Flipping the Classroom: Flipped Learning and the Performance of High School Algebra 2 Students

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Flipping the Classroom: Flipped Learning and the Performance of High School Algebra 2 Students

A Mixed Methods Study

A Project Presented to
The Graduate Faculty of
Minnesota State University Moorhead
By
Brett Bergeson

In Partial Fulfillment of the
Requirements for the Degree of
Master of Science in
Curriculum and Instruction
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Abstract

This study researched the effects a flipped classroom had on student performance, attitude, and engagement. In a traditional classroom, direct instruction can take up half of the class time, or even more. A flipped classroom moves the direct instruction to outside of class, leaving class time for learning activities. With this extra time during class for students to engage with classmates or the teacher, it is expected that performance will start to increase. To measure performance, a unit test was given at the conclusion of the unit. Scores were compared between the experimental group and the control group. The experimental group consisted of students in the flipped classroom, and the control group consisted of students in the traditional classroom setting. To measure student engagement, the researcher kept a daily journal logging quotes and interactions among students from each group. Student attitude was measured with a Likert scale at the conclusion of the unit, in which students were asked questions regarding their experience within the flipped classroom. Overall, students in the flipped classroom scored slightly better on the unit test compared to the students in the control group. The Likert scale survey results showed that the majority of the students within the experimental group enjoyed their experience with a flipped classroom, and thought they had a better learning experience. Engagement among students and their learning was higher within the experimental group compared to the control group.
CHAPTER 1

INTRODUCTION

Introduction

There is pressure for any teacher to connect with each of their students, regardless of the students’ interests, home-life, achievement level, and preferred learning style. While attempting to connect with each student, teachers also need to encourage students to attain mastery of content standards. At times this can be a frustrating and almost impossible task due to certain classroom settings such as time constraints. In many math classrooms, the focus is teacher-led instruction. The teacher will introduce new concepts to the students, and they attempt to master these concepts by working on practice problems. The practice problems often start with the basic concepts and continue to increase in difficulty. Within this setting students do much of the work individually with little collaboration amongst themselves. The flipped classroom attempts to switch the focus to be student-centered. Students are actively engaged in their learning during class time, and there is more time to receive any support that they need. With flipped instruction there is more time for students to collaborate with one another, more time to differentiate instruction, students will be more active when learning mathematics, and students will overall have more of a personalized learning experience. Students will receive more support in class, which will lead to an increase in performance, engagement, and a better attitude towards learning.

Brief Literature Review

Flipped instruction is becoming more and more popular in math classrooms. Flipped instruction is where students receive the direct instruction portion of the lesson outside of class time. This is usually done by watching a video provided to them by the teacher. Class time is
then used to enhance the students’ understanding of the concept through practice and exploring. Literature has mixed findings on whether this will improve student performance on test scores. However, the literature does report findings that student, teacher, and parent attitudes are improved with the use of flipped instruction, and the students are more engaged during class time. Various research suggests students are more motivated, confident, and less stressed in their learning. Overall, the research reports positive findings with flipped learning, but more studies need to be conducted to provide sufficient data.

**Statement of the Problem**

There are many arguments as to what the best practices are when it comes to increasing student academic success and student engagement. With all of the differing opinions, teachers should not assume one method of teaching will work for them. They need to find the method that works best for their students. The flipped instruction model may be the model that is best suited for many math teachers. In a flipped classroom, teachers have the entire class period to engage students in various tasks and activities. In a traditional, teacher-lecture, model teachers might spend over half of the class time lecturing and introducing new content. The students then are left with minimal time for any learning activities, and sometimes are left attempting practice problems outside of class time with no support or help. Flipped instruction would allow the entire class time to be used for different learning activities where the students would benefit by having more of a personalized learning experience.

**Purpose of the Study**

Teachers are expected to increase student engagement in the classroom, and student achievement in their content area which is usually measured by a standardized test. With these expectations in mind, they are required to differentiate their instruction to meet the needs of
every student, and continue to incorporate the use of technology as it becomes more relevant. The amount of class time can be an issue when trying to meet all of these expectations. The objective of this study is to determine if a flipped instruction model will help teachers in meeting these expectations and improve student achievement in mathematics. The intention of a flipped classroom is to allow more time during class where teachers can differentiate their instruction and allow students to engage themselves in more meaningful learning activities. The goal is to increase students’ engagement in their learning, which will result in greater understanding of math concepts and achieving higher results on assessments.

**Research Question**

What impact does a flipped classroom have on student performance, attitude, and engagement compared to a traditional high school Algebra 2 classroom?

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

Independent Variable: Flipped instruction model: the aim is 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.

Traditional instruction model: This model is teacher-centered and mostly comprised of direct instruction, including teacher-led lectures.

Dependent Variable - Student Performance: Student performance is the observable and measurable behavior, including assessment scores, of a student.

Dependent Variable - Student Attitude: Student attitude is the measure of students’ positive and negative feelings towards the subject.
Dependent Variable - Student engagement: Student engagement refers to the amount of time that students are on task during a class period.

