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# Flipping the Focus: Flipped Learning in a Geometry Classroom

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# Flipping the Focus: Flipped Learning in a Geometry Classroom

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# INTRODUCTION

## Introduction

As a teacher, I experience the daily pressure to connect with each individual student no matter his or her level of understanding or preferred learning style. This pressure to individualize instruction and attain mastery of all the required standards within the given constraints of the classroom setting, including time and support, can be frustrating, overwhelming, and impossible to overcome. Currently, the focus of the classroom is to provide students with a basic understanding of the material and then students are to practice that material with increasing difficulty. Flipped instruction changes that focus of the classroom to be one that is student-centered, where students are actively engaged in their learning while in class to receive any needed support. I believe that the flipped instruction model will grant me more time to engage students in a differentiated, collaborative, and active learning experience that will enhance student learning, understanding, and retention. With this type of instruction, I suspect that students will receive more personalized learning and in-class support compared to the traditional instructional method of teacher-lecture, which will lead to increased achievement and success in the geometry course of which I teach.

## Brief Literature Review

Flipped instruction is becoming an increasingly popular method of instruction used in mathematics classrooms. Flipped instruction means that students receive the direct instruction portion of a lesson outside of class time and then use the class time to enhance the understanding and practice that content. The literature and research suggest that flipped instruction may not have any statistically significant difference in test scores reported. However, the literature also indicates positive student, teacher, and parent attitudes and perceptions about this idea of a flipped classroom. According to various studies, flipped learning can increase student engagement, reduce student stress and anxiety regarding the material, and increase student confidence and motivation.

**Statement of the Problem**

In the current teaching field, there are many perceptions as to what the best practices are for increasing student success and engagement, among others. The problem is that there is an overwhelming amount of opinions as to what works best for varying types of learners and classrooms. It is important to find what works best for your classroom and your students. With a flipped classroom model, there is much more class time available to engage students in various activities and tasks. For example, without flipped learning teachers may spend thirty minutes on direct instruction where students are passively learning at best and in a fifty-minute class period, this is a significant amount of time. If there was flipped instruction in place, students would be able to be actively involved in their learning the entire class period engaging in group discussions and working through problems collaboratively, while having the opportunity to work in smaller groups with the teacher and receive a more individualized learning experience.

**Purpose of the Study**

In classrooms today, teachers are expected to increase student engagement, retention, and achievement through the use of individualized and differentiated instruction as well as applicable technology. Meanwhile, time constraints with students and the lack of teacher support and preparation time make these expectations increasingly challenging. The objective of my experimental study will be to determine if the use of a flipped instruction model will assist teachers with meeting these expectations and lead to enhanced student understanding. The intention of a flipped classroom is to give teachers adequate time to achieve all of these expectations within the allotted classroom period as well as to allow students the opportunity to engage in critical thinking activities among other enrichment exercises to facilitate higher-level understanding.

**Research Question**

What is the impact of a flipped instruction model compared to traditional teacher-lecture on student performance, student retention level, and student attitude toward learning geometric concepts among high school geometry students?

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

Independent Variable- Flipped instruction model: The flipped instruction model aims “to improve student engagement and performance by moving the lecture outside the classroom via technology and moving homework and exercises with concepts inside the classroom via learning activities” (Clark, 2015).

Traditional instruction model: The traditional instruction model is teacher-centered and mostly comprised of direct instruction, including teacher-led lectures (*Teaching Methods*, n.d.).

Dependent Variable- Student performance: Student performance is the observable and measurable behavior, including assessment scores, of a student (Yusuf, n.d.).

Dependent Variable- Student retention level: Student retention level refers to the ability for students to remember and recall previously discussed content (Gaines, 2001).

Dependent Variable- Student attitude toward learning geometric concepts: Student attitude is the “measure of students’ positive and negative feelings toward the subject” of geometry (Evans, 2007).

High school geometry students: High school geometry students refer to people currently enrolled in a high school geometry course.

**Significance of the Study**

As a practicing educator, it is important to always provide students with the best opportunity for success in the classroom and beyond. Best teaching practices are an ever evolving concept with a plethora of opinions. I believe it is imperative to find a teaching style that works for the individual teacher and the majority of the students. I believe that implementing the flipped instruction model will provide me with more flexibility to diversify the time I have with students in class in hopes of reaching more students and learning styles. My hope is that participants of this study will feel less stress about the course since there is more time for questions, help, and general support within class time using this method of teaching compared to the traditional teaching model. It is also my understanding that colleges are increasingly utilizing computer-based instruction for introductory mathematics courses, so I feel that students would benefit from being acquainted with this type of learning prior to post-secondary schooling.

**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).

**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 her teaching practice. Informed consent means that the parents of participants have been fully informed of the purpose and procedures of the study for which consent is sought and that parents understand and agree, in writing, to their child participating in the study (Rothstein & Johnson, 2014). Confidentiality will be protected through the use of pseudonyms (e.g., Student 1) without the utilization of any identifying information. The choice to participate or withdraw at any time will be outlined both, verbally and in writing.

**Limitations.** There is the possibility that the two groups will be comprised of varying numbers, abilities, demographics, and other factors that cannot be controlled.

## Conclusions

As a teacher, there is constant pressure to reach all of the standards, all of the students, all of the varying student abilities, and all of the different learning styles each and every day. While there is good intention with all of this pressure, it is completely overwhelming. I believe the flipped instruction model will provide more time in class to reach all of these needs and alleviate some of the pressure. The next chapter provides a brief overview of the current literature regarding flipped instruction and traditional teaching methods as well as student performance, retention level, and attitude.

# CHAPTER 2

# LITERATURE REVIEW

## Introduction

This study focuses on the impact flipped instruction has on student performance, student retention level, and student attitude about learning compared to the traditional teacher-lecture instruction method. This study could shed light into a new best practice for teaching mathematics and relieve teachers and students of some of the stress related to the traditional teaching model. Previously, teachers have had little time to include meaningful activities that help students deepen understanding due to time constraints and students are left to struggle with the work at home with no support. Flipped instruction allows for more time in class for teachers to diversify learning experiences, create meaningful learning opportunities, and support all learners.

## Body of the Review

### Context.

Clark (2015) conducted a study on utilizing a flipped method of instruction to determine the impact on student performance and engagement in an Algebra I classroom. The purpose of this study was to implement the flipped method of instruction in hopes of increasing student engagement, performance, and interaction compared to those students in a classroom with a traditional method of instruction. In regards to academic performance, there were no significant differences noted between those students taught using flipped instruction and those in the traditional classroom experience; however, the learning environment of the two methods of instruction were described differently by students. Students noted their appreciation of the quality of instruction, use of class time, and the ability to collaborate and communicate with peers and teachers that the flipped model of instruction allowed. According to these students, all of these factors lead to their increased engagement and active participation in the flipped classroom (Clark, 2015).

D'addato and Miller (2016) study found that the flipped classroom led to self-motivated, confident, and enthusiastic students. The role of these students changed from passive learners to students who are actively engaged in their learning. This increased engagement included collaborating with peers, being focused and on-task during activities, and overall responsibility and involvement with their educational experience. All of these attributes led to a more in-depth understanding of the mathematical concepts through the student-centered focus of flipped instruction. Parents reported that they felt flipped learning was a positive experience for both them and their students, including a decreased sense of stress related to homework (D'addato & Miller).

