taking high-stakes standardized tests are the relaxation techniques that follow:

- Have a plan of attack.
- Take breaks.
- Be aware of time.
- Clear your head.
- Eat right.

Finally, students need to be prepared on test day to perform at their highest level by resting up, waking up early, and dressing for success (Dulan).
Summary

Testing formats may have both positive and/or negative effects on different students. The reality is that students have to take assessments, whether for their own benefit or the school’s. High-stakes testing has been around for quite some time and does not seem to be going away anytime soon. Teachers need to prepare students by teaching them strategies such as underlining key words, eliminating options, and pacing themselves appropriately. Students also need to be given a chance to become familiar with different question formats they may see on high-stakes standardized tests. Testing is an important part of education and knowing how question format affects students is essential. If teachers realize how many high-stakes tests students encounter, they will hopefully change, if necessary, their current assessments to accommodate their students’ needs. In the next chapter an explanation of the design and methods used to complete this research project is given.
Chapter Three

Research Design and Method

The purpose of this study was to determine whether implementing multiple-choice questions into current Algebra I assessments would improve student achievement on high-stakes tests. In this study students practiced multiple-choice formatted assessments and learned strategies for taking multiple-choice assessments. This chapter describes the setting, methods and design used to collect data, as well as the timeline for this study. Details are given about the intervention and expected results.

Setting

As the mathematics teacher in a small public school, different teaching strategies and testing formats are implemented to sufficiently prepare students and assess their knowledge and skills. The building in which the study took place houses seventh grade through high school seniors. I worked with a variety of grade levels; the courses I was responsible for include Seventh Grade Math, Applied Math, Algebra I, Geometry, and Pre-Calculus. The number of students in each section ranged from 9 to 17. See Appendix A for complete school demographics.

The changes made in assessment format were implemented with Algebra I students. The class was made up of 14 freshman—eight males and six females. All of the participants took a pre-algebra class within the school district last year.
as eighth graders. The students in our school are required to take two major
standardized tests. Seventh graders through sophomores take the NWEA in the
fall (October) and spring (March or April). Seventh graders, eighth graders, and
juniors take the state assessment, which is used as a tool to determine whether the
school makes AYP. A circumstance that may have affected the study was the fact
that I did not teach the participants as eighth graders last year, but taught them as
seventh graders the previous year. All students in the study had the same eighth
grade instructor. The average achievement gap for Algebra I students within the
district was compared to the achievement gap of the Algebra I students of the
class of 2012 and the class of 2013. The Rasch Unit (RIT) scores were used to
determine the achievement gap. The achievement gap was calculated by
subtracting the fall NWEA RIT from the spring NWEA RIT. An RIT score is a
unit of measure that uses individual item difficulty values to estimate student
achievement. Due to small class sizes and variations in achievement, the
achievement gap of the Algebra I students of 2012 and 2013 may or may not have
created an accurate comparison to the achievement gap of Algebra I students of
the class of 2014.

**Intervention/Innovation**

Before the treatment, the assessments usually given in my classroom were
open-response. Students were allowed to receive partial credit for proper work
shown, appropriate labels, and effort. Changes were made to the format of the
Algebra I assessments to incorporate multiple-choice formatted questions. The assessment was composed of approximately half open-response and half multiple-choice questions to allow the students to practice a multiple-choice format. Also, the students learned strategies to use when answering multiple-choice questions. They were given a handout with important strategies for being successful on multiple-choice questions. The list of strategies is included in Appendix B. Examples done on the board helped assure the students had an understanding of each strategy stated.

This study was done using a pre- and post-test design. The results from the NWEA testing done in both the fall and spring were used to measure student achievement. The gaps in previous year’s mathematics scores on the NWEA were compared to the gap from fall to spring this year. Achievement gaps were examined during each of the three years separately. This year’s NWEA testing results were a representation of whether practicing multiple-choice formatted questions and learning strategies to be used on multiple-choice questions improved student achievement. A survey was also conducted to gauge the students’ comfort level with multiple-choice exams both before and after the implementation. Both a quantitative and qualitative design was used to look at the NWEA and survey results.
Description of Methods

All possible participants were informed of the purpose of this research project and were asked to volunteer. If they participated, they were educated on the data collection procedures. Upon approval by Minot State University’s Institution Review Board (IRB), data already available were collected. The IRB approval letter can be found in Appendix C. Written consent was obtained from all participants and their parents. The parent consent form can be found in Appendix D and the student assent form in Appendix E. All information collected about the participants was kept confidential. Permission from the principal had already been acquired. See Appendix F for the principal consent form.

Data was collected on fall 2010 NWEA test scores for each student in this year’s Algebra I class. Achievement gaps from fall to spring were calculated from the two previous Algebra I classes, class of 2012 and class of 2013, which formed the control group. At the beginning of the third nine weeks, after taking their first half multiple-choice, half open-response assessment, the students took a pre-survey about their views and practices on multiple-choice assessments. See Appendix G for survey questions. The survey had a scale similar to a Likert scale in which the students were asked to rate their level of agreement or disagreement with each statement.

