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Comparing Online and Traditional Assessment Practices in Middle School Mathematics

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Comparing Online and Traditional Assessment Practices in Middle School Mathematics

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Abstract

As a result of the COVID-19 pandemic, teachers across the world have been forced to explore different modalities of assessment, many of them virtual. Now that many of the most restricting policies for schools due to pandemic have been lifted, the use of these virtual assessments remain. Due to the recent nature of their use though means that not many studies have looked into the implications of these assessments on students let alone middle school students. This study aims to help fill in some of the gaps in this research. In this study, students will take one of two assessments with the exact same questions. One of the assessments will be paper and pencil, the other will be on Google Form. Students will be randomized into which modality they will complete and then the scores of the two groups will be compared. The goal of this is to determine if taking an assessment virtually provides a roadblock to displaying mastery of learning for the students. After students are done with their assessment, they will then take a short survey asking them how hard they perceived their assessment to be. The results of this study will hopefully tell us two things: whether one assessment is more challenging based on the scores and based off student's perceptions.

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Chapter 1

Comparing Online and Traditional Assessment Practices in Middle School Mathematics

In 2020, the COVID-19 pandemic took all the social and physical constructs of this world and turned them backwards. One area that certainly was affected was education. Educational institutions all over the world were forced to shift their assessment practices to a virtual format while attempting to maintain the rigor and validity that those assessments provided (Morgan et al., 2021). As the strains of the pandemic lessen and the world turns back towards teaching with more normal constraints, some of the outcomes of the pandemic remain such as use of virtual options to instruct and assess. With these new options and strategies, it's important to analyze the benefits and possible setbacks that they may provide. Throughout the first year of teaching, this teacher researcher encountered many instances where students took assessments with similar questions on both paper and virtually. Many times, the scores on the virtual assessments were weaker than those taken on paper and pencil. These situations beg the question on whether having an assessment online creates a roadblock for students as they demonstrate mastery of learning. An assessment's purpose is to elicit student thinking and provide teachers with an accurate picture of where a student is at in their learning (Barton, 2018). If giving an assessment online creates a barrier in showing a student's level of mastery, it's important that educators understand where those roadblocks may occur based on assessment modality. This research will show a correlation between assessment scores and the mode given.

Brief Literature Review

With the COVID-19 pandemic shifting the methods of assessing our students, some of the many benefits of online assessments have emerged. Some of those strengths include instant feedback to students and allowing students many ways to interact with the material (Luckritz Marquis, 2021). With all those benefits, the research on how those types of assessments affect

student outcomes is still coming to light. Students in mathematics classrooms report that even with all these technologies, the preference still lies with paper and pencil assessments for a variety of reasons but mainly because of the ease of paper and pencil (Laughlin David et al., 2021). These assessments do have the capabilities of increasing engagement in the classroom but there are some limitations that they possess which are still being researched (Asniza et al., 2021).

Statement of the Problem

The first thing the research will be looking at is how scores are affected when students are given an assessment virtually compared to paper and pencil. The study will also show how students perceived the level of difficulty on their respective exams. Half of the students will be given a paper assessment while the other half receive the same assessment virtually on a Google Form. Some of the questions on the assessment will not require work to be shown to properly answer it and the rest of the questions will best be answered by showing work on a separate piece of paper. The study will look at the relationship between types of questions and number correct on the two assessments modes.

Purpose of the Study

All teachers want to be sure that they are getting proper assessment data on students' level of learning mastery. Assessments are created to hopefully give the proper information about what students know and what they still need to work on. It's crucial to know if the mode of assessment affects the accuracy of the data that comes from it. This study will hopefully determine if virtual or online assessments can be given to students and still maintain their validity. It will look at the scores each student receives on the assessment and the level of difficulty that the student perceived the assessment to be. The goal of the study is for teachers to be able to make educated decisions on the mode of assessment that they use and whether or not

the results will be accurate. The results should also help teachers see if regardless of the scores students get, whether they felt like a particular assessment was tougher than the other. Hopefully, this study will help educators see how our assessment strategies, both old and new, can be used effectively and give the accurate data that teachers need.

Research Question

For middle school math students, how do online assessments compared to paper assessments affect student's learning outcomes?

Definition of Variables

Mode of Assessment: The mode of the assessment is the dependent variable. Students will be given assessments with the exact same questions, but one will be paper and pencil and the other will be a Google Form. Both groups will be given a survey to also determine how students perceived the difficulty of the assessment they were given.

Scores of Assessments: The questions asked on the math assessment will be the independent variable. All students will be asked the same questions on their respective assessment and then take a survey about the difficulties of their assessment.

Significance of the Study

The education world was changed forever when the COVID-19 pandemic hit. As the pandemic restrictions lift, one of the most prominent changes that continues in the classroom today is the use of virtual assessments that were so crucial during the fully virtual lessons. Now that these assessments are being used every day, it's important to understand whether these assessments are as effective as the traditional paper pencil assessments in a middle school mathematics classroom. The study aims to determine the efficacy of these assessments and even determine if there is a type of question that is better to ask on virtual assessments. Since the

pandemic is still recent, the number of studies on this topic are not plentiful and if there are studies on this, they are not conducted in a middle school mathematics classroom.

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 seek from the school district where the research project will be take place (See Appendix D).