High School Algebra 2 Students - refers to people currently enrolled in a high school Algebra 2 course.

Significance of the Study

It is important for teachers to provide their students with the best opportunity for success in the classroom. There is not one superlative teaching practice out there. Each individual teacher has to find one that works best for them and their classroom setting. The flipped instruction model has potential to be the method that works best for math classrooms. It will provide them with more class time to implement different learning activities, hopefully reaching more students with the differentiation. By reaching more students, more of them will be able to reach a higher level of understanding algebra concepts. There still will be students that do not reach higher levels, but the extra class time can be used to answer questions those students have. Overall, the flipped instruction model is expected to provide teachers with a better classroom environment, with high levels of engagement and positive attitudes.

Research Ethics

Permission and IRB Approval

In order to conduct this study, the researcher will seek MSUM’s Institutional Review Board (IRB) approval to ensure the ethical conduct of research involving human subjects (Mills & Gay, 2019). Likewise, authorization to conduct this study will be sought from the school district where the research project will 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 C) 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 is the possibility that the two groups will be composed of students with varying abilities and demographics. These factors could impact results on student performance. There may be participants in the experimental group that do not watch their instructional videos before class, which won’t allow them to participate as much during the learning activities. Student performance and engagement can be affected in a negative way if this occurs. Among these uncontrollable factors, there may be a few more that are unforeseen by the researcher.

**Conclusions**

The goal for every teacher is to connect with each student, and to be able to get each student to master the standards within the content regardless of varying abilities and learning styles. This can be a challenging task to accomplish with all of the limitations in the classroom. The flipped instruction model will be expected to provide more time in class to differentiate instruction to meet the needs of every student, and to engage each student in their learning. This will improve performance on assessments and assist students with achieving a
higher level of learning. The next chapter provides an overview of literature regarding flipped instruction impacting student performance and engagement.
CHAPTER 2

LITERATURE REVIEW

Introduction

This study aims to compare a flipped instruction model to a traditional instruction model and how they impact student performance, student outlook on learning, and student engagement during class. With the traditional teaching model, math teachers experience time constraints when attempting to incorporate meaningful learning activities to enhance the student’s learning and understanding of key concepts. Students also encounter this issue with limited time in class, which then requires the student to complete the assignment at home without necessary resources that are available to them at school. Many students often don’t even attempt the assignment at home, causing them to fall behind. Using the flipped classroom model can create more time for teachers to reach students individually during class to ensure their different needs are met, while also implementing learning activities to maximize student engagement.

There was an abundance of research articles on flipped classrooms. When focusing on articles specific to math content, it was more difficult to find relevant ones. Keywords for this literature review included: mathematics, student performance, flipped classroom/learning, and student engagement, which produced sufficient and relevant content.

Body of the Review

Context

A flipped classroom impacts students in math classrooms in a positive way. Students learn to help themselves when they are struggling and to be more self-motivated during class activities (D’addato & Miller, 2016). In a traditional style classroom, teachers do most of the talking. When a flipped learning model is implemented, students have more time to be actively
engaged in conversations with their peers and take on learning activities that require a greater understanding of the concepts. The confidence and enthusiasm students have towards learning grows (D’addato & Miller, 2016), and students have a greater desire to learn (Clark, 2015). D’addato and Miller (2016) found that while some parents were uneasy about their child learning in a flipped classroom, most parents approved of the flipped classroom. They found it to be “less stressful on their child,” and that it “increased the rigor and engagement of the classroom” (Daddato & Miller, 2016, p.41).

A flipped learning style has a positive impact on student engagement, but it is unclear the impact it has on student performance. Studies that compared student achievement in flipped classrooms to traditional style classrooms have mixed findings. “The difference among performance measures between the traditional and flipped classrooms can be described as insignificant” (Clark, 2015, p.102). However, the results of the Unal and Unal (2017) study showed that the flipped classroom model demonstrated higher student learning gains compared to the traditional teaching model, and Nielson et al. (2018) found that flipped learning improved student performance based on higher final exam scores and higher average quiz scores. The studies that were reviewed noted that there needed to be more research done on flipped learning to arrive at more concrete conclusions.

Many studies showed the positive impact a flipped classroom has on student engagement. Within a flipped classroom, students are more actively engaged, allowed better use of class time, and the quality of instruction is improved from the traditional style of instruction (Clark, 2015). The flipped learning model allows more time for students to collaborate with their peers and the teacher, and is an improvement from the traditional style of instruction when comparing student to student communication and student to teacher communication (Clark, 2015). Besides
communication, a flipped classroom improves teacher to student and student to student relationships (Kazu & Kurtoglu, 2020), which has a positive impact on student engagement during class.

**Flipped vs. 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. (Flipped Learning Network, 2014)

In the traditional teaching model, the teacher lectures in front of the class using a visual such as a whiteboard or projector. The teacher presents new content and the students complete practice problems to show understanding of the new material. Flipped learning creates more time for active learning during class. A flipped classroom approach enhances students’ curiosity by freeing class time for exploratory projects and discovery-based learning (Teehan, 2016). Teehan (2016) also added that she can involve students with challenging activities during class, which would not be possible if the concepts were not first introduced the night before at home. Rather than taking notes on a lecture, class becomes a place to work through problems, advance concepts, and engage in collaborative learning (Tucker, 2012). This creates better relationships with students, improves student engagement, and creates intrinsic motivation for students.