During the third nine weeks, all assessments were given in a half multiple-choice, half open-response format to allow students to practice taking multiple-
choice assessment in the classroom. The spring NWEA test took place in late March 2011. Since the results from the NWEA test were available shortly after the test was complete, data were collected in early April. At this time the students took a post-survey to determine whether their views about multiple-choice assessments had changed. See Appendix H for the post-survey. Throughout the intervention and data collection process, I kept a journal to record my observations and thoughts. A sample test similar to those given to students during the third nine weeks is located in Appendix I. All tests given during the third nine weeks were in this format; the only variation was the mathematical content.

**Expected Results**

The students learned strategies and practiced taking multiple-choice format exams for nine weeks. The achievement gap (or growth from fall to spring) on the NWEA test was expected to be higher this year than it had been in previous years. The students’ success might not have come solely from practicing multiple-choice exams but also from learning and applying strategies for taking a multiple-choice exam. Difficulties I encountered included making multiple-choice assessments similar to those found on standardized tests and getting students to apply the strategies they had learned on the NWEA test.

**Timeline for the Study**

The intervention started at the beginning of the third nine week period, early January 2011. After the first assessment, in which multiple-choice
assessments were incorporated, the students learned strategies and took a survey about their views on multiple-choice assessment. Since the spring NWEA testing took place in late March 2011, the interventions continued until the spring test was complete. The NWEA test results were returned quickly and collected in April 2011. In April, after the spring NWEA testing was done, the students again completed the survey on their views of multiple-choice formatted assessments in April.

Summary

Multiple-choice questions were incorporated into my Algebra I assessments, and those students learned strategies for taking multiple-choice assessments. Both interventions took place during the third nine weeks of the school year. The final data were collected in April of 2011 after the students had completed their spring NWEA testing. In the next chapter the data analysis and its results are presented.
Chapter Four

Data Analysis and Interpretation of Results

The purpose of this study was to determine whether implementing multiple-choice questions into current Algebra I assessments would improve student achievement on high-stakes tests. Data was collected on the results of the NWEA testing done in the fall and spring. Each of the recent Algebra I class’ (graduating class of 2012, graduating class of 2013, and graduating class of 2014) achievement gaps and RIT scores were looked at from their 9th grade year. A RIT score is a unit of measure that uses individual item difficulty values to estimate student achievement. This chapter includes information about the demographics of the school used in the study, a summary of statistics, and tables showing comparisons between the control group (combined data from graduating classes of 2012 and 2013) and the treatment group (graduating class of 2014). Finally, the results from the pre- and post-survey were discussed.

Data Analysis

Data were analyzed in a variety of ways. The means of the RIT scores were determined to compare the average score for each one of the three Algebra I classes. The standard deviation of each set of data was calculated to determine how spread out the data were; the t-values and p-values were also determined for the statistical tests. Achievement gaps (AG) were also used in comparison to
typical growth (TG). TG is the average growth of students who were in the same
grade and had a similar fall RIT score.

**Interpretation of Results**

Table 1 shows the demographics of each class from which data were used
for this study. As the statistics show all classes were relatively close in gender and
race. Each class size consisted of 14 students. Some of the Algebra I classes had
more than 14 students, but some data were not used because they either didn’t
take a pre-algebra class within the district, or were an older than average 9th
grader.

Table 1

*School Demographics*\textsuperscript{a}

<table>
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<th>2013</th>
<th>2014</th>
<th>All\textsuperscript{b}</th>
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<td>White</td>
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<td>7%</td>
<td>0%</td>
<td>7%</td>
</tr>
<tr>
<td>Hispanic</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>1%</td>
</tr>
</tbody>
</table>

*Note.* \textsuperscript{a}No students in the sample population were on IEPs or 504 Plans.
\textsuperscript{b}All refers to the percentages in the district for grades 7-12.

Table 2 shows summary statistics referencing NWEA math RIT scores for
the group receiving the intervention (treatment group) as well as the groups used
for comparison (combined to form the control group); specifically the classes of
2012, 2013, and 2014 in their 9th grade year. The fall and spring columns
represent the average RIT score for each class. The AG column contains the
average AG for each class in each year. The number in parentheses denotes the
standard deviation of the RIT scores. The summary data show that for all groups the average growth or achievement gap was positive and reasonably close each year. Fairly large standard deviations indicate that achievement gaps were highly variable which was due in part to many students earning negative AGs even though growth was expected for all students throughout the year.

Table 2

*Summary Statistics of RIT Scores and Achievements Gaps (AG)*

<table>
<thead>
<tr>
<th>Class</th>
<th>9th Grade</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fall</td>
<td>Spring</td>
</tr>
<tr>
<td>2012</td>
<td>247.14</td>
<td>249.64</td>
</tr>
<tr>
<td></td>
<td>(6.43)</td>
<td>(8.45)</td>
</tr>
<tr>
<td>2013</td>
<td>244</td>
<td>247.43</td>
</tr>
<tr>
<td></td>
<td>(13.82)</td>
<td>(13.57)</td>
</tr>
<tr>
<td>2014</td>
<td><strong>248.64</strong></td>
<td><strong>251.86</strong></td>
</tr>
<tr>
<td></td>
<td>(8.59)</td>
<td>(8.75)</td>
</tr>
<tr>
<td>All</td>
<td>246.60</td>
<td>249.64</td>
</tr>
<tr>
<td></td>
<td>(10.04)</td>
<td>(10.42)</td>
</tr>
</tbody>
</table>

*Note.* The Fall and Spring columns represent the class’ average RIT score. The AG column represents the average achievement gap for each class. The numbers in parentheses represent the standard deviation of the class data. The numbers in bold represent the intervention group’s data.