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 (See Appendix X) 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 his 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

There are some limitations to the study. The first is the population of students that will be studied. The students who will take part in the study will be in seventh or eighth grade so the results may not be able to be applied to all levels of middle school students. Further, the seventh-

grade classes who will participate are all part of the accelerated math program so it may not apply to the traditionally tracked seventh grade students. The eighth-grade students are on the traditional track.

Conclusion

This chapter discussed why this study is occurring and the importance of the results it will provide. Assessment is one of the most powerful tools that educators can use to determine where students are at in their learning process. It's crucial to know how effective the assessments are and whether the data they provide is accurate. The results of this study will hopefully provide all teachers with more information to make the decision of what mode of assessment to give based on the types of questions being asked. The next chapter discusses the research that's been done on virtual assessments, how COVID has impacted it, the benefits and shortcomings, and how students perceive these assessments.

Chapter 2

Literature Review

With the Covid-19 pandemic, schools and educational institutions across the country and world had to adjust their methods of teaching and learning to fit an online environment, many times without proper training (Byrne et al. 2021). As a result, assessments that used to be given in a traditional paper-pencil format have now been adopted to fit an online platform while trying to maintain its integrity (Morgan et al. 2021). In this post-pandemic life with schools adjusting to a new normal, the question about how to best assess our students' learning remains along with whether or not assessing a student using a virtual program can add an unintended barrier to demonstrating a mastery of learning.

Student Assessment of Learning

Wilsey et al. (2020) researched middle school teachers' ideas of assessment. One issue that's facing teachers in regard to assessment is that teachers and administrators all have different ideas of what it is and how it should be used. Used incorrectly, assessment won't provide accurate pictures of student knowledge and will only create anxiety for the students who are taking them (Wilsey et al., 2020). This shows the need for schools as a whole to come to a common consensus about the purposes of their assessments. In all types of assessment, the types of questions used is crucial to making sure the data being collected accurately shows what a student knows. After studying middle school math practices, Beesley et al. (2018) found that students feel they are judged and assessed more on their innate ability to do math rather than how much they improve. Part of the reason for this feeling is the emphasis on right answers rather than correct strategies. In order for teachers to get proper data about student learning, students shouldn't feel defeated before they even start an assessment which may happen when only

correct answers are rewarded. To change this, teachers should focus on the feedback that they give to students and make sure the students feel empowered by the assessment process (Beesley et al., 2018).

As stated before, throughout the literature, there are varying definitions of what defines formative and summative assessment but, the purpose of each remains clear. Barton (2018) believes that rather than calling it formative assessment, we should instead call it “responsive teaching” (p. 34). With that name, it’s clearer what the role of formative assessment should be: using students’ evidence to guide our teaching. Teachers should use formative assessment to help elicit student thinking and determine where there may be gaps in learning and then guide their instruction accordingly. Another view of formative assessment is presented by Jones et al. (2018) who states formative assessment “operates as a feedback loop in which teachers and students play active, distinctive, yet complementary roles in enabling learning” (pp. 78-79). This pulls together many of the key ideas found about assessment in that it’s a continuous loop where both the students and teachers play active roles. Even with the definition coming more into focus, what this looks like is different in every classroom. Whether it’s using specific and guided multiple-choice questions or with conversations with students, assessment is a powerful tool if utilized correctly (Jones et al., 2018).

Types

General. One of the key components to all assessments is the types of questions that are asked. Shaw et al. (2019) states, “Traditionally, to assess student knowledge, we examine a student’s ability to recall information... or recognize information...” (p. 124). This begs us to ask the question if we are genuinely asking students to have a strong understanding and mastery of the topic or if we are simply asking them to recognize a correct response? If the goal of

assessment is to see where student learning is at, asking questions where students must recognize information might give a skewed idea of where they are at in their learning. Teachers should ask questions that force students to recall information and engage with the learning to accurately get a good picture of where the student is at (Shaw et al., 2019). Caspari-Sadeghi et al. (2021) studied the multiple-choice question which is common in assessments. After some analysis of the questions used in university courses, they showed that “90% of MCQ [multiple choice questions] generated by instructors targeted the lowest two levels of the Bloom’s Taxonomy” (p. 3). These multiple-choice questions also have a hard time measuring high-level knowledge and understanding. This shows the need to shift our assessment practices in order to get at eliciting higher levels of thinking (Caspari-Sadeghi et al., 2021).

Hickey and Harris (2021) discussed types of assessment with different grading practices to help elicit accurate student data. In regard to getting data from a summative assessments, it’s important to also make sure that questions given on summative assessment are different than the ones found on the formative assessment. Instead, assessments should be well aligned with each other to provide students with support between assessments but not too much where the results are skewed with a student’s ability to recall past assessment answers and processes (Hickey & Harris, 2021). Different assessments should be administered across the levels to give students new ways to engage in the content being presented as well. With these practices in place, teachers can engage their students in learning and get student data that accurately shows their levels of learning over various times in the course (Hickey & Harris, 2021).