Struggling students are often characterized as shy and unwilling to seek help during class. With a flipped learning model, the teacher is freed up to interact with every student every day. Teachers have more time to spend with struggling students during class, while advanced students have more freedom to learn individually (Tucker, 2012). With the struggling students able to
spend more time with the teacher working on concepts, the achievement gap between struggling and advanced students will get smaller throughout the school year (Tucker, 2012). Bhagat et al. (2016) showed how the achievement gap can be closed, explaining that a flipped learning model improved test scores of students in the low to medium range of achievement. Struggling students saw more success and gained more confidence when participating in a flipped classroom.

**Student Performance.** Bhagat et al. (2016) conducted a study examining whether there is a significant difference in learners’ achievement scores between flipped classrooms and conventional style classrooms. The experiment included a pretest, followed by a trigonometry lesson, and ended with a posttest. Students were categorized into high, medium, and low achievers. Overall, students in the flipped classroom scored better on their posttest compared to the ones in the conventional style classroom. The study then broke down the results and looked at them by categories. There was no significant difference in achievement within the high achieving group, but for the medium and low groups there was a significant difference in achievement when comparing the two teaching methods (Bhagat et al., 2016). Carter et al. (2018) agreed that flipped classroom pedagogy is associated with improved test scores.

Unal and Unal (2015) completed a study to determine the impact that flipped learning has on student achievement. In this experiment, 16 teachers prepared 5-day lessons for both flipped and traditional classrooms. They conducted a pretest before the 5-day lesson, and then a posttest once the 5-day lesson was completed. Ten out of the 16 teachers scored significantly higher on their flipped classrooms when comparing pretest and posttest results (Unal & Unal, 2015). Utilizing student surveys, the study found that students were generally satisfied with the use of a flipped classroom approach. The class was more enjoyable and students were more motivated compared to being in a traditional classroom (Unal & Unal, 2015). Teachers also had positive
reviews of the flipped learning model. They said it provided their students better personalized learning, improved mastery and retention of information, and better opportunities for communication and collaboration (Unal & Unal, 2015).

Casem (2016) conducted a study to determine the effects of flipped instruction on the performance and attitude of high school students in Mathematics. To measure performance, Casem compared pretests and posttests of students in a flipped classroom and those in a traditional classroom. Students in the flipped classroom and traditional classroom scored about the same on both the pretest and posttest. The difference was that there was more gain from the students in the flipped classroom (Casem, 2016). Casem concluded that their gain scores differed significantly, showing that the students in the flipped classroom improved more than those in the traditional classroom. Casem found that the flipped classroom had a positive effect on the math performance for those students. Students in the flipped model were able to prepare prior to each class and had more opportunities to interact with the instructor and other peers than in the traditional model (Casem, 2016).

**Student Engagement.** A flipped learning model increases student engagement. Instruction is much more student-centered compared to the traditional classroom where the teacher lectures most of the class period. Discussion in a flipped classroom goes back and forth between the students and teacher (Hodgson et al., 2017). Hodgson et al. (2017) examined the relationship between flipped classrooms and student engagement by direct observations of three teachers and their students in flipped and traditional classroom settings. In the traditional classroom, there was a small group discussion during the lesson, but most of the lesson consisted of teacher instruction. The flipped classroom included group discussion of the video they watched at home, where the discussion flipped back and forth between students and the teacher.
In order to maximize student engagement, though, students need to come to class prepared, which in this case includes watching the video at home (Siguroardottir & Heijstra, 2020).

Steen-Utheim and Foldnes (2018) investigated students’ perceptions of their learning experience in a flipped classroom compared to a traditional classroom. The participants in the study were exposed to each method of teaching, one semester each. Students felt more committed to participate in a group when in the flipped classroom compared to the traditional classroom. Steen-Utheim and Foldnes (2018) suggested that this may have to do with the stronger structural support for group learning in the flipped classroom. With group learning, the students felt supported in their learning and engagement because of the discussions they were able to have with their peers (Steen-Utheim & Foldnes, 2018). The flipped classroom model allows for much more group learning than the traditional lecture model.

Theoretical Framework

Secondary math classes in low socioeconomic environments are struggling to get their students to the level they are expected to perform at. Flipped instruction is a method that can change this outcome. In traditional education, concepts are introduced in the classroom, and students practice the concept as homework (D’addato & Miller, 2016). For many students, especially ones from low-income families, this homework does not get done because there may be no resources available at home, therefore their performance suffers. Flipped instruction moves the introduction of the material as homework and allows for students to be engaged in active learning activities or projects during class time (D’addato & Miller, 2016). D’addato and Miller cited a survey where 71% of teachers reported improvement in academic achievement once switching to a flipped classroom. Many other studies concluded that there was an increase in
student performance when switching to a flipped classroom. Clark (2015) was the only study in which the difference in student achievement between a flipped model and traditional model was insignificant. The Bhagat et al. (2016) study found improvements in performance from students in the low to medium achievement groups, which suggests that teachers can close the achievement gap by using a flipped classroom model.