**Flipped v. Traditional.** "Flipped Learning is a pedagogical approach in which direct instruction moves from the group learning space to the individual learning space, and the resulting group space is transformed into a dynamic, interactive learning environment where the educator guides students as they apply concepts and engage creatively in the subject matter" (Definition of Flipped Learning, 2014). The flipped instruction model aims to utilize more class time for engaging students in enriching learning experiences that are driven by student curiosity (Teehan, 2016). The teacher is seen as a facilitator of learning in this environment and students are able to work collaboratively with others while actively learning (Albanese & Bush, 2015). Since the lecture has been removed from class, educators are better able to build relationships with students and interact on a more individualized level by having more time available due to the flipped instruction (Tucker, 2012).

Flipped instruction provides a student-centered learning environment in which teachers have a greater insight into student understanding due to the more frequent student/teacher interactions provided. This method of instruction also allows students more opportunities to receive support, especially those students who may be hesitant to ask questions during whole-class instruction (Roehl, Reddy, & Shannon, 2013). These more frequent opportunities to work one-on-one with the teacher should alleviate some of the stress and anxiety that students have when working on math problems.

**Student performance.** The purpose of the study that Casem (2016) conducted was to "determine the effects of flipped instruction on the performance and attitude of high school students in Mathematics" (p.1, 2016). The study found that there was no significant difference in achievement on the posttest between the two methods of instruction. However, the students who received the flipped method of instruction showed more growth from pretest to posttest than the traditionally taught students. Casem contends that this is due to students having more opportunities to work with the teacher and their peers. Furthermore, there does appear to be a slight increase in the confidence in learning math and attitude toward success in math subscales for those students who partook in the flipped instruction. Casem believes the increased positive attitude and boost in confidence stems from not having to worry about missing in-class material, because instruction could be replayed online.

The purpose of Unal and Unal (2017) study was to examine the impacts of flipped instruction on student achievement, perception, and educator satisfaction compared to more traditional methods of instruction. Although no significant differences were found in the scores of the post-test, Unal and Unal noted that, in most cases, students who received flipped instruction showed increased learning growth and teacher satisfaction as well as more positive student perceptions in comparison to those students who worked with a traditional method of instruction. Both the student and teacher survey results showed that both parties were satisfied with the flipped classroom approach, confirming that this type of instruction was inspiring and successful. Teachers reported that they preferred using this method compared to traditional methods, because it is more gratifying, exciting, and motivational. Students stated that the flipped classroom provided more individualized learning as well as more opportunities to collaborate and communicate with peers (Unal & Unal, 2017).

The purpose of Mattis (2015) study was to "investigate flipped classroom instruction versus traditional classroom instruction on learning and cognitive outcomes" (p. 2). Mattis examined these learning and cognitive outcomes by measuring accuracy and mental effort during various degrees of difficulty of the math problems. The results indicate that students who received flipped instruction showed increased accuracy on the post-test compared to those students who received the traditional method of instruction, particularly on moderately complex mathematical questions. Furthermore, highly complex problems took less mental effort for those students who participated in the flipped instruction (Mattis, 2015).

**Student retention level.** Andriotis (2017) defines learning retention as "the process by which new information is transferred from our short term to our long-term memory" (2017) (i.e. being able to recall and remember information as time passes). Terada (2017) explains that students are able to retain more information if they are able to make connections to other concepts. Some of the effective teaching strategies that increase student retention are peer-to-peer explanations, revisiting key concepts throughout the school year, combining various problem types, and providing visual aids. Smith (2019) agrees, stating that as students continue through their education experience, subjects seem to become more disconnected. She further suggests connecting the current content to students' futures as a means to help students retain the information (2019). Cox adds that retention increases when students are able to discuss the concepts and work collaboratively in groups as well as when the current information is related to their prior knowledge and experiences.

The expected outcome for student performance is that students who received the treatment (flipped instruction) will perform better than those students who did not (traditional instruction). The expected outcome for student retention level is that students who received the treatment (flipped instruction) will retain more information after one month after the concepts have been tested than those students who did not (traditional instruction). The expected outcome for student attitude toward learning geometric concepts is that students who received the treatment (flipped instruction) will think more positively about their learning experience than those students who did not (traditional instruction).

**Research Question**

What is the impact of a flipped instruction model compared to traditional teacher-lecture on student performance, student retention level, and student attitude toward learning geometric concepts among high school geometry students?

**Conclusions**

After examining research studies already conducted, there does not seem to be a significant increase in student performance of those students who have been instructed via the flipped model compared to the traditional method. However, student attitude about learning, student engagement, and the ability to think at a higher level are all positives observed in these studies. Next, we will look at the methods being used in this research study, including a brief description of the participants and instrumentation as well as a summary of the data collection and analysis.

# CHAPTER 3

# METHODS

## Introduction

This study aims to explore the impact flipped instruction has on student performance, student retention level, and student attitude about their learning experience. Flipped instruction is the teaching technique in which the lecture occurs outside of the classroom and student practice occurs during class time to ensure students have access to support while working through various problems. This new method of instruction has the potential to change the way teachers utilize their time in class by providing students more opportunities to practice problems, improve skills, and deepen understanding.

## Research Question

What is the impact of a flipped instruction model compared to traditional teacher-lecture on student performance, student retention level, and student attitude toward learning geometric concepts among high school geometry students?

## Research Design

A research design of quasi-experimental was chosen due to there being no randomization of participants and to explore the different teaching methods and their effects. There will be two groups of participants, one group being the control group who do not receive the treatment and the other group being the experimental group who do receive the treatment of flipped instruction. The control group will be taught by the traditional teacher-lecture instructional method and the experimental group will be taught by the flipped instruction model. There will be a pre-post comparison of the unit 1 tests as well as group comparisons of the test to measure growth, quiz to measure retention level, and survey to measure the attitude of students.

## Setting

This study took place in a high school Geometry classroom in a North Dakota town with a population of roughly 55,000. According to the US Census Bureau, the county includes a population of approximately 86% Caucasian, 5% African American, 3% American Indian, 3% Asian, and 4% Hispanic persons. This town is known for the local university, which has a highly rated Aerospace program as well as its schools of medicine and law. There are currently just under 1,000 students enrolled at the high school with about 35% of these students qualifying for free/reduced lunch and about 18% of these students enrolled with an IEP. The ethnic breakdown of students is roughly 60% Caucasian, 10% Asian, 10% American Indian, 10% African American, and 10% Hispanic.

## Participants

The participants were average achieving sophomore students, approximately fifteen- and sixteen-years-old, approximately equally split between the two groups comprising of about sixty students per group (sixty-two students in the experimental group and sixty-four students in the control group). They were about 50% females and 50% males with about 35% of these students qualifying for free/reduced lunch. About 18% of these students receive some type of special education services. The ethnic breakdown of students was roughly 60% Caucasian, 10% Asian, 10% American Indian, 10% African American, and 10% Hispanic.

**Sampling.** This is a purposive sample, as the two groups will be assigned based on the instructor of their Geometry class. At my school, there are two Geometry teachers, so I will be instructing with the flipped model and the other teacher will be instructing with the traditional model. For the most part, students are randomly assigned by the school counselors (without instructor input) based on the student's schedule, so every student has an equal chance of being assigned to either the control or experimental group. Since both of the instructors are teaching three sections of the same Geometry course, the two different groups should be relatively equivalent, consisting of approximately sixty students per group.