Mathematics. As teachers are working on providing accurate math assessments, some commonalities emerge from the research as to what questions are being asked. Pelkola et al. (2018) finds that in many math assessments, students are asked questions that are procedural

based rather than conceptual. This means students are more often asked to recall and mimic a procedure rather than apply a concept to a new type of problem. The problem with this is that students may be able to pass the assessment with only a surface level understanding of the topic being assessed. Kinnear et al. (2020) also studied the types of questions used in math assessments and found similar results. In the United Kingdom, Kinnear found that most tests administered in higher education institutions were closed book tests and mainly assessed routine. Based on these results, he then used ideas from Bloom's Taxonomy which were translated into math specifics to help gauge the levels of questions being asked. This MATH taxonomy can be used to help break apart assessments and determine what questions can be adjusted to make a stronger test. This tool could be pivotal for assisting instructors with creation of assessments that both accurately elicit student understanding and ask them to apply higher levels of thinking (Kinnear et al., 2020).

Online Assessment

Transition—COVID

Part of the reason for this action research is a result of the COVID-19 pandemic and the major shift to online learning. Pu and Xu (2021) studied the shifting thought processes that resulted from Chinese teachers transitioning to online learning. Before the pandemic, teachers were mostly in line with the purpose of assessment which was to guide student learning and teacher instruction (Pu & Xu, 2021). Once the shift to online came though, the focus of the teachers was mostly on instruction rather than assessment. It wasn't until weeks into the semester that teachers finally realized that they didn't have any evidence of student learning. It was found that in an online setting, teachers didn't know how to implement assessment like they did in a

face-to-face setting. Upon further analysis, it was determined that the lack of online assessment knowledge came from a lack of understanding how online assessments work (Pu & Xu, 2021).

Byrne et al. (2021) states that the lack of understanding of online assessment was apparent again. They found that Graduate School instructors had a lack of online teaching knowledge. The school then tried to help remedy that situation but wasn't successful in providing those instructors with meaningful tools and information to bring transformative assessments to their work. Another study by Morgan et al. (2021) found that a pharmacy school during the pandemic grappled with how to continue their high integrity tests over a virtual format. The methods the school tried included proctored exams over zoom and un-proctored exams with a time limit. In these scenarios, the students reported that adding an additional technological piece to the already high stakes tests added more stress and complications due to technology issues. 31% of students felt that their test scores went down because of the added technology pieces (Morgan et al., 2021). Overall, the shift to online learning seemed to bring out the gaps in assessment knowledge among instructors.

Guidelines for Online Assessment

With the shift to online assessments, it's important to understand some of the many benefits that the online modality presents. Mahapatra (2021) states that offering feedback to students after an online assessment is essential and one of the biggest concerns with the shift to online teaching. One benefit found is that giving and receiving feedback was much more accessible to all learners in online settings. This feedback can be written or recorded (both audio and/or visual). Having quick feedback was shown to help motivate learners to continue to learn and grow (Mahapatra, 2021). The study also found that there were aspects of the formative assessment that needed improvement but that was expected because most teachers had no formal

training in using online assessment. This shows that with further education, additional benefits on top of the fast feedback could be utilized in the future with online assessment (Mahapatra, 2021). A study by Ma et al. (2021) also emphasized the importance of feedback in an online setting. Because feedback is so crucial in an online assessment, they found that students may need some training and scaffolding in order to know how to use the feedback given to further their learning. Once students knew how to use the feedback though, they perceived the online feedback loop positively (Ma et al., 2021).

The emphasis on feedback was also prevalent in a study by Luckritz Marquis (2021). They state different benefits that arose due to online capabilities. The first is that feedback is instant and more frequent. Students at times can now immediately find out if their answer or process is correct helping to stop some deep-rooted misconceptions that can appear with slower feedback responses. Online assessment can also provide many different ways for students to show their learning rather than the traditional multiple-choice and short answer modes (Luckritz Marquis, 2021). With these benefits, teachers are now better able to build a stronger, more equitable class for their students that engage them in learning and builds students' abilities to self-reflect on their educational goals (Luckritz Marquis, 2021).

Gaming

Another possibility for web-based assessments is with the use of computer or tablet applications and games. These types of assessments and practice can help foster student engagement. One popular game-based assessment was studied by Asniza et al. (2021) and analyzed student perceptions after using a website called Kahoot! which is a multiple-choice competition quiz software where students answer questions on their own devices. After implementing Kahoot! regularly in a biology classroom, they found that students had positive

perceptions of the active approach that Kahoot! offered and increased engagement overall. While the student's perception of Kahoot! was overwhelmingly positive, teachers found that it was very tough to track student's individual progress. This shows that Kahoot! is beneficial to increase student engagement but has its specific uses in the realm of formative assessment (Asniza et al., 2021).

Cayton-Hodges et al. (2015) also attempted to increase student engagement through online applications. They researched the use of tablet-based applications to help reinforce math concepts previously taught. The introduction of tablets to schools opens a slew of possibilities for student interaction and connection. With the rising popularity, the authors looked at specific applications to determine if they provided students with a rich mathematics experience or if they were strictly a game without much learning tied to it. What they found was that many of the mathematic applications had inadequacies in the accuracy and the richness of the mathematics content it portrayed (Cayton-Hodges et al., 2015). With that information in mind, Cayton-Hodges et al. (2015) state that these applications on tablets have the potential to be beneficial in the classroom. It's first recommended to preview all applications you give to students and then provide supplemental material like scaffolds, self-reflections, or student explanation of the problems completed in order to make maximize the learning and engagement among students.