**Research Question**

What impact does a flipped classroom have on student performance, attitude, and engagement compared to a traditional high school Algebra 2 classroom?

**Conclusions**

When comparing flipped classrooms with traditional style classrooms, the studies reviewed found student engagement increased when using the flipped learning method. The greater amount of in-class time allows for more active engagement from students. Most of the studies, however, did not find significant differences in student performance. The next chapter includes the methods used in this study, which consists of the design, setting, participants, instrumentation, and data collection and analysis.
CHAPTER 3

METHODS

Introduction

This study intended to find the effect a flipped classroom has on student performance, student attitude towards math, and student engagement during class. Rather than lecturing during class, students in a flipped classroom setting watch the lecture on video before class which allows the entire class period to be used for learning activities. This allows the students to receive maximum support while doing the practice work. This method of instruction can potentially be an effective way teachers can use their class time to improve their students’ skills, and help them better understand difficult concepts.

Research Question

What impact does a flipped classroom have on student performance, attitude, and engagement compared to a traditional high school Algebra 2 classroom?

Research Design

Two different teaching methods were used in this study, and the effects they had on a class were compared. This is why an experimental design was used, but the participants of each class were not randomized so specifically a quasi-experimental design was used. There was one control group, in which the participants were part of a traditional classroom setting where they received the lecture during class time. The participants in the experimental group were part of the flipped classroom, where they watched the lecture before class. A pretest was given prior to the start of unit one, and the results were compared to the posttest for unit 1 to measure growth and overall student performance. A survey was given to both groups to measure student attitude, and
the researcher kept a journal throughout the unit to measure student engagement during class.

Setting

This study took place in a high school Algebra 2 classroom in a small southwest Minnesota town. The population of the town is about 5000 people. According to the US Census Bureau, the county is made up of 87% White, 5% American Indian, 3% Asian, and 2% Hispanic persons. The town is mostly known for its agriculture, just like most small Minnesota towns. The town is close to a Native American Indian Reservation, so it has a high value on Native American culture. The student population is about 335 total, and there are three main ethnic groups within the student population. The students at the school are made up of 69% White, 25% American Indian, and 5% Hispanic. Thirty percent of the students qualify for free and reduced lunch, and about 18% of students receive special education services.

Participants

The participants were average achieving Juniors (16 to 17 years old). There were 2 Algebra 2 classes, each containing 20 students. One of the classes was the control group while the other was the experimental group. Fifty percent of the students were males and 50% of them were females. Of the 40 participants, 18% of them were receiving special education services and 30% of them qualified for free and reduced lunch. Seventy percent of the students were White, 25% were American Indian, and 5% were Asian or Black.

Sampling. This is a convenience sample since the two groups were made up of students that participated just because they were part of my class. There was no criteria in choosing the control group from the experimental group. The two groups were equivalent in math performance prior to the study based off of average scores from past STAR tests.
Instrumentation

The instruments used in this study consisted of a pretest and posttest on unit 1, a Likert scale survey, and a journal that the researcher updated daily during class time. The pretest and posttest (Appendix A) were designed by the researcher to measure student performance on the unit 1 content. The data from these tests measured two things: growth from each student from the start of the unit to the end, and final results from the unit to compare which group scored higher after all of the unit 1 content was presented to them. The Likert scale survey (Appendix B) analyzed the students’ attitude towards learning the content. The data was compared between the two groups to see if there was a difference in attitude from the students in the control group and the students in the experimental group.

Data Collection. Students were given a pretest and posttest covering content from unit 1. The scores from the tests were compared from the control group to the experimental group to see if there was a difference between the two. The researcher looked for differences in posttest scores, and differences in growth from each participant. A Likert scale survey was given to each student following the unit 1 posttest. The students rated their attitude towards learning algebra concepts. The data from the results were analyzed and compared between the two groups to see if there was a significant difference in results. The researcher kept a daily journal to write down observations about student engagement. The observations between the two groups were compared to see if there was a difference in student engagement depending on which learning model was used. The observations included how often there was student to student discussion, how often students stayed on task, and the amount of times students would ask questions to deepen their understanding about the learning targets for that day.
Data Analysis. The scores from the unit 1 pretest and posttest were used to find the mean of each group separately. The difference between the mean scores were analyzed along with the standard deviation. A t-Test was then used to see if there was a significant difference in the results. The Likert scale scores were compared the same way. A t-Test was also used to see if these results were significantly different. The researcher also used these results to see if it would be practical to use one teaching method over the other.