**Instrumentation**

I have developed several instruments to be used for data collection, including a pre-test, post-test, follow up quiz and Likert scale survey (Appendix B). The pre-test and post-test (Appendix A) were designed to test student performance on the content presented in the first unit of study. The data obtained from these tests will be used to evaluate student growth throughout the unit. The follow up quiz (Appendix C) was designed to address the highlighted topics from unit 1 and to evaluate the student retention level of that content. Lastly, the Likert scale survey was designed to analyze student attitude towards learning geometric concepts by the different instruction models. Samples are provided in the Appendix.

**Data Collection.** As noted in Table 3.1, students were given a pre-test, post-test, and follow up quiz on the same unit of study. The pre- and post-test aims to measure student performance growth related to the content in the first unit of Geometry. The follow up quiz aims to measure student retention level of this same material after one month. Students will also be given a Likert scale survey in which they will be asked about their attitude toward learning geometric concepts by each of the instructional methods. The two groups' data will be analyzed and compared to determine if there was any significant difference between the two instructional methods.

**Data Analysis.** The achievement scores from the unit 1 test and the follow up quiz on unit 1 were calculated (i.e., means, medians, standard deviations, percentages, and ranges) and entered on an Excel spreadsheet. Mean score values were calculated by the different instructional strategies used separately. These values were compared using t-Test to determine whether they are significantly different or not. The Likert scale score means were calculated by the different instructional strategies used separately. These values were compared using t-Test to determine whether they are significantly different or not. Beyond statistical significance, I will explore the practical significance of the results. That is, "in what way can my teaching practice benefit from the results obtained in this study?"

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

Table 3.1.
Research Question Alignment

| Research Question | Variables | Design | Instrument | Validity & Reliability | Technique (e.g., interview) | Source |
|---|---|---|---|---|---|---|
| What is the impact of a flipped instruction model compared to traditional teacher-lecture on student performance, student retention level, and student attitude toward learning geometric concepts among high school geometry students? | IV: Flipped instruction<br>IV: Traditional instruction | Quasi-experimental | | Absence rates are a potential validity threat as students who are not present in class for instruction but are present for the assessment will affect the outcomes. The amount of students who are chronically absent in the two groups will probably not vary, but should still be considered. Data collector characteristics and bias will attempt to be controlled by using the same answer key with the same point values attached to test items. | | High School geometry students will be the source of data for all dependent variables<br>Sample size: Roughly 60 (all of my Geometry students for the fall of 2019) |
| | DV: Student performance | | Math test on unit 1 to evaluate performance & compare between groups | | Math test on unit 1 | |
| | DV: Student retention level | | Follow up quiz on unit 1 to evaluate performance & compare between groups after a period of time | | Follow up quiz on unit 1 | |
| | DV: Student attitude toward learning geometric concepts | | Likert scale to identify differences in student attitude regarding the instructional strategies used | | Likert scale survey | |

**Procedures**

The control group was those students who do not receive flipped instruction, instead they received the traditional teacher-lecture instruction. The traditional teacher-lecture method of instruction typically consists of a direct-instruction lesson in which the teacher explains the content and materials. During this type of instruction students are usually passive learners and listeners, instead of actively participating in learning, and uses roughly half of a regular fifty-minute period. The experimental group were those students who received the treatment of flipped instruction for the first unit of study. Flipped instruction will have students actively participating for the full class period in tasks aimed to deepen understanding and receive small group support. Students received the direct instruction explanation outside of class time via a video lesson. This allows students to watch the lesson when they are focused and distraction free as well as provides students the opportunity to re-watch parts of the lesson that they struggle understanding. All of the students in the experimental group had access to the instructional videos and were able to watch and listen to these videos without distraction. Before the unit begins (roughly the second day of school), the students took a pre-test to determine each student's prior level of understanding about the content to be presented. The students in my class received the treatment every day during the first unit of study (i.e. roughly one month) by partaking in the flipped instruction model, while the other teacher's students did not receive the treatment every day during the first unit of study and partook in the usual teacher-lecture traditional model of instruction. After the month-long instruction, students took the post-test to measure their current level of understanding as well as complete the survey about their attitude towards learning geometric concepts. Roughly a month after the unit had been completed and the post-test had been taken, students completed a follow-up quiz with questions regarding the first unit of study to gauge how much information the students recalled depending on their instruction method.

**Ethical Considerations**

There is no risk of harm for students physically or psychologically during this proposed study. Students may be uncomfortable with this new method of instruction and even potentially refuse to watch the videos at home; however, there is no associated danger for participants.

**Conclusions**

This quasi-experimental research study aims to gather insight on the use of flipped instruction as a means of teaching as it pertains to the high school Geometry classroom. Data was gathered through the use of a pre-test, post-test, follow up quiz, and Likert scale survey to analyze how this method of instruction impacts student performance, student retention level, and student attitude about learning geometric concepts. The following chapter will include the results of the study.

# CHAPTER 4

# FINDINGS

## Research Question

The purpose of this study was to determine if a flipped instruction model would improve students' understanding, students' ability to retain the information, and students' attitudes toward learning geometric concepts. A flipped instruction model moves the direct-instruction portion of a lesson to outside of the classroom and leaves the time in class, where teacher-support is readily available, to practice the concepts. Students' understanding was measured by their performance on the chapter test, students' ability to retain information was measured by a short quiz given roughly one month after the chapter test, and students' attitudes toward learning geometric concepts was measured by a survey. The experimental group contained sixty-two students, while the control group contained sixty-four students, both of varying, but approximately equal ability.

## Results of the Study

**Student Understanding.** The chapter test, given at the end of the chapter, was used to determine the impact the flipped instructional model had on student understanding. The scores on this assessment for the experimental group were compared to scores of the control group (the students who were taught via in class teacher-lecture). The chapter test was comprised of twenty-six questions, including one bonus question. The questions covered all of the standards of the chapter, including parallel and perpendicular lines as well as the angle relationships related to those lines. The two instructors of both the experimental and control groups used the same answer key with the same point values attached to each component of every question, so the grading of the assessment was consistent between both groups, i.e. the score was independent of the teacher that graded the chapter test.