Barriers

While there are many benefits to online assessments, there also are some barriers that need to be considered. One barrier is presented by Alshwiah (2021). In this study, it was found that the lack of education for the teachers resulted in barriers for students. Before the pandemic, teachers had very minimal training and experience with online formats of assessment. Teachers then took their knowledge of face-to-face assessment and transitioned it to an online mode which

doesn't transfer seamlessly. Because of that, students had trouble showing their level of learning on the assessments (Alshwiah, 2021). Another barrier researched by Van and Hi (2021) is the access to internet at home. Many students around the world and in the United States don't have high speed internet at their residences. Therefore, if assessments were expected to be completed outside of school hours, students without high-speed internet could not access the assessments and therefore could not show their learning (Van & Hi, 2021).

Laughlin Davis et al. (2021) reviewed specific math software to hopefully find a suitable replacement for paper-pencil assessments in math. They researched software called FluidMath which allowed students to use touch screen capabilities to show their work on their devices as they would on paper. While students reported feeling like FluidMath was better than online math assessments using keyboards, they still stated that paper pencil was more favorable than showing their work using a touchscreen. One of the roadblocks that students found was that it was tougher to erase work and navigate FluidMath compared to a paper-pencil assessment. Even though they received instructions prior to the test, the students found that technical difficulties and challenges with navigation were reasons to favor paper and pencil (Laughlin David et al., 2021).

Theoretical Framework

The question of how students learn best and how they are able to show that learning is best explained by a constructivist theory. This theory states that knowledge is not able to be obtained through passive means. Rather, people learn best by taking an active and engaging role in learning (Grady et al., 2012). Constructivism argues that students take their knowledge and apply it to new situations where they can find the connections. This connects to assessment because students need to have an assessment that allows them to make those connections and be able to show them. Steffe (2016) states that teachers must create environments and assessments

that bring out those connections for students. This shows the importance of assessment in the world of teaching and learning. If an assessment doesn't bring out those connections, the student isn't able to accurately show their level of learning. Further, if making an assessment virtual creates one of those barriers to demonstration of mastery, teachers need to be cognizant of their use of virtual assessment. Constructivism helps bring out the importance that assessment plays in the eyes of students because of the importance of connection.

Research Question

For middle school math students, how do online assessments compared to paper assessments affect my student's learning outcomes?

Conclusion

Research on online assessments in middle school mathematics classrooms is scarce, but the research on assessments (both traditional and online) show that there is a time and place for online assessments. It's first crucial to make sure there is strong assessment validity, and that the assessment accurately reflects the outcomes being assessed. From the research, it seems that there are many benefits but also some roadblocks when using online assessment. We need to be sure that internet access is available to students and the software usability doesn't prevent a student from showing content mastery. This action research will hopefully show a connection to type of question and roadblocks to demonstration of mastery in an online or virtual assessment. The next chapter will show how this conclusion will be measured, interpreted, and used.

Chapter 3

Methods

With technological advancements and the COVID-19 pandemic, the use of virtual and online assessments has increased. The necessity for using online assessments throughout the pandemic brought to light a lot of benefits and potential downfalls that those assessments provide. Studies showed that online assessments provided the opportunity to give quality feedback more equitably and quicker but still, a majority of students preferred working with a pencil and paper compared to online software (Laughlin David et al., 2021; Mahapatra, 2021). While those aspects are apparent, one part of virtual assessments that hasn't been researched much is the effect of these assessments on the outcomes of middle school math students. This study will look at those effects on a student's demonstration mastery on a formative assessment. Students will be given an assessment either on paper or on a Google Form. Regardless of the assessment mode that they are given, the students will all answer the exact same questions. After both assessments, students will answer a survey which will help show how difficult the student perceived their assessment. The results of this study will hopefully help educators make informed decisions about the type of assessment they use to guide their teaching.

Research Question

For middle school math students, how do online assessments compared to paper assessments affect student's learning outcomes?

Research Design

The experiment will utilize a random selection design amongst all the researcher's classes. For each of the participating five classes, students will be randomly selected to determine which ones will be taking the paper/ pencil assessment and which ones will be in the

experimental group of taking the assessment on a Google Form. This design will hopefully allow the data to be as accurate as possible because there won't be the possible unintentional skewing of data by the researcher picking the groups. Students in both groups will take the same survey after their respective assessment is complete.

Setting

The setting of the research study will take place at a middle school in north central Minnesota. The city is located in rural Minnesota but has a population of about 20000 people. The area is known for outdoor recreation and is common for vacations during the summer – tourism is a large part of the summer economy. The school district is comprised of six elementary schools, one middle school, one high school, and three alternative education sites and educates about 6700 students overall. The middle school has a population of 1895 students. Of those students, 91% identify as white, 2% identify as American Indian, 2% identify as Hispanic, 1% identify as black, and 4% identify as having more than one ethnicity. 25% of the students qualify for free lunch and 11% qualify for reduced lunch.

Participants

The participants in this study will be 149 algebra students divided into five different classes. Two of the classes, comprised of 52 students, are eighth graders on the traditional math track taking the grade level math course. The other 97 students divided into three classes are seventh graders all in the accelerated math track. Seven of the students have been identified as having a learning or behavioral disability according to the Americans with Disabilities Act.

Sampling

All of algebra students in the co-investigator's classes that give consent will be a part of this study. No consenting student will be excluded from the study. Students will be randomized to determine which assessment they take.