Research Question and System Alignment. 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>
<thead>
<tr>
<th>Research Question</th>
<th>Variables</th>
<th>Design</th>
<th>Instrument</th>
<th>Validity &amp; Reliability</th>
<th>Technique (e.g., interview)</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>What impact does a flipped classroom have on student performance, attitude, and engagement compared to a traditional high school Algebra 2 classroom?</td>
<td>IV: Flipped Instruction</td>
<td>Quasi-experimental</td>
<td>Unit 1 Math Test to evaluate performance and compare results between the two groups</td>
<td>Chronical absence from students can affect scores on tests, which can threaten the validity of the study. Students in the flipped model that don’t watch the video prior to class can also have an</td>
<td>Unit 1 math test</td>
<td>High school Algebra 2 students Sample size: 40 students, with 20 in the control group and 20 in the experimental group</td>
</tr>
<tr>
<td>DV: Student Performance</td>
<td>IV: Traditional Instruction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DV: Student Attitude</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3.1.
Research Question Alignment
DV: Student Engagement

<table>
<thead>
<tr>
<th></th>
<th>attitude in regards to learning algebra concepts</th>
<th>effect on the validity of the study.</th>
<th>Observation journal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Journal kept by researcher to document how engaged students are in their learning and compare results between the two groups</td>
<td>They won’t be able to participate in class activities as well without the prior knowledge of the content.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Procedures**

The control group consisted of the students that did not receive the flipped instruction. They were part of the traditional instructional model where they learned new content through direct instruction during the first part of class. During this time, the teacher explained new concepts and went through example problems while the students took notes and attempted example problems on their own. When the teacher was done with direct instruction, the students would participate in the learning activities the rest of the class time. These activities consisted of individual work time on practice problems, group work on practice problems, or other group activities. The experimental group consisted of students that did receive the flipped instruction. Students in this group received any direct instruction prior to class from a pre-recorded video made by the teacher, or from one that the teacher used from a different resource. During class, students participated in learning activities the entire class period. These learning activities were
intended to keep the students engaged the entire time by using partner, group, and whole class activities and discussions.

At the start of unit 1, students from each group completed the pretest. The researcher analyzed the results to see how much of the content each student already understood prior to the unit beginning. Throughout unit 1, which lasted about a month, the teacher kept a journal, noting the engagement levels of students throughout the class period. Those results were used to compare engagement levels of students between the two groups. After the month of instruction for unit 1, the students in each group took the posttest. The results were used to see the current level of understanding of the unit 1 concepts and were compared between the two groups. The day after the posttest, students completed the Likert scale survey to indicate their attitude level in regard to learning the unit 1 concepts. Again, the results from each group were compared to see if students had a more positive attitude depending on which instructional model they were part of.

**Ethical Considerations**

Students partaking in this study are not at risk of harm physically or psychologically. The students in the control group will have no change to their school routine. The students in the experiment group might feel uncomfortable right away being part of an instruction model that they are not used to, but they will not be harmed in doing so.

**Conclusions**

This study was of a quasi-experimental design and its intentions were to gather data on the use of a flipped instruction model compared to a traditional instruction model in a high school Algebra 2 classroom. Data was gathered using a pretest and posttest to measure student
performance, a Likert scale to measure student attitude, and journal observations to measure student engagement levels. The following chapter will discuss the results of the study.
CHAPTER 4

DATA ANALYSIS AND INTERPRETATION

The purpose of this study was to determine if a flipped classroom instruction model would improve student performance, attitude, and engagement in an algebra 2 classroom. In a flipped instruction model, the direct instruction portion of the lesson takes place outside of the classroom. This leaves more time in class for learning activities and for students to explore mathematical concepts on a deeper level. With the traditional instruction model, direct instruction often times takes at least half of a class period, if not longer. Students then are expected to complete any problems that they do not finish during class at home. With the limited resources available outside of school, many students won’t even attempt the problems. This is causing students to only learn mathematical concepts at the surface level. The purpose of this study is to determine if a flipped classroom will increase student performance in the math classroom. The purpose of a flipped classroom is to open up more time for differentiation and student engagement during learning activities.

Results

RQ 1: Student Performance

The unit test, given as the pretest and posttest for the unit, was used to measure student performance. The scores on the posttest for the experimental group were compared to the scores from the control group, and the growth between the pretest and posttest were also compared between the experimental and control groups. The unit test was comprised of eighteen questions, which covered all of the standards in the unit.
Figure 4.1 shows a comparison of the scores of the unit test for both the experimental and the control group. The scores are arranged from lowest to highest. As one can see, the students who received the flipped instruction model scored slightly better than the students who received the traditional model.

**Figure 4.1**

*Comparison of posttest scores sorted low to high*
The box-and-whisker plot in Figure 4.2 reveals that although the average scores were similar, the experimental group’s scores were slightly higher.

**Figure 4.2**

*Box-and-Whisker Comparison of Posttest Scores*

![Box-and-Whisker Diagram](image)

The median scores differed by more, though, with the experimental group having a median score of 83 and the control group a median score of 77. This means half of the students in the experimental group scored above 83%, and half of the students in the control group scored above 77. The standard deviation for the experimental group is 16.47 and for the control group it is 14.87. This indicates that the test scores for both groups have about the same dispersion. The researcher also performed a t-test to determine if the results of the study are significant. The p-value of the results is 0.6539, which indicates that the results of the study are insignificant. The last thing to check for student performance is the improvement from the pretest to the posttest. The mean scores of the experimental group for the pretest was 59, and the mean for the control
group was 56.95. The improvement was very similar between the two groups, as the mean increased by 18.55 for the experimental group and by 18.30 for the control group.