The scores of the sample group receiving the intervention, class of 2014, are shown in bold. They reflect an achievement gap of 3.21 on average, which is lower than the class of 2013 in their ninth grade year but higher than the ninth graders in the class of 2012. When compared to the overall average, the treatment group has a higher AG by 0.16 points.

Table 3 contains the sample size, mean, and standard deviation of the control and treatment groups. The fall scores, spring scores, and achievement gaps (AG) from fall to spring are all present for comparison. The treatment group
(class of 2014) started out in the fall with an average RIT score 3.07 points higher than the control group (classes of 2012 and 2013 combined). When comparing fall to spring, the treatment group’s score improved 0.25 more than the control group. Although the treatment group improved more, the growth was not significant at the 5% level of significance. T-tests were run, as shown in Table 4, to determine whether there was a significant difference in the fall scores, spring scores, and AG growth of the two groups. A $p$-value of 0.05 or less is significant at the 5% level.

Table 3

**Descriptive Statistics for the Control and Treatment Groups**

<table>
<thead>
<tr>
<th>Group</th>
<th>Fall Scores</th>
<th>Spring Scores</th>
<th>AG Fall to Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$N$</td>
<td>$M$</td>
<td>$SD$</td>
</tr>
<tr>
<td>Control</td>
<td>28</td>
<td>245.6</td>
<td>10.7</td>
</tr>
<tr>
<td>Treatment</td>
<td>14</td>
<td>248.64</td>
<td>8.59</td>
</tr>
</tbody>
</table>

*Note. $N$ stands for the number of participants in each group. $SD$ stands for the standard deviation of the data.*

Table 4

**Mean Differences (Control – Treatment)**

<table>
<thead>
<tr>
<th></th>
<th>$M$ Diff</th>
<th>$t$</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall Scores</td>
<td>-3.07</td>
<td>-1.00</td>
<td>0.323</td>
</tr>
<tr>
<td>Spring Scores</td>
<td>-3.32</td>
<td>-1.06</td>
<td>0.15</td>
</tr>
<tr>
<td>AG Growth Fall to Spring</td>
<td>-0.25</td>
<td>-0.13</td>
<td>0.447</td>
</tr>
</tbody>
</table>

The data in Table 4 show there were no significant differences in the fall scores ($t = -1, p = 0.323$) or the spring scores ($t = -1.06, p = 0.15$). A $t$-test was also run on the growth of AG fall to spring scores, and no significant difference
was found between the groups \((t = -0.13, p = 0.447)\). This showed there was no significant difference in achievement levels for the two groups.

Data were also analyzed by comparing the achievement gap (AG) and typical growth (TG) of each group. Table 5 contains descriptive statistics for the AG and TG of both the control and treatment group. The sample size, mean, and standard deviation are given for comparison. Table 6 includes the \(t\)-test results for the comparison of the achievement gaps and typical growth of the control and treatment groups. I assumed AG would be significantly greater than TG for both groups.

Table 5

<table>
<thead>
<tr>
<th>Group</th>
<th>(N)</th>
<th>(M)</th>
<th>(SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control AG</td>
<td>28</td>
<td>2.96</td>
<td>6.08</td>
</tr>
<tr>
<td>Control TG</td>
<td>28</td>
<td>2.14</td>
<td>0.45</td>
</tr>
<tr>
<td>Treatment AG</td>
<td>14</td>
<td>3.21</td>
<td>5.05</td>
</tr>
<tr>
<td>Treatment TG</td>
<td>14</td>
<td>2.07</td>
<td>0.27</td>
</tr>
</tbody>
</table>

Note. \(N\) stands for the number of participants in each group. \(SD\) stands for the standard deviation of the data.

Table 6

<table>
<thead>
<tr>
<th>Group</th>
<th>(M) Diff</th>
<th>(t)</th>
<th>(p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>0.82</td>
<td>0.72</td>
<td>0.238</td>
</tr>
<tr>
<td>Treatment</td>
<td>1.14</td>
<td>0.77</td>
<td>0.227</td>
</tr>
</tbody>
</table>

When looking at the data in this perspective, the results were also not significant at the 5% level of significance. The control group exceeded their typical growth by 0.82 points, but the AG was not significantly greater than the
TG ($t = 0.72, p = 0.238$). The treatment group also did better, but AG was not significantly greater than TG ($t = 0.77, p = 0.227$). The treatment group did have a larger difference, 1.14, than the control group, 0.82, when comparing their typical growth to their achievement gap.