Instrumentation

To measure the desired data, students will be given an assessment either on paper or on Google Form. Regardless of the assessment that a student is given, the questions on the assessments will be the exact same. The students' assessments will be graded using the same key and standards. After students are done with the math assessment, they will all complete a paper survey to help determine how difficult the students perceived the math assessment. The results of all of those should help determine if students score lower on a specific assessment and whether or not students thought a specific assessment was more challenging.

Data Collection

Data will be collected from the number of correct answers that a student answers on their respective math assessments. The mean and p-score of both assessments will be compared to determine how the scores differ. Students will also take an assessment on their opinions on the difficulty of their assessment. That assessment will be given as a Google Form and the mode of the student's answers will be analyzed to determine if one assessment was perceived to be tougher than the other.

Data Analysis

For the quantitative portion of the data, the mean and the p-score of the students' scores will be analyzed to determine if there is a difference between the two assessment scores. For the

survey that students take afterwards, data will be analyzed and organized into graphs and charts to see if any trends present themselves.

Research Question and System Alignment

Table 3.1

Research Question Alignment

Research Question	Variables	Design	Instrument	Validity & Reliability	Technique (e.g., interview)	Source
For middle school math students, how do online assessments compared to paper assessments affect my student's learning outcomes?	DV: The dependent variable is the mode of assessment. The two modes will be paper/pencil or via Google Form IV: The independent variable are the questions on the two assessments. Regardless of modality, students will be asked the same questions on both assessments.	The research will follow a random selection design. Students will be randomly assigned which mode of assessment they will take.	The scores on the respective assessments will be the data collected for the quantitative study. After the math assessment, students will take a survey asking about the difficulty of their assessments; that will be the data for the qualitative portion.	The scores students score on the multiple-choice assessment will be the data along with the student's feelings about the test from the post survey. Both quantitative and qualitative data on the Google Form assessment will be compared to the data from the paper/pencil assessments.	Students will take a standard multiple-choice assessment and survey.	The students chosen will be from the co-investigator's 7 th and 8 th grade algebra students. All students that are given consent from guardians will participate.

Procedures

Like all other quizzes, students will know this quiz is coming before they walk into class. As class begins, students will find out which quiz they've been randomized to take. After they know which form of the quiz they are taking, the students will take their respective quizzes and surveys. Students will be given plenty of time to take their quizzes to ensure that the scores show the results of their knowledge and assessment modality rather than a limited time. Once students submit their quizzes, the researcher will grade the paper quizzes and put all data into a spreadsheet to analyze and draw conclusions with.

Ethical Considerations

The risk by participating in these studies for the students is minimal. No student names or identifiers will be used in the study and the data presented will be taken from the whole group and not any one individual. Students take assessments like this frequently so there aren't any added risks to taking a virtual assessment than students encounter on a daily basis.

Conclusion

This chapter discussed the methodology of the study, the participants, and the way data will be collected and analyzed. Through this study, participants will take an assessment either on paper or virtually to determine if the mode of assessment affects a students' outcomes. The next chapter will discuss the results and trends of the study after implementation.

Chapter 4

Results

The purpose of this study is to determine whether giving assessments through an online platform creates barriers for students in showing demonstration of mastery. Another aspect of this study looks at how difficult the study was perceived by the students to determine if there one modality of assessment was perceived to be more challenging. Because of the COVID-19 pandemic, teachers had to adjust their lessons and assessments to be taken virtually because of the constraints of the pandemic on schools. With their rise comes a necessary look at how these relatively new assessment practices effect student achievement. Participants in this study were either given a paper/pencil quiz or a quiz on Google Form. Regardless of the modality of assessment, the questions were all the same. On the day of the study, participants were randomized to determine which mode they would take. All participants were given the same resources such as a calculator, access to notes, and scratch paper regardless of their mode. Once they finished their math assessment, all participants completed a short paper survey to help determine how challenging they perceived the exam and which mode they would prefer to take their assessments in. All students in the researcher's class were given the opportunity to give consent to participate in the study. 107 students participated in the study and were made up of 2 eighth grade algebra and 3 seventh grade accelerated algebra students.

Description of Data

All participants were given a quiz with the same questions in the same order. All the questions were multiple choice as well. The first four problems included questions that could be answered without the need of any showing to properly answer. An example of this question is, "Is pi rational or irrational?" The next four problems included questions that most participants

would likely need to show work to come to the correct answer. An example of this type of question is, “Find the hypotenuse of a right triangle with legs length 12 centimeters and 9 centimeters.” Again, all problems were multiple choice. The results of this study look at the scores that participants received on the overall quizzes and on the scores received on the first four questions versus the last four questions.

The survey taken after the quiz included different questions to help determine the participant’s opinions about assessments. One series of questions asked participants to rate the difficulty of their assessment and then provide a justification for why they rated it that way. The other question asked participants to share which modality they preferred to take. That data was compiled to determine any trends that presented themselves and whether any conclusions could be drawn. Once all quizzes and surveys were completed, the quizzes were graded using the same key. Data from the quizzes were put into a spreadsheet. The means and p-scores were calculated to be compared with each other. The survey results were also compiled into a spreadsheet to better organize and draw conclusions.

Research Question

For middle school math students, how do online assessments compared to paper assessments affect student’s learning outcomes?

Results

Upon looking at all the data, some interesting conclusions were able to be drawn about the scores on the participant’s respective quizzes and their perceptions. While there is only one research question, the researcher will display many different data points that will then be used to draw an overall answer to the research question.