Figure 4.1 Comparison of All Test Scores

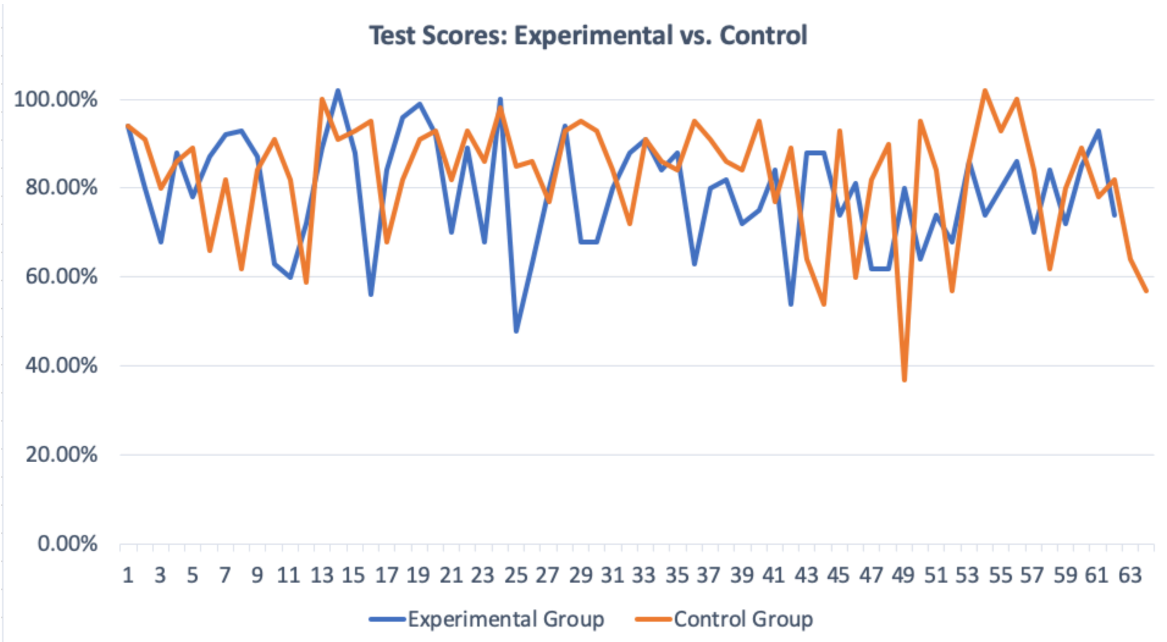



Figure 4.2 Comparison of Test Scores Sorted Low to High

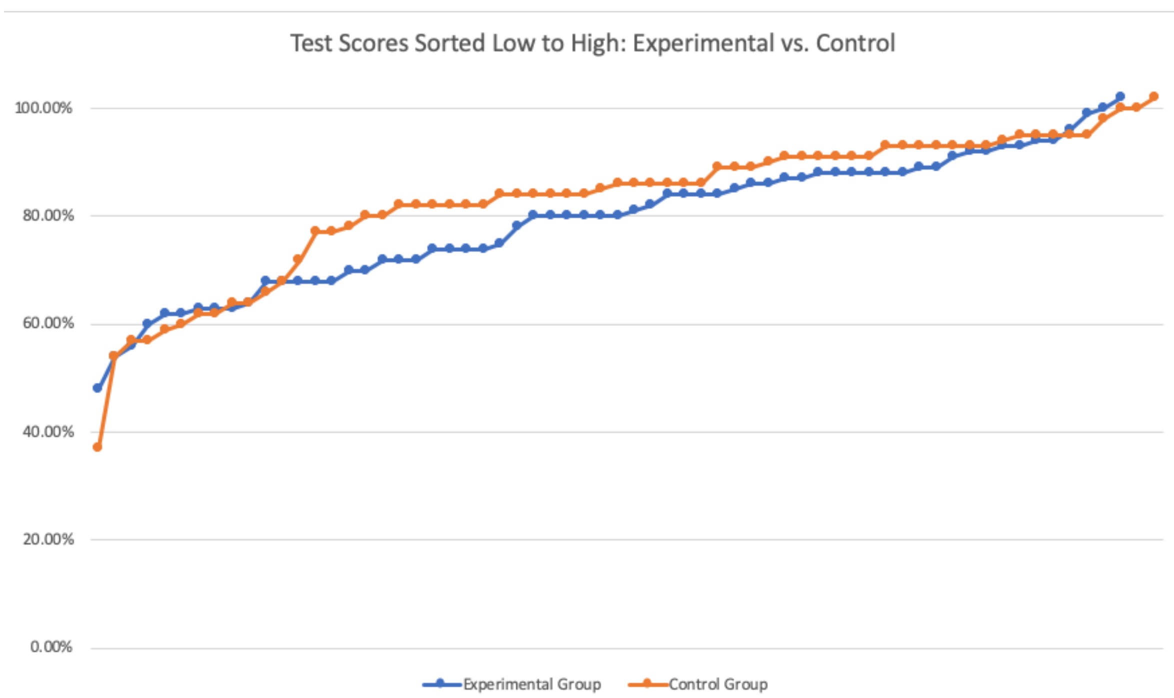
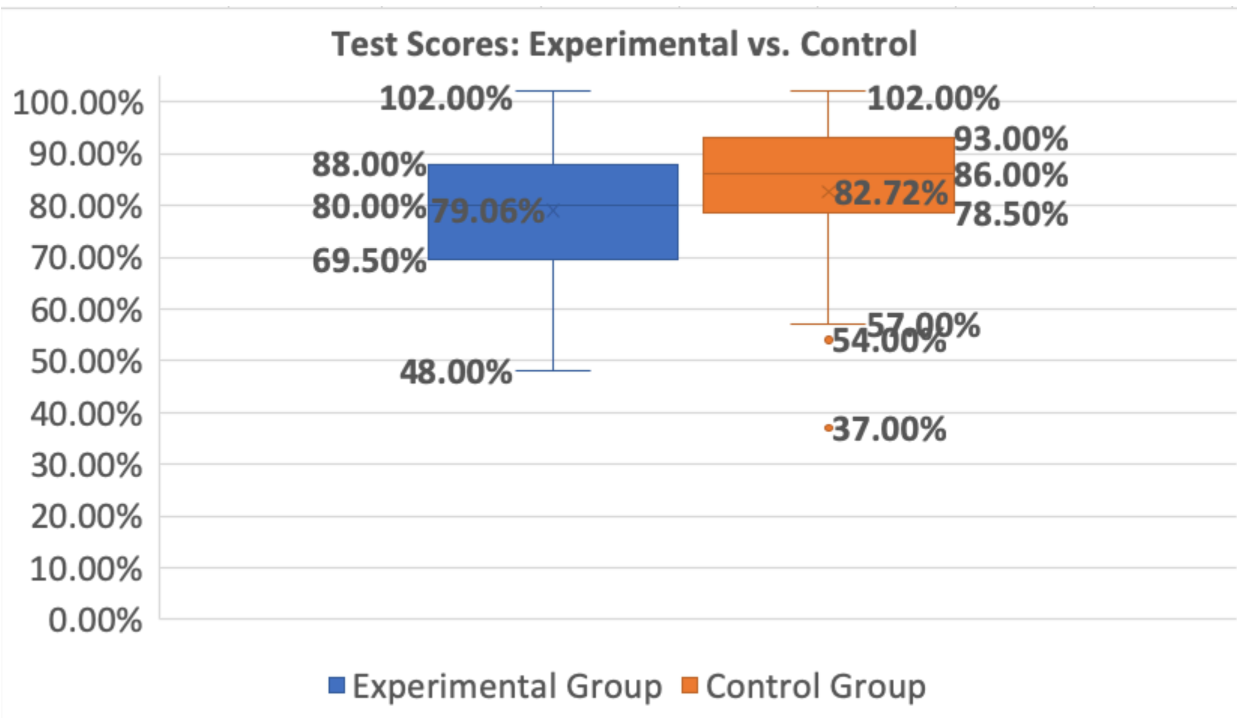