**Data Analysis**

I did not know what to expect for results of this portion of the study. The literature review had mixed results on whether a flipped classroom improves student performance or not. Unal and Unal (2017) found that students in a flipped classroom demonstrated higher learning gains than students in a traditional instruction model. Nielson et al. (2018) also found that students in a flipped classroom scored higher on final exam scores compared to those in a traditional model. However, Clark (2015) found that the difference among performance measures between the traditional and flipped classrooms can be described as insignificant. All of the studies that were reviewed noted that there needs to be more research on flipped classrooms to arrive at more solid answers. My study showed that the students in a flipped classroom performed slightly better than those in the traditional classroom. The mean and median scores were both higher for the flipped model, and the traditional model had more lower scores. A major problem that the researcher came across during this study was when students in the experimental group did not come to class prepared (i.e. did not watch the video prior to class). This may skew the data slightly.

**RQ 2: Student Attitude**

A four-question survey was used to determine students’ attitude toward learning with a flipped instruction model. The first question asked students to rate how much they liked learning using the flipped instruction model. They used a scale from 1-5, with 1 being they did not like it at all and 5 being they really liked it. I had 20 total students in the flipped classroom, and figure 4.3 breaks down the responses by how many students gave a certain rating. The majority of the class gave a rating of a 5 or 4, meaning they liked the flipped model. Figure 4.4 asked the
students if they learned better, and again the majority said yes. There were some comments on this question where students mentioned they liked having the entire class time to work on assignments. Figure 4.6 shows, again, that the majority of the students wanted to continue learning through flipped lessons.

**Figure 4.3**

*Student Response for Question: I liked learning using the flipped instruction model*

**Figure 4.4**

*Student Response for Question 2: I learned better using the flipped instruction model*
**Figure 4.5**

*Student Response for Question 3: Flipped instruction enhanced my learning and understanding*

![Pie chart showing student responses to Question 3](image)

**Figure 4.6**

*Student Response for Question 4: Do you want to continue doing flipped lesson next chapter?*

![Pie chart showing student responses to Question 4](image)

**Data Analysis**

D’addato and Miller (2016) and Clark (2015) both found that students’ confidence and enthusiasm grew when in a flipped classroom and they had a greater desire to learn. D’addato and Miller (2016) also said that students learned to help themselves when they were struggling and were more self-motivated during class if the direct instruction took place outside of the classroom. I expected the attitudes of my students in the flipped classroom to be the same as
these studies, and they were. The students in the flipped classroom having good attitudes towards learning mathematics may be associated with their improved test scores. If a flipped classroom would not have impacted their test scores, or even brought them down, then I would imagine their attitudes would be different.

**RQ 3: Student Engagement**

For the duration of the unit, I kept a daily journal writing down what I noticed about student engagement within both groups. Within the control group, I had students answer questions that I posed during instruction, and they discussed with group members when I prompted them to. When it was time to work on an assignment, students mostly worked individually. Students asked each other and me questions about solving a certain problem. With the experimental group, students seemed more engaged. Students asked questions about the video from the day before, and I witnessed them discussing the contents of the video with each other. I was able to advance most learning activities on a daily basis with this group because I had more time to do so. This allowed much more time for group collaboration. Many times I heard students talk about how much better a flipped classroom was because they didn’t have to work on assignments at home, not knowing how to solve the problems.

**Data Analysis**

I expected more engagement out of students within the experimental group. Hodgson et al. (2017) found that there was more time for group discussion and collaboration within a flipped classroom. That is the same conclusion that I came to. Steen-Utheim and Foldnes (2018) also said that flipped classrooms have a stronger structural support for group learning compared to a traditional classroom.
**Recommendations for Future Research**

The researcher understands that the results of action research are relative only to the setting in which it took place, which is a limitation of the generalizability of the study. The next steps to further research flipped classrooms will be to perform another study with a different unit to see if the same results appear. Another step to solidify results would be to expand the population of students to those in other math classes taught by other teachers. There would be more concrete conclusions if the studies kept showing the same results. If the researcher were to do this study again, he would expand the duration of the study to a full semester. If students in a flipped classroom were consistently getting higher scores over the length of a semester, the results of the study would be more widely accepted.

**Conclusion**

The study followed anticipated results suggested by the literature, besides not knowing what to expect for student performance. The literature had mixed findings on whether flipped classrooms improve student performance, and this study found that students in a flipped classroom perform better on assessments. The literature suggested that students’ attitudes and engagement would be higher in a flipped classroom, which was consistent with the findings from this study.
CHAPTER 5

IMPLICATIONS FOR PRACTICE

The purpose of this study was to determine the effects a flipped classroom had on student performance, attitude, and engagement compared to a traditional classroom setting. The results of this study showed that students in a flipped classroom performed slightly better on the end of the unit assessment compared to the students in the traditional instruction model. The majority of the students in the flipped instruction model indicated that they enjoyed learning that way and that they would like to continue doing it in the future. Students overall seemed to be more engaged in their learning when they were in the flipped model compared to the traditional model.