Additionally, a journal was kept with observations made throughout the intervention. Before handing the classroom assessments back, during the third quarter, I calculated a percentage for each student on the multiple-choice section, open-response section, and overall score. Most of the students either received close to the same score on the multiple-choice section as the open-response section, or they did well with a particular format on one test and excelled on the opposite format the next test. No gender issues were noted, neither boys nor girls seemed to excel on either format. About the same score was earned when comparing each student’s grade during the third quarter to the rest of the school year.

In addition to test data, survey information on student comfort levels on taking multiple-choice assessments was compiled before and after the intervention. The results in Appendix J show that most students felt comfortable taking multiple-choice exams prior to receiving the intervention. This could be due to the popularity of this type of exam in public education today. However, after receiving instruction related to skills for taking multiple-choice exams, almost all students in the class stated that they felt more comfortable taking
multiple-choice tests. Additionally, students stated that they used the skills taught in class when taking multiple-choice exams.

Many students stated that they preferred multiple-choice over open response. They noted that they liked to eliminate choices, work backwards and, in reference specifically to math, their confidence increased when the answer is present in the question.

**Summary**

In summary, the results of this study showed little correlation between practicing multiple-choice assessments in math and improved performance on high-stakes tests. By analyzing data using a variety of summary statistics and t-tests it was shown that when comparing the treatment group to the control group within the school, no conclusions related to the intervention can be drawn.

While the results of this study were not as the author expected, it is possible that some situations regarding the study group could have a significant impact on the study. First, the group is a relatively small sample, only 14 students. Furthermore, many of the students had returned from a Future Business Leaders of America trip immediately before the spring NWEA test day which could have impacted their performance on the exam. In the next chapter conclusions about the study, reflections, recommendations, and further action plans are discussed.
Chapter Five

Conclusions, Action Plan, Reflections, and Recommendations

The research question this study attempted to answer was as follows: Does practicing multiple-choice formatted questions improve student achievement on high-stakes testing? From the results discussed in Chapter Four, none of the findings were statistically significant. Students participating in the intervention (i.e., treatment group) did not score significantly higher on the NWEA spring test and their growth from fall to spring on the NWEA tests was not significantly greater than the control group. This chapter includes a discussion of the conclusions, action plan, reflections, and recommendations from this study.

Conclusions

Although the treatment group did not significantly outperform the control group, they did not do significantly worse than the control group. The multiple-choice questions did not have an adverse effect on the student’s mathematics achievement in my Algebra I class. Students did not seem to excel on a particular question format. Most of the students either received close to the same score on the multiple-choice section as the open-response section, or they did well with a particular format on one test and excelled on the opposite format the next test. When looking at gender issues, research has shown that girls perform better than boys on open-response assessments. Boys, however, do better than girls on multiple-choice formatted assessments (DeMars, 2000). None of the data
collected on the third quarter tests showed the same results as found in DeMars’ study.

It was also found from the pre- and post-surveys that students felt fairly comfortable taking multiple-choice assessments before the intervention, but stated they were even more comfortable after the intervention. Students furthermore acknowledged using the strategies for taking multiple-choice assessments taught to them during the third quarter while taking the spring NWEA test.

Throughout this study, the format of an assessment was not influential on student scores. If students have learned the material, they will do well on the assessment regardless whether the questions are multiple-choice or open-response. The students earned about the same scores during the third quarter while the intervention was taking place as they did during the rest of the school year. Students did however ask if the tests for the rest of the year could contain multiple-choice questions. As stated in Chapter Four, students enjoyed the reassurance the multiple-choice format gave when their answer was one of the choices.

**Action Plan**

After doing this study I plan to incorporate a few multiple-choice questions on all my Algebra I assessments. Since the students began to feel more comfortable by practicing multiple-choice questions, it would be beneficial to the students to continue with this practice. However, the majority of my assessment
questions will be in the open-response format. Open-response is more rigorous, and I think more is learned about a student’s mathematical knowledge. The trial-and-error process used on multiple-choice assessments does not make students show their problem solving or mathematics reasoning skills like open-response questions do.

In the future I would be interested in doing action research on self-reflection in mathematics. Students sometimes do not take the time to look at why they got a problem wrong; they just look at the overall score. If more reflection was done after an assessment or even on their daily homework, would students’ grades begin to rise? In my current mathematics classroom, common problems students had on the last assessment are discussed, but writing a reflection may give them a better understanding of a concept leading to higher scores in the future.

**Reflections and Recommendations for Teachers**

Students perform similarly on both formats; therefore, I need to concentrate on their math skills instead of teaching them “tricks” for test-taking. If the students have learned the material, they will be successful no matter which format is used. Teachers should teach to the test by teaching content the test will cover, not by teaching the style of the test.

If this study was redone, a larger sample size and a control group from a different section during the same school year would be used. The control group
could take an open-response test and the treatment group a multiple-choice test with the same questions. I wouldn’t have to rely on the NWEA testing results and could make the tests contain the exact same questions. With the small class sizes and only having one section of each subject, it was hard to find any other way to do this study at the time. I also would have liked to implement the intervention for a longer period of time.

One major frustration during the study was about half of the students were on a school trip for two days prior to taking their spring NWEA test. They hadn’t been in school for four days and the first thing they did when they returned was to take their math NWEA test. The trip may have had no effect on their performance, but after four days of doing no school work, they may have needed time to get back into “school mode.”