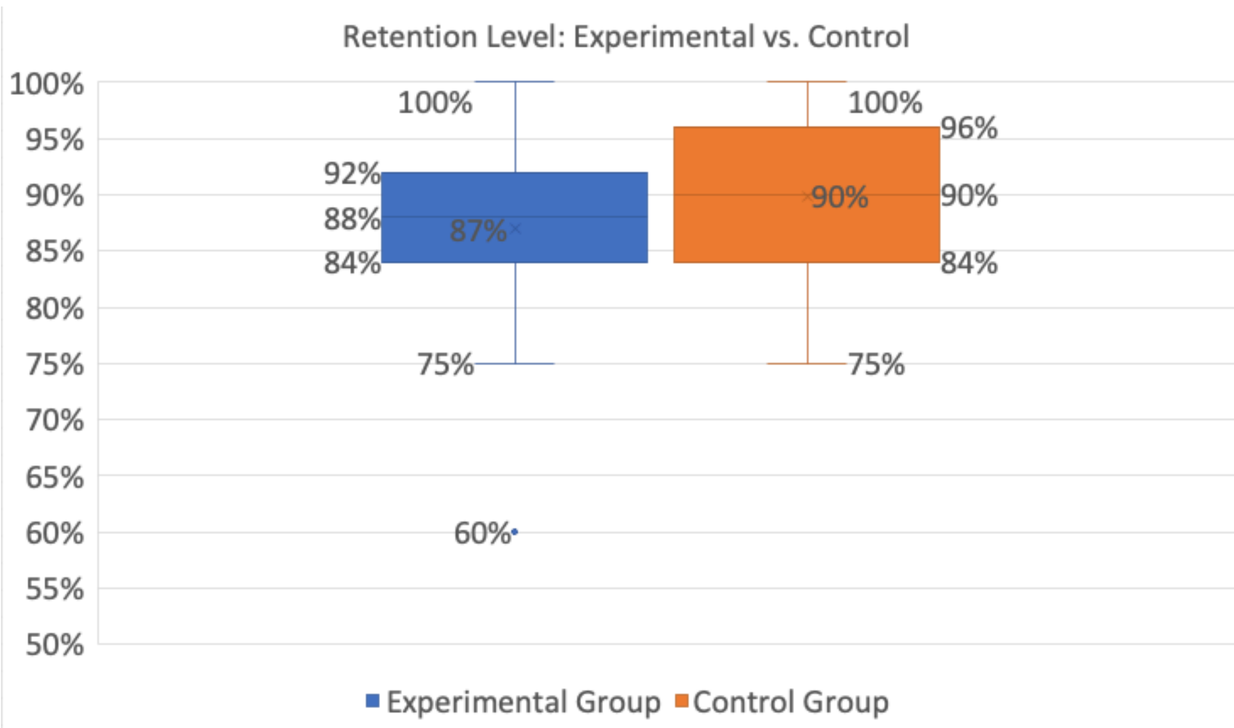
Figure 4.1 shows a comparison of the scores of the chapter test for both the experimental group and the control group. The scores in Figure 4.1 are arranged based on the how the scored appeared in the gradebook; however the scores in Figure 4.2 are arranged from low to high for both groups for ease of visual comparison. As shown in Figure 4.2 more clearly, those students in the control group, students who received the traditional teacher instruction in class, performed slightly better, on average, than those in the experimental group, students who received direct-instruction outside of class time.

Figure 4.3 Box-and-Whisker Comparison of Test Scores




A box and whiskers plot is shown in Figure 4.3 to better summarize the results of the chapter test scores. Both the experimental and control groups had a highest score of 102%, but the lowest score varied (48% for the experimental group and 37% for the control group). As noted by the number in the box, the average for the test scores differed somewhat, 79% for the experimental group versus about 83% for the control group. The median test scores varied even greater, 80% for those in the experimental group and 86% for those in the control group, meaning that 50% of the students scored above and below those scores. It is interesting to note that the spread for the experimental group was more than the spread of test scores for the control group. Again, in Figure 4.3 you can see that the test scores for the control group were mostly higher than those for the experimental group. In fact, the lowest-performing 25% of the students in the control group scored a 78.5% or below, while the average for the experimental group was about 79% and the median for the experimental group was 80%. This tells us that the amount of students who performed below 80% for the experimental group was much greater than those who scored below 80% for the control group.

Figure 4.4 Box-and-Whisker Comparison of Student Retention Quiz Scores




**Student Retention Level.** The results of the quiz used to measure students' ability to retain information are provided in Figure 4.4. Again, the highest scores are the same for both the experimental and control group; however, the lowest score is quite different (60% for the experimental group and 75% for the control group). The control group achieved a higher average, 90% compared to the experimental group average of 87%, as well as a higher median score 90% compared to the experimental group median of 88%. Further, the spread of the data is greater for the control group, 84%-96%, than the experimental group, 84%-92%; however, the lowest 25% of students scored between 75% and 84% for both groups.