Action Plan

Based on the results of my study, I will start to implement a flipped classroom with all of my classes. The results of this study showed that performance increased when students were in a flipped classroom. Students are more engaged when they don’t have to sit through a lecture during the class period. They can start the learning activities right at the start of class, and engage with other students or the teacher to deepen their learning. With more time during class, students get through more learning activities than they normally would in a traditional classroom, causing them to learn more content. Most of my students do not attempt any problems outside of class time, so I do not want to take up half of the class or longer with direct instruction. Students can get this portion at home, and utilize the resources at school when working on problems. I will share my results and research process with my coworkers in case they are seeing the same issues that I was. They might want to conduct their own research on flipped classrooms, and this study would be a good resource for them, especially since the student population is the same. My coworkers might have ideas to enhance this process, as well. The education world is shifting, and
a flipped classroom benefits students in ways that haven’t been mentioned yet. If students have to miss school, they won’t miss any direct instruction because they have access to the videos at home. They will not fall behind if they miss bigger chunks of school at a time. If there are days of inclement weather, schools are shifting to E-Learning days, where students still have to do school work at home. If a teacher is running a flipped classroom, this process is much easier for students.

I have already changed my teaching practice. I have started making my direct instruction videos for all of my classes, and have been changing my learning activities for when students are in class. One addition to this study that I would like to explore is how a self-paced flipped classroom would affect student performance. A possibility I thought of is if students are ahead of pace, they can work in an alternate area, such as the media center. I would set up discussion posts for students to still be engaged with each other. Students that are working at the minimum pace would stay in the classroom so I can make sure they stay on task and don’t fall behind. I think students would be more motivated to watch the videos and complete their assignments so they can get the rewards of going to the media center and also possibly finishing math early. One other option to get more accurate data would be to include a study with multiple teachers. If multiple teachers are involved, with a mix of flipped classrooms and traditional classrooms, and they are giving common assessments then the results will be more of an accurate representation of how a flipped classroom can impact student learning. I can see mathematics moving more in the direction of a flipped classroom rather than the traditional way of having direct instruction followed by an assignment.
Plan for Sharing

I will share this study with my colleagues in the high school. I am going to use a staff meeting to present my study. I will talk about why I chose to research flipped classrooms, and the procedures I used in my study. I will present the results so my colleagues interpret the data how they wish. If my principal thinks it would be a good idea, I will also share with the school board and the entire district. I will not share this research with any national organizations or journals because it is such a small sample size. If I conducted a study for a longer duration and had more students in the population, then I think it would be worth to share at more of a state or national level.
REFERENCES


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Appendix A: Unit 1 Test

Algebra II

NAME: __________________

Functions Test

*Benchmark 9.2.1.3: Find the domain of a function defined symbolically, graphically or in a real-world context.*

The function \( h(t) \) describes the height, in feet, of an object at time \( t \), in seconds, when it is launched upward from the ground at an initial speed of 112 feet per second.

![Graph of \( h(t) \)](image)

a) Find the domain. Write in interval notation.

b) What does the domain mean in this context?

If \( P(x) \) is an even function with a negative leading coefficient, describe its end behavior.
Benchmark 9.2.1.4: Obtain information and draw conclusions from graphs of functions and other relations.

Benchmark 9.2.1.6: Identify intercepts, zeros, maxima, minima and intervals of increase and decrease from the graph of a function.

The graph shows membership costs at a gym. How much was the initial membership fee?

![Gym Membership Costs](image)

Martha’s text message plan cost $15.00 for the first 1000 test messages sent plus $0.25 per text over 1000 sent. Let \( C(t) \) represent the cost of sending \( t \) messages over 1000. Sketch a graph of this relationship and find and interpret the \( C(t) \)-intercept.

![Graph of C(t)](image)

Don opened a savings account with $300. Each month, he will add $50 to the account. Let \( y \) represent the amount of money in the account after \( x \) months. Write an equation to model this situation. What do the slope and \( y \)-intercept mean in this situation?
Benchmark 9.2.1.9: Determine how translations affect the symbolic and graphical forms of a function. Know how to use graphing technology to examine translations.

Describe the following transformation of the graph $g(x) = \frac{2}{5} f(x - 8) + 3$.

Use this description to write the function in vertex form: A function is vertically stretched by a factor of 4, translated 7 units left and 1 unit down.

Without using graphing technology, sketch the parent graph and translate it to obtain a graph of $y + 2 = |x + 5|$.

The formula for converting temperatures from kelvins $K$ to degrees Fahrenheit $F$ is $F = \frac{9}{5} K - 459.67$. Find the inverse of this function and find the equivalent temperature of $-121^\circ F$ in kelvins.
A plumber charges $40 an hour. For each job he charges an additional $25 for the service call. Write an equation that represents the plumber’s total charge with respect to the number of hours worked. Find the inverse of your equation. What does the inverse equation represent?