The data presented for this research question will look at the many facets of student learning outcomes. First, the researcher will compare the averages of the overall test scores. Then, the scores from the first four questions on the quiz will be compared between the online and the paper/pencil quizzes. The same thing will be done to questions five through eight as well. After, the average perceived level of difficulty and the preference of assessment modality will be shared as well. See Appendix A for the paper quiz, Appendix B for the Google Form Quiz, and Appendix C for the student survey.

Quiz Scores

Table 4.1 below displays the number of participants, mean, and p-value of the overall scores on the math assessment based on modality. There were 50 participants who took the paper and pencil quiz while 57 took the Google Form. The students were randomized to determine which quiz they took. All students in the researcher's classroom took the assessment regardless of whether their guardians returned the consent form. Because of that, some guardians returned the forms after the quiz had been administered which led to the number participating for the to not be even. All scores displayed in the tables below are rounded to the nearest hundredth if necessary. The mean scores for the 8 questions on the paper/pencil assessment is 7.28 and the mean for the Google Form assessment is 7.29. When comparing the two sources of data, the p-value is 0.94.

Table 4.1

Mean and P-Value for Math Assessment

	Number of Participants	Mean	P-Value (for both)
Paper and Pencil	50	7.28	0.94
Google Form	56	7.29	

Below in table 4.2 is the data comparing the scores participants received on questions one through four. For participants to answer those questions, work would not necessarily have to be shown to answer properly. The mean score on the paper/pencil test for the first four questions was 3.82 and 3.89 for the Google Form. The p-value for those questions is 0.27.

Table 4.2

Mean and P-Value for First Four Questions

	Number of Participants	Mean	P-Value (for both)
Paper and Pencil	50	3.82	0.27
Google Form	56	3.89	

Table 4.3 shows the same information for questions five through 8 which are the questions that require work to be shown for most participants to correctly get an answer. The average score on the paper and pencil assessment is 3.46 and 3.4 for the Google Form quiz. The p-value for that set of questions is 0.67.

Table 4.3

Mean and P-Value for Second Four Questions

	Number of Participants	Mean	P-Value (for both)
Paper and Pencil	50	3.46	0.67
Google Form	56	3.4	

Survey Results

Graph 4.4 displays the results of the first survey question which asked participants to rate the difficulty of their respective assessment. The scale goes from one to ten with one being very easy and ten being very hard. The average of those scores is 2.39 out of ten. 41.1% of students rated the assessment difficulty to be a 1 out of 10 meaning they thought the assessment was easy and 28% of students rated the assessment a 2 out of 10. Therefore, 69.1% of respondents thought the assessment was very easy.

Figure 4.4

Student Rating of Assessment Difficult

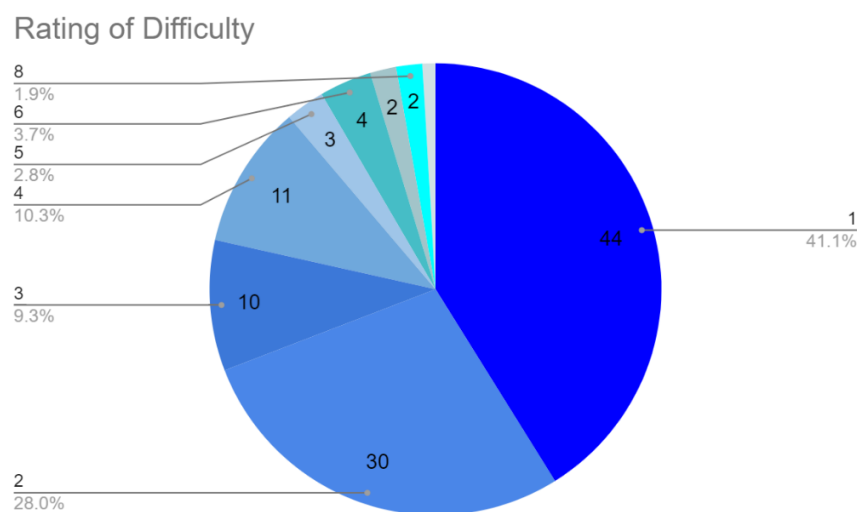


Table 4.5 shows the survey responses for online quiz takers compared to paper/pencil. Participants on average who took the paper/pencil quiz rated the difficulty as 1.96 out of ten while the Google Form respondents rated their assessment a 2.79 out of ten even though they all had the exact same questions. The p-value for those scores is 0.017 showing a strong significance with those averages.

Table 4.5*Paper vs. Online Rating of Difficulty*

	Number of Participants	Mean	P-Value (for both)
Paper and Pencil	50	1.96	0.017
Google Form	56	2.79	

The last question of interest on the survey is what mode participants would prefer to take their assessments on. The data of those responses is shown in table 4.6. Of the 106 respondents, 40 stated that they would prefer to take their assessments on Google Form or another online assessment tool. 58 respondents stated that paper is their preference would be to take their math assessments on paper. Eight participants said that either mode works. That means about 38% of students preferred online assessments, about 56% prefer paper, and about 8% said either assessment mode is preferable. The participants in the researcher's classroom are composed of two classes of 8th grade algebra students on the traditional math track and three classes of seventh graders in the accelerated math track. When the data is split between those two groups, 37% of seventh graders and 39% of the eighth graders stated that they would prefer to take the Google Form test.

