Using a Flipped Classroom for Algebra 1:

A First Semester Curriculum for Algebra 1

by

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Curriculum Development

Submitted in partial fulfillment of the requirements for the

Master of Science Degree in Education

Graduate Studies

Martin Luther College

New Ulm, MN

January 2021

Signature Page

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Abstract

Algebra students in WELS Area Lutheran High Schools come from a variety of backgrounds, schools, and teachers. This variety leads to different stages of understanding of algebra concepts. Research suggests that the use of video instruction and use of digital tools improve student achievement and understanding. This curriculum project aims to analyze the results of flipping an Algebra 1 classroom created for incoming freshmen as an alternative to the traditional classroom. Student test scores and survey comments were collected. This data showed that students were successful in the flipped classroom and capable of using the technology necessary.

Acknowledgments

I would like to thank all who supported me through this project and my journey getting here including Eastside Lutheran School and Lakeside Lutheran High School. They have supported me financially and kept me focused on my goals. I would also like to thank my wife and family for their patience with me during my late nights, busy weekends, and full summers. Finally, I would like to thank my advisor, Dr. Grunwald, for all of this support and assistance throughout my graduate studies and for keeping me as an advisee after retirement.

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Chapter I: Introduction

The Purpose of the Project

Algebra is a fundamental tool in the areas of mathematics, science, and engineering. It is essential in the progression of knowledge through higher levels of math, and it also promotes the development of critical thinking skills, problem solving, and reasoning. Our goal as educators is to prepare students for what is coming next in their lives. The goal of this capstone project was to design an Algebra 1 curriculum for one semester in a high school freshman class that makes use of current digital resources to better differentiate and meet the needs of students who come from a variety of backgrounds in mathematics. This was done by using a flipped classroom model of instruction. A flipped classroom presents new material outside of class through the use of videos, pictures, and written study guides. The time in class is then spent doing the practice with the teacher available for help.

Importance of the Project

Algebra is sometimes overlooked as an important and essential part of the overall math curriculum. Even in our Area Lutheran High Schools, it is sometimes taught by teachers who may not have a passion for mathematics. Students come into a freshman Algebra 1 classroom from a variety of backgrounds in mathematics. These backgrounds may use different terminology and a different set of standards from what the high school course needs. Oftentimes, differentiation is needed in the classroom because of the wide range of abilities and preexisting content knowledge of each student. A curriculum that allows the basic content to be introduced and practiced outside of the classroom allows a teacher to give more hands-on practice to those who need extra help and allow students

who already know the basics of the content to apply that knowledge in extension activities.

This project is important for Lakeside Lutheran High School. Even though there is a solid Algebra curriculum, students coming from more than twenty federation schools have a wide range of backgrounds in mathematics. Many of the schools have different textbooks that do not match up with the high school curriculum. This leaves the high school Algebra teacher in a tough spot. There is not enough time in a typical class period to teach an effective lesson, give help to the struggling student, and challenge the student who already knows most of the content.

The solution of a flipped classroom could apply to more Algebra classrooms than just those at Lakeside Lutheran. In the spring of 2020, many classrooms were thrown into confusion and turbulence with the forced need to move into the world of online learning. Making a shift to using digital tools regularly in a flipped classroom would make the transition to online learning more manageable for both teachers and students. This would also help prepare students who are interested in taking classes to supplement their education with classes that may only be available online.

Project Goal

This completed curriculum provided a flipped classroom model of basic instruction for Algebra 1 using digital tools to deliver the lesson and provide the first levels of assessment. The flipped classroom model of instruction freed up classroom time to meet the needs of struggling students and enhance the learning of those who had a firm grasp on the basic content. This curriculum aligned with the curriculum and standards in place at Lakeside Lutheran High School.

Chapter II: Literature Review

Students in the U.S. are not performing as well in mathematics as other countries. According to Slavin, Lake, and Groff (2008), American 15-year olds were ranked 28th out of 40 countries on the Program for International Student Assessment (PISA) in 2003 but showed improvement from the 1995 PISA. This improvement did not continue. In 2015, 15-year olds in the U.S. ranked 40th out of 70 nations who participated in PISA on mathematics achievement (Comparative Education Research Unit & Ministry of Education, 2017). Slavin et al. (2008) stated that this issue is of great concern to many and may indicate the nation's future economic potential.

With so many different math curriculum resources to choose from, what makes one better than another? Many schools and educators choose to use resources that are similar to how they were taught or what matches with what they feel are the most important concepts. This can be problematic for high schools where students have a variety of experiences and backgrounds in their math instruction. The curriculum may not be the issue, however. Slavin et al. (2008) proposed that the real issue lies with the instruction and which tools are being used or overlooked. It is only with quality instruction and the use of effective tools that student achievement in math will improve.

Most teachers today were taught using a traditional lecture style approach. According to Love, Hodge, Grandgenett, and Swift (2013), many teachers still use this method even though they may not think it is the best option, because they are familiar with it. They also point out that the traditional method may yield positive results, but question whether it is the best option for everyone when one factors in learning styles and

flexibility. This traditional method also makes it challenging and very time consuming to personalize or differentiate learning for every student (Bergmann & Sams, 2012).

Educators continue to seek out ways to make learning student-centered and more personalized. Fulton (2012) warns us about jumping on passing fads and chasing the newest innovations. Slavin et al. (2008) researched a variety of math curricula including traditional textbooks, computer assisted instruction (CAI), and cooperative learning models. They found that while some CAI and cooperative learning increased student achievement, the best results may come if all three types are used together. Dyer, Reed, and Berry (2006) argued that math teachers should work together with technology teachers to help show students the application of certain math skills.