Figure 4.5 Student Response for Question 1

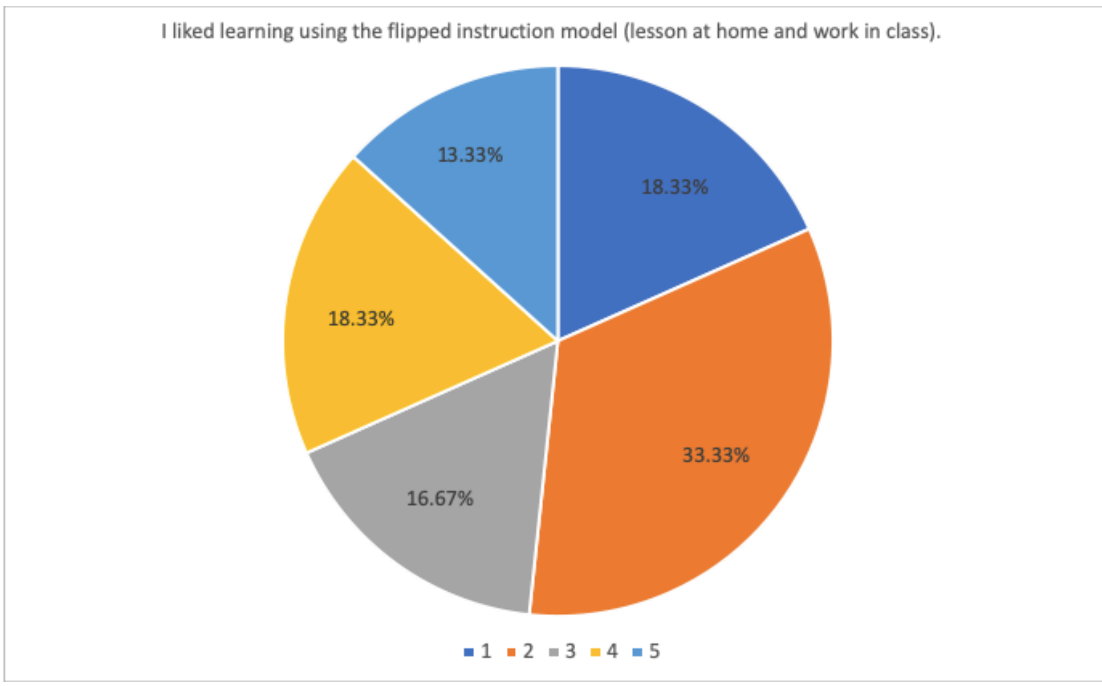


Figure 4.6 Student Response for Question 2

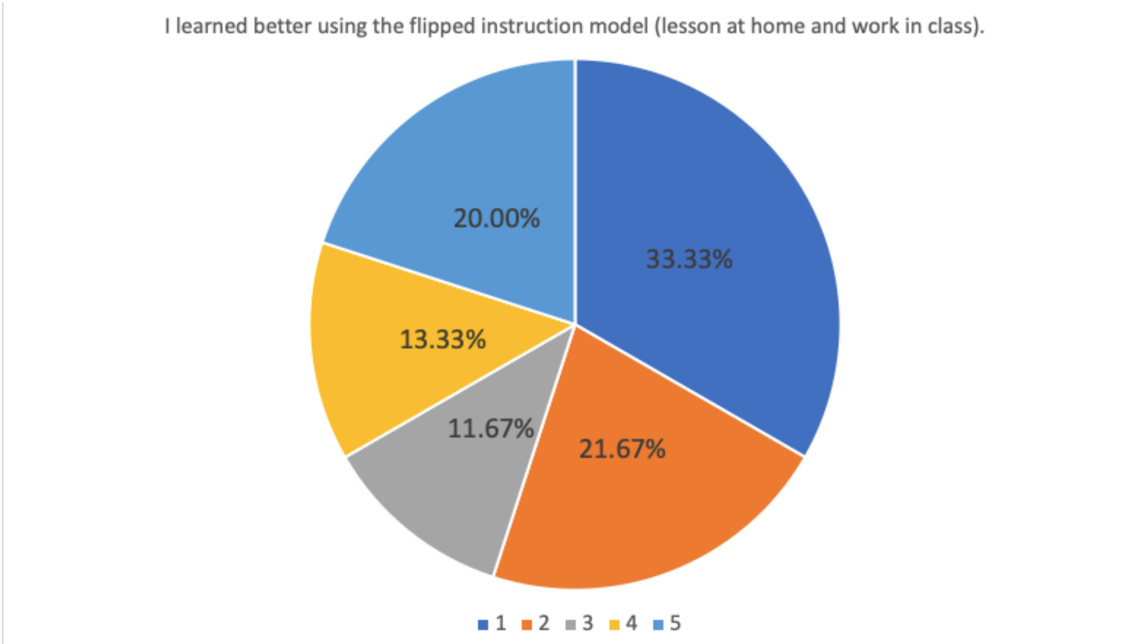



Figure 4.7 Student Response for Question 3

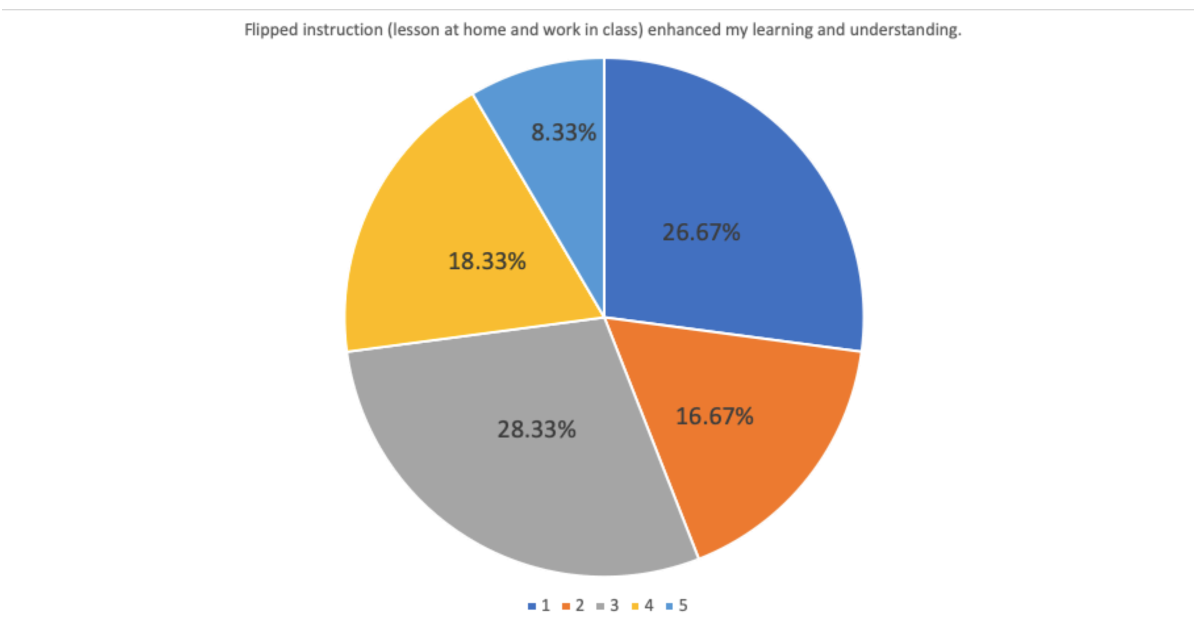
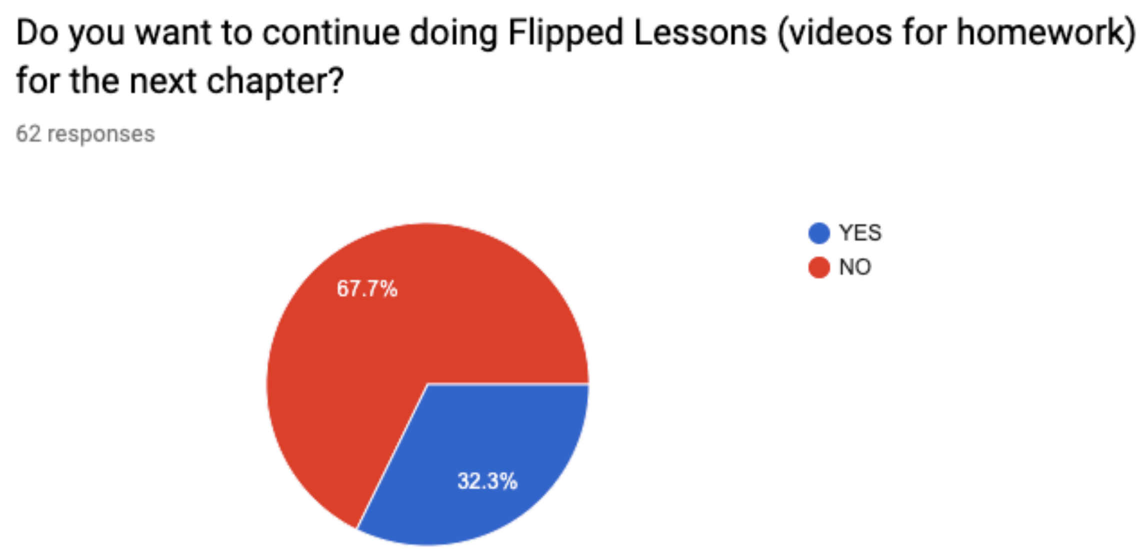


Figure 4.8 Student Response for Question 4




**Student Attitude.** A four-question survey was used to determine students' attitude toward learning via the flipped instruction model. First, students were asked to rate how much they liked learning using the flipped instruction model using a 1-5 scale, with 1 being that they did not like it at all and 5 being that they really liked learning via video lessons. Figure 4.5 has the percentages of how much students enjoyed watching lesson videos outside of class, with 51.66% of students saying they did not like it (either strongly disliked or disliked) compared to 31.66% of students who said they liked it (either strongly liked or liked), with 16.67% of students being neutral to the flipped method. In Figure 4.6, 55% of the students said they did not learn better using flipped instruction compared to 33.33% who voted that they did learn better. Students were also asked if they felt that flipped instruction enhanced their learning. Students responded that 43.34% felt it did not enhance their learning, 26.66% felt it did enhance their learning, and 28.33% felt indifferently, as shown in Figure 4.7. Lastly, when asked if students wanted to continue the flipped instruction, an overwhelming 68% voted to not continue with the new instructional model, according to Figure 4.8.

**Interpretation**

These results were not anticipated by the researcher. According to prior research, student performance, i.e. test scores, should have relatively been the same; however, that is not truly the case in this study. Although the averages of the two groups appear roughly the same, the further break down of the data in Figure 4.3 suggest that the students in the experimental study performed lower than those in the control group. These results contradict what the literature has suggested, i.e. that test scores are relatively the same. A point of interest to the researcher is the age of the students and how frequently they have previously been instructed with various methods. The experimental and control group in this study have only been previously instructed via in-class direct instruction with teacher lecture, so students were very skeptical that they would be able to learn any other way.