At a carnival, you pay $15 for admission, plus $3 for each ride you go on.

a) Write a function $A(r)$ that models the amount $A$, in dollars, you would spend to ride $r$ rides at the carnival.

b) Find the inverse of $A(r)$. Show your work.

c) What does the inverse function found in part b represent in the context of the problem?

Benchmark 9.2.2.6: Sketch the graphs of common non-linear functions such as $f(x) = |x|$.

Benchmark 9.2.4.6: Represent relationships in various contexts using absolute value inequalities in two variables; solve graphically.

Solve $-\frac{1}{2}|6 - 3x| = -6$ algebraically.
Graph the solutions to $2|x - 3| < 2$.

Machine parts must be specific sizes so that they fit perfectly within the machine. A certain machine part has a diameter of 14.53 cm with an absolute deviation of at most 0.12 cm.

a) Write an absolute value inequality that can be solved to find the least and greatest acceptable diameters of a machine part. Then find the least and greatest acceptable diameters.

b) A machine part like the one described has a diameter of 14.67 centimeters. By how many centimeters does this part's diameter exceed the greatest acceptable diameter?
Appendix B: Likert scale

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
Appendix C: Informed Consent

March 20, 2021

100 George Ramseth Drive
Redwood Falls, MN 56283

Dear Parent or Guardian,

Your child has been asked to participate in a study to see if a flipped instruction model will improve their performance, engagement, and attitude compared to a traditional instruction model in Algebra 2.

Your child was selected because he/she is in one of my Algebra 2 classrooms. If you decide to participate please understand that your child will be asked to do the following, which involve no risk to your child.

1. Your child may be asked to watch videos explaining new content outside of class time, which will allow class time to be used to enhance their learning of the new concepts. Students in the flipped classroom will be asked to do this.
2. Students will be given a pretest and posttest to see how their performance has improved throughout the unit.
3. Students will be asked to fill out a survey, rating how they enjoyed the flipped instruction model, and asking them to elaborate on a few questions.

Principal Rick Jorgenson has granted me permission to conduct this study. However, since the information is being used to help me complete my master’s degree at Minnesota State University Moorhead, I need to have parental consent to use this information in my final paper that I am required to do as part of my degree. I would still be implementing this research into my classroom even if I didn’t need it for my degree, and I wouldn’t need signatures if that was the case. If you sign this form, you are giving me consent to use all of the information that I gather. All information that is used will remain confidential. Please note that your child can choose to not participate at any time without consequences.

Feel free to ask any questions you may have regarding this study. You may contact me here at school at 507-644-3521 ext. 8149 or bbergeson@redwoodareaschools.com. You may also contact the Principal Investigator, Tiffany Bockelmann at tiffany.bockelmann@mnstate.edu. Any questions about your rights may be directed to Lisa Karch at irb@mnstate.edu.

You will be offered a copy of this form to keep. Your signature indicates that you have read the information above and have decided to participate. You may withdraw at any time without prejudice after signing this form should you choose to discontinue participation in this study.

_________________________________________  ________________
Signature of parent or guardian          Date

_________________________________________  ________________
Signature of Investigator               Date
Appendix D: IRB Approval

DATE: September 17, 2021

TO: Tiffany Bockelmann
    Brett Bergeson

FROM: Lisa Karch, Chair
      Minnesota State University Moorhead IRB

ACTION: APPROVED

PROJECT TITLE: [1810051-1] Flipping the Classroom: Flipped Learning and the Performance of High School Algebra 2 Students

SUBMISSION TYPE: New Project

APPROVAL DATE: September 17, 2021

EXPIRATION DATE: September 17, 2022

REVIEW TYPE: Exempt Review

Thank you for your submission of New Project materials for this project. The Minnesota State University Moorhead IRB has APPROVED your submission. This approval is based on an appropriate risk/benefit ratio and a project design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

This submission has received Exempt Review based on the applicable federal regulation.

Please remember that informed consent is a process beginning with a description of the project and insurance of participant understanding followed by a signed consent form. Informed consent must continue throughout the project via a dialogue between the researcher and research participant. Federal regulations require that each participant receives a copy of the consent document.

Please note that any revision to previously approved materials must be approved by this committee prior to initiation. Please use the appropriate revision forms for this procedure.

All UNANTICIPATED PROBLEMS involving risks to subjects or others and SERIOUS and UNEXPECTED adverse events must be reported promptly to the Minnesota State University Moorhead IRB. Please use
the appropriate reporting forms for this procedure. All FDA and sponsor reporting requirements should also be followed.

All NON-COMPLIANCE issues or COMPLAINTS regarding this project must be reported promptly to the Minnesota State University Moorhead IRB.

This project has been determined to be a project. Based on the risks, this project requires continuing review by this committee on an annual basis. Please use the appropriate forms for this procedure. Your documentation for continuing review must be received with sufficient time for review and continued approval before the expiration date of.

Please note that all research records must be retained for a minimum of three years after the completion of the project.

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.

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