Although multiple-choice assessments are common practice on high-stakes tests, I believe mathematics teachers should have a majority of their tests open-response. Teachers are able to learn more about which steps or concepts a student does not understand by looking at the student work shown in an open-response format. Also, O’Neil and Brown (1998) stated, “Generally, students were more likely to use a trial-and-error or guessing approach for multiple-choice items, whereas for open-ended items, students much more frequently employed a mathematical line of reasoning” (p. 333). I believe teachers should challenge their
students to use their problem solving skills instead of allowing them to use trial-and-error on multiple-choice assessments.

Action research is very beneficial to the classroom teacher as well as the students. The only way to decide if what is being implemented in the classroom is beneficial is to collect data and analyze it. Although nothing found was statistically significant, things can still be taken from this study to benefit the students when it comes to assessments. By implementing a few multiple-choice formatted questions, students can begin to feel more comfortable with the format and the teacher is still able to gain insight on the knowledge of each student by having a majority of the assessments in the open-response format.

**Summary**

Overall, the process of action research is valuable. Teachers can learn whether implementing a new method in their classrooms will help their students. From this particular study I learned that implementing multiple-choice formatted questions on mathematical assessments had no significant effect on student achievement. If the students understand the material, they typically will be successful on both formats. Open-response gives the teacher more information about each student’s knowledge of covered concepts.

Although I did not find the treatment group significantly outperformed the control group, the students in the treatment group expressed they felt more comfortable with multiple-choice assessments at the end of the study. They
learned skills to use when taking a multiple-choice assessment, and some of them learned the hard way about pacing themselves. Even though the data did not show improvement, I hope the students learned skills they can apply when taking high-stakes tests.
References


Appendices
Appendix A

School Demographics

<table>
<thead>
<tr>
<th>Enrollment 7 - 12</th>
<th>153</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender Percentages</td>
<td><img src="#" alt="Gender Percentages" /></td>
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<tr>
<td>Male: 47%</td>
<td></td>
</tr>
<tr>
<td>Female: 53%</td>
<td></td>
</tr>
<tr>
<td>Racial/Ethnic Distribution</td>
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</tr>
<tr>
<td>White: 141</td>
<td></td>
</tr>
<tr>
<td>American Indian: 11</td>
<td></td>
</tr>
<tr>
<td>Hispanic: 1</td>
<td></td>
</tr>
<tr>
<td>No other minorities exist in the school district.</td>
<td></td>
</tr>
<tr>
<td>Percentage of students on IEPs</td>
<td>7%</td>
</tr>
<tr>
<td>Percentage of students on 504 plans</td>
<td>0</td>
</tr>
<tr>
<td>Percentage of ESL/ELL students</td>
<td>0</td>
</tr>
<tr>
<td>Percentage of Low-Income families</td>
<td>32%</td>
</tr>
<tr>
<td>Age of Participants</td>
<td>14 – 16 yrs old</td>
</tr>
</tbody>
</table>
Appendix B

Strategies for Multiple-Choice Assessments

The following are tips to help you be successful on future multiple-choice assessments.

- **Study**
  - Look over any material covered you are unsure of.
  - Materials can be purchased to help you study for standardized tests such as the ACT.

- **Understand the question**
  - Underline critical words in the question.
  - Cover up the choices while reading the question.
  - Read the question with each choice and decide the truth value.
  - DO NOT jump to conclusions.

- **Eliminate options**
  - Cross out any options you know are false.
  - Options with the words “always” and “never” are less likely to be correct.

- **Look for grammatical clues**
  - If a question ends in “an” look for an option that begins with a vowel.

- **Don’t waste time**
  - Skip problems that usually give you trouble and come back to them later.
  - Pace yourself by dividing the test into quarters.

- **Preparation**
  - Get plenty of sleep
  - Eat right
  - Take breaks
  - Clear your head
Appendix C

Notice of IRB Approval

Institutional Review Board
MINOT STATE UNIVERSITY
500 University Avenue West • Minot, North Dakota 58701 • (701) 858-3125 • 1-800-777-0150 • FAX (701) 858-4286

Notice of IRB Approval

Name of Principal Investigator: Loni Hall
University Address: Math & Computer Science
Title of Project: Practicing Multiple-Choice Assessments: The Effects on Student Achievement

January 12, 2011

The above project has been reviewed and approved by the IRB under the provisions of Federal Regulations 45 CFR 46.

This approval is based on the following conditions:

1. The materials you submitted to the IRB provide a complete and accurate account of how human subjects are involved in your project.

2. You will carry on your research strictly according to the procedures as described in materials presented to the IRB.

3. You will report to the chair of the Institutional Review Board any changes in procedures that may have a bearing on this approval and require another IRB review.

4. If any changes are made, you will submit the modified project for IRB review.

5. You will immediately report to the IRB Chair any problems that you encounter while using human subjects in your research.

[Signature]
Dr. Brent A. Askvig
Chair, Minot State University's IRB
Appendix D

Written Consent Form

Practicing Multiple-Choice Assessments: The Effects on Student Achievement

Invitation to participate: Your child is invited to participate in a study of practicing multiple-choice questions to determine the effects it has on student achievement. This study is being conducted by Loni Hall, mathematics instructor at Garrison High School, and a graduate student at Minot State University.