Table 4.6*Student Preference of Assessment Modality*

	Prefer to take Online (such as Google Form)	Prefer to take on Paper	Either Mode
Preference	40	58	8

Conclusion

The data from the quiz scores shows that students' scores were not majorly affected by the modality of their quiz. Those results make an argument that either mode of assessment is effective and could be used in a middle school math classroom and still hold its validity. But, upon looking at the results from the survey, even though scores weren't affected, the perception of difficulty was higher with the participants that took the Google Form quiz. Even though those students scored the same as their counterparts did, their perception was that their assessment was more challenging. With the perceived level of difficulty being easy for most students, further research is needed to determine how these results would look if the assessment was considered to be more challenging.

With that in mind, a majority (56%) of participants stated that they would prefer to take a test with paper and pencil rather than online. While that is a majority, 43% of students still stated that the online assessment is either their preference or feel unaffected by which mode their assessment it. All this data shows that both assessment practices could and probably should be used in middle school mathematics classrooms in order to help reach the diverse needs of all students with many forms of assessment. More research would also be needed to determine if this data is true for students who take part in intervention math classes as well because this data followed students in mainstream and accelerated settings.

Chapter 5

Implications For Practice

Action Plan

With the conclusion of this research, the researcher plans to continue to use both paper/pencil as well as online assessments in their classroom. This way, the researcher will be able to better meet the needs of all students with the knowledge that the assessment's validity still holds. The researcher also plans to continue action research in their school in order to help determine if the results of this study carry over into open ended questions rather than only multiple choice, with students who receive intervention services, and with more challenging questions throughout the assessment. This data does give a starting point at better understanding the way that online assessments effect students. Where possible, the researcher also plans to allow choice of assessment mode to their students to best fit their needs.

Plan for Sharing

The school that the researcher works in has a strong focus on collaboration by participating in Professional Learning Communities and curriculum cohorts. Through those functions, the researcher plans to share their findings with coworkers to help all teachers provide the best possible learning environment for their students. On top of sharing with coworkers, the researcher will take steps to get the research presented to teachers across the world. Those steps include possible publication, posting to online professional learning communities, and presenting at educational or research seminars. Any further research completed by the researcher will also be shared with coworkers to and other professionals to help all teachers better understand how students show their demonstration of mastery most effectively.

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Appendix A
Paper Math Assessment for Students

Classifying Numbers and the Pythagorean Theorem Quiz

Name: _____

Hour: _____

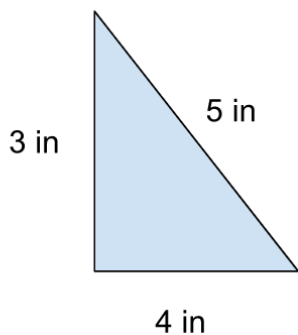
Directions For problems 1-3, classify each number as **rational** or **irrational** (1 point each)

1. $\sqrt{49}$

2. $\frac{21}{5}$

3. π

4. Consider the triangle below. Which value represents the hypotenuse?



A. 3 in

B. 4 in

C. 5 in

D. There isn't a hypotenuse

5. Solve the following equation. Remember, there are two answers to this equation.

$$x^2 = 4$$

A. $x = 2$

B. $x = 16, -16$

C. $x = 2, -2$

D. $x = 4, -4$

6. Solve the following equation. Remember, there are two answers to this equation.

$$h^2 - 7 = 18$$

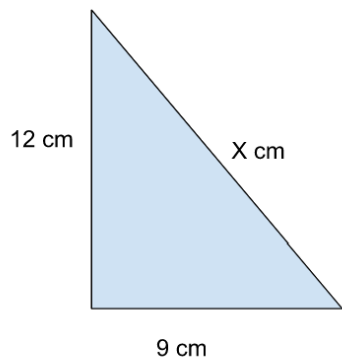
A. $h = \sqrt{11}$

B. $h = 5, -5$

C. $h = 5$

D. $h = 25$

7. Given the triangle below, use the Pythagorean Theorem to find the measure of the **hypotenuse**.



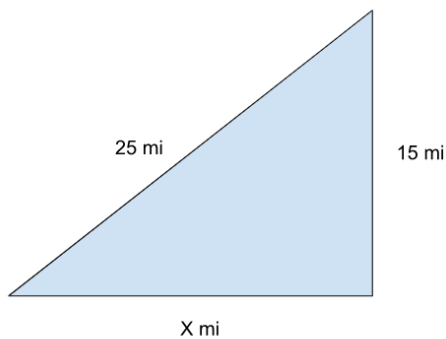
A. $\sqrt{21}$ cm

B. 15 cm

C. $\sqrt{225}$ cm

D. 15 in

8. Given the triangle below, use the Pythagorean Theorem to find the measure of the missing **leg**.



A. $\sqrt{850}$ mi

B. 20 mi

C. 29.15 mi

D. $\sqrt{400}$ mi

Appendix B

Google Form Math Assessment

Classifying Numbers and the Pythagorean Theorem Quiz

* Required

1. Email *

2. First Name *

3. Last Name *

4. Hour *
- Mark only one oval.
- 1st Hour
 - 2nd Hour
 - 3rd Hour
 - 4th Hour
 - 7th Hour

$\sqrt{49}$
Mark only one oval.

- Rational
- Irrational

6. Classify the following number as **Rational** or **Irrational** * 1 point

$\frac{21}{5}$
Mark only one oval.