Although there were not many previous studies completed comparing the ability for students to retain information learned via a flipped method of instruction, the results of this study suggest that the topic could use further research. Even though the students in the experimental group initially performed slightly lower on the chapter test, the retention quiz results were much closer in comparison to the control group. This topic should be further explored to examine if students are better able to retain the information when learned through a video lesson. Some students in this study noted that they were better able to focus on the material during the flipped lesson than they normally are able to in class, due to distractions of peers and other interruptions.

The main area that the researcher was optimistic about was students' attitude toward learning geometric concepts. The prior literature suggests that students feel more confident in math and less stressed; however, the students in this study did not mention any of those feelings. The majority of the experimental students did not like learning via lesson videos nor think there learning was enhanced by using this instructional method. Some students did mention that they liked being able to ask more questions, they could focus better at home than in class, that they felt the teacher was more available to them during class time, and that they were able to watch the material as many times as they needed. On the other hand, many students mentioned that they were not able to learn at all through watching the lesson on a computer screen and/or that they did not have any time to watch the lesson.

There were not any problems in data collection or the instrumentation and the researcher feels that the tools did indeed adequately represent what they were designed to test. The only potential problem that could have skewed the data was any student who was unable to access the video lessons. The researcher made sure to ask students if they had access to watch the videos either at home or at school, and every participant said they did; however, student(s) could have been too embarrassed to mention otherwise. There are some potential reasonings that the researcher feels could have impacted the data. First, the students did not approach the experiment with an open mind, some students even mentioning that they knew they could not learn through video lessons so they were just going to fail even before the study commenced. Also, the researcher believes it would be insightful to compare video completion to homework completion, i.e. compare those students who did not watch the videos to those who do not hand in assigned homework either. The researcher wonders if there are the same number of students who did not have time to watch the lesson videos or just did not want to watch them compared to the number of students who do not hand in homework that is to be done outside of class. After completing a chapter with the same students using a traditional method of instruction, the researcher feels that there are even more students who do not complete the homework. This topic should be further researched as well.

The researcher would have liked to spend more time interviewing students to better understand why they did not prefer the flipped instruction model. One of the points of interest to the researcher is the plausible explanations that could explain why students did not prefer to watch the lesson at home. The researcher wonders how many students who watched the lesson videos were truly focused, and if they were not focused, would they change their preference if they changed their participation. For example, a student could say that they watched the video when in fact they had the video muted or they watched parts of it at a time instead of all at one setting. Another missing component of this study is parent/guardian perception. One of the benefits of the flipped instruction model is that parents/guardians are mostly relieved of having to remember how to complete geometry problems, as students should be able to ask questions directly to the teacher. This is another aspect that should be further looked at.

**Conclusions**

The research study did not follow the anticipated findings suggested by the literature; however, there are interesting pieces that the researcher believes should be studied further. The performance of students was found to be lower in those students who received direct instruction on their own compared to students who were taught directly in class, which contradicts the literature. The students' attitudes toward learning geometric concepts in this study were also not expected, as they were not as optimistic as the previous research implied. However, student retention level could potentially be an upside to flipped instruction but should be further researched.

# CHAPTER 5
# ACTION PLAN

## Plan for Taking Action

Based on the data, the researcher would not move to a completely flipped classroom model with this group of students. These students are used to being taught mathematics in a very traditional way, and since the beginning of the study, students have been reluctant to learn geometric content by any other method besides teacher-led in-class direct instruction. However, the researcher does believe that there are benefits to a flipped lesson model and that as students experience more non-traditional classrooms, they will become more open to this way of learning. The research from prior studies is very compelling, especially in regard to students' attitudes toward learning mathematics, and leads the researcher to speculate if an older, more mature group of students would deliver these same results as the research suggests.

The researcher also believes that there are potential further areas of research to study based on this experiment. Some of those areas were mentioned in Chapter 4, including student motivation and focus and parent/guardian perception of the flipped method of instruction. Another area that could be further researched is how to incentivize students to actually watch the videos. During this study, the researcher tried several different models. First, the researcher did not provide any external incentive to watch the video, besides to gain understanding of the material. Next, the researcher assigned a lesson quiz related to the material in the lesson video that was graded based on correctness. And, lastly, the researcher assigned points to watching the lesson video. All of these models were only used a few times each, so there is not even research to conclude which method gets students to watch the videos the most. However, through all of those methods there were many students who still did not watch the video. How do we incentivize these students and are these students the same ones who will not complete traditional homework?

**Plan for Sharing**

The researcher has shared the results of the study with content colleagues and the direct supervising associate principal. Once a month at the school where the study was conducted, the mathematics department convenes to work collaboratively on how to improve student learning. As a part of these meetings, the department analyzes data from various common assessments in an effort to determine areas of improvement for educators. For example, in a previous meeting it was detected that most Geometry students across all teachers performed poorly on a particular question on an assessment, so it was decided that we needed to revisit that material and change the wording of the question as to not confuse students. During the last meeting, the researcher shared the results of the study, as many colleagues were interested to find the results. Some teachers were surprised to find that students did not enjoy learning via video lessons, because they have used video lessons at times (never for a whole chapter) in class and students have mentioned that they preferred that method of instruction. The researcher would be curious to examine if upperclassmen and/or advanced students would favor the flipped instructional model and how the results of a study would differ.

The results of the study were also shared with the supervising associate principal of the researcher. The principal was informed of the study and was also interested to hear the outcome of the experimental study. At the beginning of the year, educators at the school where the study was conducted are asked to submit goals for instruction to their supervising principal. The researcher chose a goal of increased engagement in the classroom, including student movement and hands-on activities. Due to the flipped instruction model, there was increased class time available to complete these tasks. During various conversations with the principal, the increased engagement was discussed as well as student motivation and improved support available to students due to the amount of useable class time. Both the principal and researcher were shocked to find that students did not prefer the flipped instruction style of learning, as they both thought that the classroom was more interactive and engaging for students.

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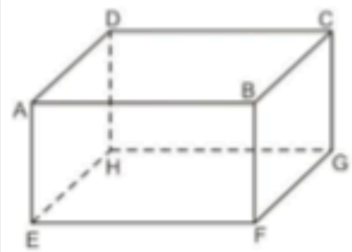
# Instrument A. Chapter Test

**Geometry Unit 2 TEST** **Name:**____________________
**Form A** **Period:**_____

**Use the diagram at the right.**

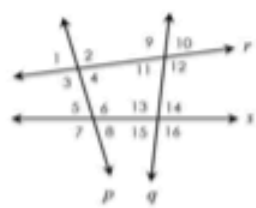



______1. Which segment is parallel to segment DH?
A. BC B. CG C. AB D. EH

______2. Which segment is perpendicular to segment DH?
A. BC B. CG C. AB D. EH

______3. Which segment is skew to segment DH?
A. BC B. CG C. GH D. EA

**For questions 4-9, place the letter of the angle relationship that best represents the given angle pair in the box.**




4. ∠2 and ∠7

5. ∠2 and ∠10

6. ∠2 and ∠16

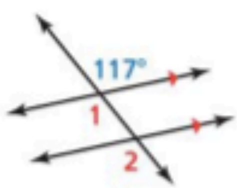
7. ∠2 and ∠11

8. ∠8 and ∠14

9. ∠4 and ∠6

A. Alternate Interior Angles
B. Alternate Exterior Angles
C. Same-Side Interior Angles
D. Corresponding Angles
E. No Relationship

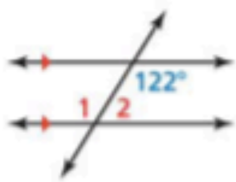
10.




m∠1 =

m∠2 =

11.