Basis for Subject Selection: Your child has been selected because he/she is in Miss Hall’s Algebra I class and has taken pre-algebra within the Garrison School District. Your child’s class was chosen because there is a relatively even split between gender. If everyone agrees to participate there will be 14 students who meet the criteria for the study.

Overall Purpose of Study: The purpose of this paper is to help me and possibly other mathematics teachers improve their assessments to benefit the students in their classrooms and on high-stakes tests (e.g., ACT, AYP). The main goal of changing my assessments is to determine whether student achievement improves with practice of a particular question format.

Explanation of Procedures: If you decide to allow your child to participate, your child will be asked to do the following:

a. Take assessments with multiple-choice formatted questions which will be incorporated into regular Algebra I assessments.

b. Learn strategies to be used when taking a multiple-choice assessment.

c. Take two surveys about his or her views of multiple-choice assessments.

The identity of all participants will remain confidential. All research will be done in the classroom. The implementations will begin the third nine weeks of school and will continue until the NWEA testing is done in the spring, late March or early April.

Potential Benefits: Each participant will learn strategies to use when taking a multiple-choice assessment. They will practice taking multiple-choice assessments to prepare for the NWEA Spring testing. After both interventions are implemented the participants will hopefully see improved achievement on standardized assessments.
Alternatives to Participation: If you decide to not allow your child to participate, he/she will still take the same assessments during class, but will not be required to take the two surveys and his or her NWEA test data will not be collected.

Compensation for Participation: Each student that chooses to participate will receive 20 extra credit daily points during the third quarter. These points will not affect the grade of those choosing not to participate.

Assurance of Confidentiality: The identity of all participants and their data will remain confidential and stored in a locked file cabinet or on a password-protected computer. Any data collected will not be linked to the participants or the school district in any way. Following the study and completion of my master’s degree, all data will be destroyed.

Withdrawal from the Study: Your child’s participation is voluntary. Your decision whether or not to allow your child to participate will not affect his/her grade. If you decide to allow your child’s participation in the study, you are free to withdraw your consent and discontinue participation at any time. If you would like to withdraw call or email Loni Hall.

You should feel free to ask questions now or at any time during the study. If you have questions, you can contact Loni Hall at 463-7770 or loni.c.hall.1@sendit.nodak.edu. If you have questions about the rights of research subjects, contact the Chairperson of the MSU Institutional Review Board (IRB), Brent Askvig at 701-858-3052 or Brent.Askvig@minotstateu.edu.

Guardian Consent:

You are voluntarily making a decision whether or not to allow your child or legal ward to participate. Your signature indicates that, having read and understood the information provided above, you have decided to permit your child or legal ward to participate. You will be given a copy of this consent form to keep.

_______________________________
Participant (please print student name)

_______________________________
Signature of Parent or Guardian   Relationship to subject   Date

_______________________________
Researcher’s Signature   Date
Appendix E

Student Assent Form

Practicing Multiple-Choice Assessments: The Effects on Student Achievement

Invitation to participate: You are invited to participate in a study of practicing multiple-choice questions to determine the effects it has on student achievement. This study is being conducted by Miss Hall, mathematics instructor at Garrison High School, and graduate student at Minot State University.

Basis for Subject Selection: You have been selected because you are in Miss Hall’s Algebra I class and have taken pre-algebra within the Garrison School District. Your class was chosen because there is a relatively even split between gender. If everyone agrees to participate there will be 14 students who meet the criteria for the study.

Overall Purpose of Study: The purpose of this paper is to help me and possibly other mathematics teachers improve their assessments to benefit the students in their classrooms and on high-stakes tests (e.g., ACT, AYP). The main goal of changing my assessments is to determine whether student achievement improves with practice of a particular question format.

Explanation of Procedures: If you decide to participate, you will be asked to do the following:

a. Take assessments with multiple-choice formatted questions which will be incorporated into regular Algebra I assessments.

b. Learn strategies to be used when taking a multiple-choice assessment.

c. Take two surveys about your views of multiple-choice assessments.

The identity of all participants will remain confidential. All research will be done in the classroom. The implementations will begin the third nine weeks of school and will continue until the NWEA testing is done in the spring, late March or early April.

Potential Benefits: Each participant will learn strategies to use when taking a multiple-choice assessment. They will practice taking multiple-choice assessments to prepare for the NWEA Spring testing. After both interventions are implemented the participants will hopefully see improved achievement on standardized assessments.
Alternatives to Participation: If you decide not to participate, you will still take the same assessments during class, but will not be required to take the two surveys and data will not be collected on your NWEA testing results.

Compensation for Participation: Each student that chooses to participate will receive 20 extra credit daily points during the third quarter. These points will not affect the grade of those choosing not to participate.

Assurance of Confidentiality: The identity of all participants and their data will remain confidential and stored in a locked file cabinet or on a password-protected computer. Any data collected will not be linked to the participants or the school district in any way. Following the study and completion of my master’s degree, all data will be destroyed.