- Rational
- Irrational

7. Classify the following number as **Rational** or **Irrational** * 1 point

π
Mark only one oval.

- Rational
- Irrational

https://docs.google.com/forms/d/1BKwYtS_wgeYJ-UZcmORIBkSIYog4xhQooY0Z-8c/edit

1/7

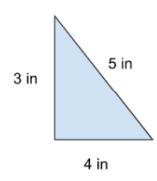
https://docs.google.com/forms/d/1BKwYtS_wgeYJ-UZcmORIBkSIYog4xhQooY0Z-8c/edit

2/7

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Classifying Numbers and the Pythagorean Theorem Quiz

8. Consider the triangle below. Which value represents the hypotenuse? * 1 point



- Mark only one oval.
- 3 in
 - 4 in
 - 5 in
 - There isn't a hypotenuse

9. Solve the following equation. Remember, there are two answers to this equation. * 1 point

$x^2 = 4$
Mark only one oval.

- x = 2
- x = 16, -16
- x = 2, -2
- x = 4, -4

3/15/23, 4:03 PM

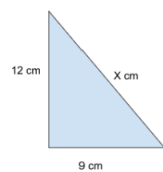
Classifying Numbers and the Pythagorean Theorem Quiz

10. Solve the following equation. Remember, there are two answers to this equation. * 1 point

$h^2 - 7 = 18$
Mark only one oval.

$h = \sqrt{11}$	$h = 5, -5$
<input type="radio"/> A	<input type="radio"/> B
$h = 5$	$h = 25$
<input type="radio"/> C	<input type="radio"/> D

11. Given the triangle below, use the Pythagorean Theorem to find the measure of the **hypotenuse**. * 1 point



Mark only one oval.

$\sqrt{21} \text{ cm}$	15 cm
------------------------	-----------------

A

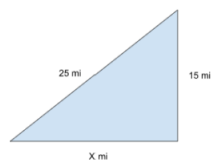
B

$\sqrt{225} \text{ cm}$	15 in
-------------------------	-----------------

C

D

12. Given the triangle below, use the Pythagorean Theorem to find the measure of the missing **leg**. Write your answer rounded to the nearest hundredth (if necessary) * 1 point



Mark only one oval.

$\sqrt{850} \text{ mi}$	20 mi
-------------------------	-----------------

A

B

29.15 mi	$\sqrt{400} \text{ mi}$
--------------------	-------------------------

C

D

Appendix C

Student Survey

Quiz Survey

Name: _____

Please answer the following questions about the quiz you just took. This will not be graded so please be as honest as you can while answering this survey.

1. Which quiz did you take?

- a. Google Form
- b. Paper and Pencil

2. On a scale of 1 - 10 (1 being easy, 10 being hard) how hard would you rate the quiz you just took?

Easy 1 — 2 — 3 — 4 — 5 — 6 — 7 — 8 — 9 — 10 Hard

3. Why did you rate the level of difficulty the way you did?

4. How would you prefer to take a quiz like this?

- a. On Paper
- b. Online (like with a Google Form)
- c. Another way (please list which you'd prefer) _____

Appendix D

Signed Consent Form

Informed Consent for Participation in an Action Research Study

Title: Comparing Online and Traditional Practices in Middle School Mathematics

Purpose: The purpose of this study is to determine if giving a math assessment in an online or virtual format creates a roadblock for students in showing their demonstration of mastery of content.

Study Information: The study will compare the test scores of students who receive the questions on a math topic but half will take the assessment with paper and pencil and the other half will take it on Google Forms. After students take the assessment in their respective format, they will also take a short survey which will help determine how hard they thought their assessment was. The goal is determine if the scores differ between the two assessments and whether students perceive one assessment to be tougher than the other.

Time: Students will complete the assessment for the study during their regularly scheduled algebra class throughout the spring semester of 2023.

Risks: The risks associated with this study are very minimal.

Benefits: The data from this study will help their teachers use online assessments properly to help ensure that the grades received from the assessments will be accurate.

Confidentiality: Personal participant information will only be shared with the principal investigator, Dr. Kathy Enger, and the co-investigator, Maxwell Krueger. Participant names will be recorded using pre-assigned numbers instead of their names.

Participation and Withdrawal: Participation in the study is completely voluntary. Participants can choose to withdraw from the study at any time without any risk of penalty of grades, relationship to instructor, or relationship with the school.

Contact: Any questions or concerns regarding the study can be forwarded to the following individuals

Maxwell Krueger

Co-Investigator

Ph. (218) 454- 6672

Email: maxwell.krueger@isd181.org

Dr. Kathy Enger, Ph. D

Principle Investigator

School of Teaching and Learning

College of Education and Human Services

Minnesota State University Moorhead

Email: Kathy.enger@mnstate.edu

Any questions about your rights may be directed to Dr. Robert Nava Ph. D., Chair of the MSUM Institutional Review Board, at 218-477-4308 or by robert.nava@mnstate.edu. You will be given a copy of this form to keep.

“I have been informed of the study details and understand what participating in the study means. I understand that my child’s identity will be protected and that he/she can choose to stop participating in the study at any time. By signing this form, I am agreeing to allow my child to participate in the study. I am at least 18 years of age or older.”

Name of Child (Printed): _____

Parent/Guardian Signature: _____ Date: _____

Signature of Investigator : _____ Date: _____