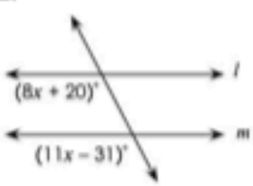



m∠1 =

m∠2 =

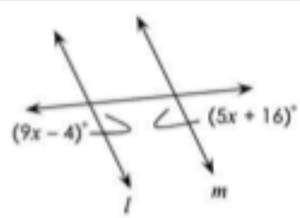
**For questions 10-11, if *l* || *m*, find the value of *x*. (Show your work!)**

12.




x =

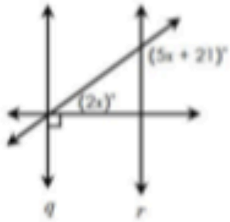
13.




x =

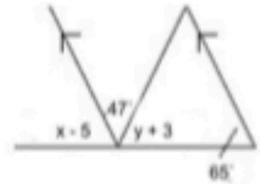
**Find the value of the variable(s). (Show your work!)**

14. p ll q




x =

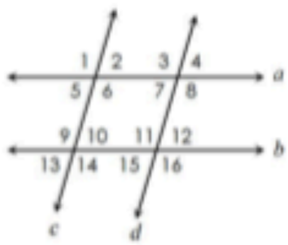
15.




x =

y =

**Determine which lines, if any, can be proved parallel given the angle relationship. Write the letter that corresponds to the converse to justify your answer.**




A. Alternate Interior Angles Converse
B. Alternate Exterior Angles Converse
C. Same-Side Interior Angles Converse
D. Corresponding Angles Converse

16. Given: ∠1 ≅ ∠8 Which lines are parallel? ________ Why? ________

17. Given: m∠7 + m∠11 = 180° Which lines are parallel? ________ Why? ________

18. Given: ∠3 ≅ ∠1 Which lines are parallel? ________ Why? ________

**Determine whether QR and *ST* are parallel, perpendicular, or neither.**

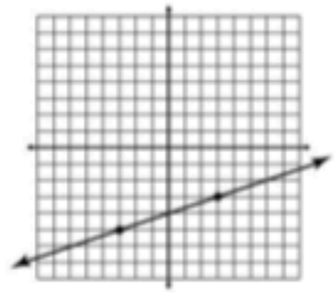
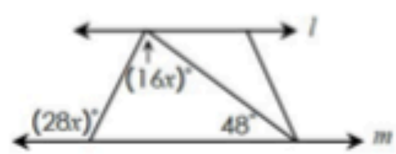
19. *Q*(-6, 11), *R*(2, -1), *S*(-4, 8), *T*(-1, 10) Show your work to support your decision.

☐ **Parallel**
☐ **Perpendicular**
☐ **Neither**

**Which two of the three given lines are parallel? How do you know?**

20.

I. 7y = -3x - 7
II. 7y = -1 - 3x
III. -3x + y = -7

| | |
|---|---|
| **21.** Write a linear equation that passes through the point (2, -9) and has a slope of -5 in slope-intercept form. | **22.** Write the equation of the line in slope-intercept form.  |
| **23.** Write the equation of the line that is **parallel** to the line y = 3x + 6 and passes through the point (4, 7). | **24.** Write the equation of the line that is **perpendicular** to the line y = − 2/3x + 7 and passes through the point (-2, 4). |
| **25.** Write the equation of the vertical line that passes through the point (-1, 8). | **Bonus:** Find the value of x so that l ‖ m.   |

Instrument B. Survey

# Student Perception & Attitude

The goal of this survey is to evaluate students' perceptions and attitudes regarding flipped instruction.

* Required

1. **I liked learning using the flipped instruction model (lesson at home and work in class).** *
*Mark only one oval.*

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Strongly Disagree | ◯ | ◯ | ◯ | ◯ | ◯ | Strongly Agree |

2. **I learned better using the flipped instruction model (lesson at home and work in class).** *
*Mark only one oval.*

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Strongly Disagree | ◯ | ◯ | ◯ | ◯ | ◯ | Strongly Agree |

3. **Flipped instruction (lesson at home and work in class) enhanced my learning and understanding.** *
*Mark only one oval.*

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Strongly Disagree | ◯ | ◯ | ◯ | ◯ | ◯ | Strongly Agree |

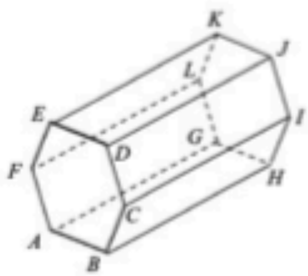
4. **Do you want to continue doing Flipped Lessons (videos for homework) for the next chapter?** *
*Mark only one oval.*

◯ YES
◯ NO

Instrument C. Retention Quiz

**Unit 3 Quiz Recap** Name ______________________

**Use the diagram below for #s 1-3.**

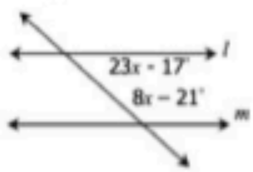



1. Name a pair of parallel lines.

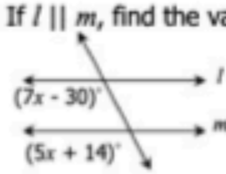
2. Name a pair of skew lines.

3. Is DJ skew to IJ?

4. **If *l* || *m*, find the value of *x***



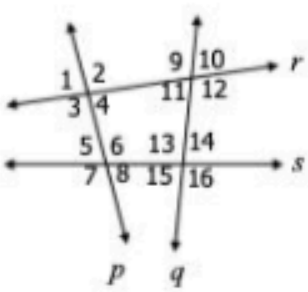

5. **If *l* || *m*, find the value of *x*.**




6. Write an equation that is parallel to 2x - 3y = 2 and passes through (-6,-11).

7. Write an equation that is perpendicular to y = -8x + 5 and passes through (-2, 5).

**Use the diagram below for #s 8-10.**




8. Name a pair of alternate exterior angles.

9. Name a pair of corresponding angles.

10. Name a pair of consecutive interior angles.

**Institutional Review Board**

MINNESOTA STATE UNIVERSITY MOORHEAD

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| | |
|---|---|
| DATE: | October 24, 2019 |
| TO: | David Kupferman, Principal Investigator<br>Christina Dittus, Co-Investigator |
| FROM: | Lisa Karch, Chair<br>Minnesota State University Moorhead IRB |
| **ACTION:** | **DETERMINATION OF EXEMPT STATUS** |
| PROJECT TITLE: | [1495729-2] Flipping the Focus: Flipped Learning in a Geometry Classroom |
| SUBMISSION TYPE: | New Project |
| DECISION DATE: | September 30, 2019 |

Thank you for your submission of New Project materials for this project. The Minnesota State University Moorhead IRB has determined this project is EXEMPT FROM IRB REVIEW according to federal regulations under 45 CFR 46.104.

We will retain a copy of this correspondence within our records.

If you have any questions, please contact the Minnesota State University Moorhead IRB. Please include your project title and reference number in all correspondence with this committee.

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This letter has been issued in accordance with all applicable regulations, and a copy is retained within Minnesota State University Moorhead's records.