Withdrawal from the Study: Your participation is voluntary. Your decision whether or not to participate will not affect your grade. If you decide to participate in the study, you are free to withdraw your consent and discontinue participation at any time. If you would like to withdraw call or email Loni Hall.

You should feel free to ask questions now or at any time during the study. If you have questions, you can contact Loni Hall at 463-7770 or loni.c.hall.1@sendit.nodak.edu. If you have questions about the rights of research subjects, contact the Chairperson of the MSU Institutional Review Board (IRB), Brent Askvig at 701-858-3052 or Brent.Askvig@minotstateu.edu.

Student Consent:

You are voluntarily making a decision whether or not to participate. Your signature indicates that, having read and understood the information provided above, you have decided to participate. You will be given a copy of this consent form to keep.

Participant (please print name)

______________________________

Signature of Participant Date

______________________________

Researcher’s Signature Date
Appendix F

Principal Consent Form

I. Research Background

Title of the Study: Practicing Multiple-Choice Assessments: Effects on Student Achievement

Name of Researcher: Loni Hall Phone: (701) 463-7770

Street address: 215 HancockWay #8 City: Garrison State: ND Zip: 58540

E-mail: loni.c.hall.1@sendit.nodak.edu

II. Description of Research Proposal

Researcher is to provide the principal with a copy of the executive summary and the time requirement.

III. Agreement (to be completed by principal)

I, ____________________________, principal of ________________________school, understand

- the study and what it requires of the staff, students, and/or parents in my school,
- that the privacy and confidentiality of any staff or student will be protected,
- that I have the right to allow or reject this research study to take place at my school,
- that I have the right to terminate the research study at any time,
- that I have the right to review all consent forms and research documents at any time during the study.

☐ I grant permission to the researcher to conduct the above named research in my school as described in the proposal.

☐ I DO NOT grant permission to the researcher to conduct the above named research in my school as described in the proposal.

☐ I understand that data should be released only by the departments that own them. My staff and I shall not release data to the researcher without approval from the IRB.

________________________________
Signature of Principal
Darwin Routledge
Garrison High School
Appendix G

Multiple-Choice Assessment Pre-Survey

I am interested in your comfort level on multiple-choice assessments. Your answers will help me have a better understanding of how you feel about a standardized test format.

Please indicate your gender: Female______ Male ______

You will not be graded on your answers and this survey is completely anonymous. Please indicate how you feel about the following statements by placing an X in the appropriate box.

SD = Strongly disagree, D = Disagree, A = Agree, SA = Strongly agree

<table>
<thead>
<tr>
<th>Statements</th>
<th>SD</th>
<th>D</th>
<th>A</th>
<th>SA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I feel comfortable taking multiple-choice assessments.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. I take multiple-choice assessments frequently in my math classroom.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. I know strategies to use on multiple-choice assessments.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. I use strategies to eliminate possible answers when taking a multiple-choice assessment.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. I pace myself when taking a multiple-choice assessment.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. I get nervous when taking high-stakes assessments because of the unfamiliar format.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. I prefer multiple-choice assessments because my score comes completely from finding the correct answer.</td>
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Appendix H

Multiple-Choice Assessment Post-Survey

I am interested in your comfort level on multiple-choice assessments. Your answers will help me have a better understanding of how you feel about a standardized test format.

Please indicate your gender: Female______ Male ______

You will not be graded on your answers and this survey is completely anonymous. Please indicate how you feel about the following statements by placing an X in the appropriate box.

SD = Strongly disagree, D = Disagree, A = Agree, SA = Strongly agree

<table>
<thead>
<tr>
<th>Statements</th>
<th>SD</th>
<th>D</th>
<th>A</th>
<th>SA</th>
</tr>
</thead>
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<td>2. I feel I have benefited from practicing multiple-choice assessments.</td>
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<td>3. I use the strategies taught in class on multiple-choice assessments.</td>
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<tr>
<td>5. My views on multiple-choice assessments have not changed in the past 9-weeks.</td>
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<tr>
<td>6. Do you prefer multiple-choice or open-response questions? Why?</td>
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<tr>
<td>7. Which type of assessment do you feel you excel on? Why?</td>
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<tr>
<td>8. Which type of assessment do you feel gives the teacher a better understanding of your ability as a mathematics student? Why?</td>
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</tbody>
</table>
Appendix I

Sample Classroom Test

Algebra I – Test 9

Name __________________________

Solve each problem, show all necessary work and circle your answer.

1. Simplify: $\sqrt{45}$

2. Find the lateral surface area of this right prism whose bases are regular pentagons. Dimensions are in meters.

![Prism Diagram]

3. Solve the system by **substitution**:
   
   \[
   \begin{align*}
   x + 2y &= 7 \\
   4x - y &= 10
   \end{align*}
   \]

4. The school being featured in a newspaper article caused the number of students enrolled to increase by 190 percent. If 330 students were enrolled before the article, how many were there after the article?

5. Add. Write the answers with all exponents positive. $x^3y^{-1} + 9z^{-3}$
6. Graph: \( x + 4y = 4 \)

7. Simplify: \( \frac{e}{y} \cdot \frac{y}{u+e} \)

8. Add: \( \frac{4s}{t^2} + \frac{2}{t+u} + 5 \)

9. Graph the following inequality on a number line: \( x + 2 \geq -3; D = \{ \text{Integers} \} \)

10. Write a conjunction that describes this graph. Specify the domain.

11. \( \sqrt{17} \) is between what two consecutive whole numbers?

12. The average of the first 6 weights was 25 pounds. The average of the next 7 weights was 32 pounds. The average of the last 7 weights was 38 pounds. What was the overall average of the weights?

13. Indicate whether each of the following numbers is a rational or irrational number.
   a. 4.27  
   b. \( \sqrt{9} + 1 \)
   c. -5
   d. \( \pi \)
Solve each problem and choose the best answer from the list of choices.

14. Which number line shows the graph of $x + 3 \geq -1$; $D = \{\text{Real numbers}\}$

15. Which inequality and domain match the graph?

A. $x > 0$; $D = \{\text{Integers}\}$
B. $x > -1$; $D = \{\text{Positive integers}\}$
C. $x > 0$; $D = \{\text{Real numbers}\}$
D. $x > -1$; $D = \{\text{Integers}\}$

16. Which of the following square roots is an irrational number?

A. $\sqrt{16}$  B. $\sqrt{23}$  C. $\sqrt{4}$  D. $\sqrt{\frac{1}{4}}$

17. $\sqrt{29}$ is between what two consecutive whole numbers?

A. 4 and 5  B. 28 and 29  C. 6 and 7  D. 5 and 6

18. After taking 5 quizzes, your average is 79 out of 100. What must your average score be on the next five quizzes to increase your average to 87?

A. 95  B. 88  C. 92  D. 83
19. Add: \( \frac{2}{x+3} + \frac{5}{x-3} \)

A. \( \frac{7}{x^2+9} \)  
B. \( \frac{7x+9}{7} \)  
C. \( \frac{7}{x+3} \)  
D. \( \frac{7x+9}{x^2-9} \)

20. Simplify: \( \sqrt{75} \)

A. 15\( \sqrt{10} \)  
B. 10\( \sqrt{6} \)  
C. 5\( \sqrt{3} \)  
D. 10\( \sqrt{3} \)

21. Calculate the surface area of the right triangular prism.

A. 408 m\(^2\)  
B. 720 m\(^2\)  
C. 363 m\(^2\)  
D. 360 m\(^2\)

22. During the hockey season Monique scored goals on 19% of the shots she took. If she scored 38 goals, how many shots did she take?

A. 20  
B. 200  
C. 72  
D. 722

23. Add. Write the answer with all positive exponents. \( x^3y^2 + 8z^2 \)

A. \( \frac{y^2z^2+8x^3}{x^3z^2} \)  
B. \( \frac{x^3z^2+8y^2}{y^2z^2} \)  
C. \( \frac{y^2z^2+8}{x^3z^2} \)  
D. \( \frac{y^2z^2+x^3}{8x^3z^2} \)
24. Graph: $3x + y = 9$

25. Simplify: $\frac{c}{a + c} = \frac{cb + ab}{c^2}$

A. $\frac{cb + ab}{c^2}$  B. $\frac{c^2 + ca}{b}$  C. $\frac{b}{c + a}$  D. $\frac{ca + c^2}{ab}$

26. Solve the system using substitution:

$3x - 4y = 0$
$y = x + 1$

A. $(0, 0)$  B. $(-3, -2.25)$  C. $(-4, -3)$  D. $(-3, -2)$
## Appendix J

### Pre and Post Survey Results

<table>
<thead>
<tr>
<th>Statements</th>
<th>Pre Survey</th>
<th>Post Survey</th>
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<tbody>
<tr>
<td>1. I feel comfortable taking multiple-choice assessments.</td>
<td>7.1% 0.0% 14.3% 78.6%</td>
<td>0.0% 0.0% 78.6% 21.4%</td>
</tr>
<tr>
<td>2. I take multiple-choice assessments frequently in my math classroom.</td>
<td>7.1% 92.9% 0.0% 0.0%</td>
<td>0.0% 0.0% 78.6% 21.4%</td>
</tr>
<tr>
<td>3. I know strategies to use on multiple-choice assessments.</td>
<td>0.0% 14.3% 85.7% 0.0%</td>
<td>0.0% 0.0% 64.3% 35.7%</td>
</tr>
<tr>
<td>4. I use strategies to eliminate possible answers when taking a multiple-choice assessment.</td>
<td>0.0% 0.0% 64.3% 35.7%</td>
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<td>5. I pace myself when taking a multiple-choice assessment.</td>
<td>0.0% 0.0% 85.7% 14.3%</td>
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<tr>
<td>6. I get nervous when taking high-stakes assessments because of the unfamiliar format.</td>
<td>7.1% 50.0% 42.9% 0.0%</td>
<td>0.0% 14.3% 57.1% 28.6%</td>
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<td>7. I prefer multiple-choice assessments because my score comes completely from finding the correct answer.</td>
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<td>0.0% 57.1% 42.9% 0.0%</td>
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<td>8. I prefer open-response assessments because I receive credit for showing my work.</td>
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