Some may consider a flipped classroom to be a current fad in education, but it takes the best parts of many different models and puts them together to enhance student learning. A flipped classroom is like a traditional classroom where direct instruction is given, followed by an assignment. The difference lies with when each of those two parts are given to the students. In essence, a flipped classroom is just changing the times when homework and direct instruction are given. The direct instruction is given outside of class in a video, guided notes, or some other digital method. Then, when students return to the classroom, students have time to do the homework with the teacher available to help students during the assignment.

Bergmann and Sams (2012) incorporated many of the ideas about personalized learning, using technology, and active learning into their flipped classroom model, but the idea of flipping a classroom was around long before Bergmann and Sams started using it in their own classrooms. Lage, Platt, and Treglia (2000) made use of an inverted

classroom for an economics course where the material typically taught inside the classroom was now taught outside the classroom using various multimedia options. Class time for this course was now used to incorporate experiments and more group interactions. Overall feelings of the participants were positive with this inverted model. Strayer (2007) also made use of a flipped classroom for a statistics course where he made use of an intelligent tutoring system (ITS) to give basic instruction to his students outside of the classroom. While he found that the flipped classroom allowed for more innovation and cooperation in the classroom, there were too many challenges for him to fully recommend the use of this strategy. According to Bergmann and Sams (2015, p. 85) "the power of flipped learning lies in the delivery of instruction to individual learners." Because of the mixed results in early flipped classrooms, more people researched what was possible with student learning and achievement by flipping a classroom.

Hodgson, Cunningham, McGee, Kinne, and Murphy (2017) pointed out that student engagement is the main reason for the interest in flipped classrooms. In their research, they state, "…the opportunity to engage students in a broad range of learning activities in a setting in which [the teachers] and the students' peers are readily available to assist and collaborate" (Hodgson et al., 2017, p. 248). Bergmann and Sams (2015) agreed that the flipped class allows math teachers to move toward more active forms of learning. Lage et al. (2000) also pointed out that an inverted classroom gives opportunity for faculty-student interactions. Bergmann and Sams (2012) made use of these same principles by walking around helping the struggling students during the class time. According to Clark (2015), students in a flipped Algebra 1 course felt they were more actively involved in their learning and participated more in class than they had in the

traditional classroom. He also pointed out that participants felt that there was a better use of class time with the flipped model. Hodgson et al. (2017) added that the high student engagement in learning led to more student communication about mathematics and high levels of behavioral engagement. Tucker (2012, p. 83) also pointed out in his article "that thoughtful course redesigns lead to improved learning" for "dozens of colleges that have successfully experimented with similar ideas across math, science, English, and other disciplines." With a greater focus in schools today on science, technology, engineering, and mathematics (STEM), math teachers can use the flipped classroom model to engage students in deeper analysis of mathematical concepts and connect learning with other STEM areas (Bergmann & Sams, 2012).

Strayer (2007) did not have a positive experience with his flipped classroom. He felt that the flipped classroom was more fragmented than a traditional classroom, and students felt that they had little control over their learning. One area he pointed out as a weakness for his study was the use of the ITS, Assessment and Learning in Knowledge Spaces (ALEKS). What he wanted to do during the class period with the students did not always mesh with what students were learning through ALEKS. Although his study showed mainly negative feelings towards a flipped classroom, he recommended that teachers who want to use a flipped classroom should allow students to choose how they access course content, use more step-by-step activities for introductory courses, and allow students to reflect on their learning (Strayer, 2007). He also pointed out a similar finding to Bergmann and Sams (2012) that in a lecture setting, teachers do not deliver the content at the best speed for all students. Videos allow students to pause, rewind, or even speed up delivery of the content.

As more studies show the positives to student engagement (Hodgson et al., 2017) in flipped classrooms, more studies will be recommended and completed. Byron High School in Minnesota implemented a successful flipped classroom model for their math classes and were first to admit that there was not just one correct way to implement a flipped classroom (Fulton, 2012). More educators need to embrace this opportunity to engage their students and find the potential for "improving student engagement and performance in the secondary mathematics classroom" (Clark, 2015, p. 112). Similarly, Love et al. (2013) shared a similar sentiment in the summary of their findings, "Hence, further research is needed in other disciplines, instructional contexts, and by additional STEM educators...." (p. 323).

Chapter III: Implementation

Introduction

Algebra 1 is a required course for most high school students. This requirement causes a grouping of students with varying abilities and backgrounds. A flipped classroom model for Algebra 1 allows the teacher to better differentiate between the wide range of abilities the various students have and gives time to meet Algebra students where they left off coming from different schools with many different curricula and modes of instruction in mathematics.

Teachers have used flipped classrooms to cover missed days of class, sudden illness, or even just as a change of pace. In a traditional classroom, this may just happen for a few days, but the potential is there for it to work for a semester or even an entire school year. This chapter describes what it was like laying out the curriculum for a semester in an Algebra 1 course, creating the flipped lessons, and working one-on-one with students during classroom time.

Procedures

This course covers the same content that was taught in previous years during the normal first semester of Algebra 1 (Appendix A, Appendix B, and Appendix C). All sections of the Algebra course made use of Google Classroom as our hub of information and links to online resources. The lessons posted to Google Classroom contained a study guide, a video or two, what the key concepts for the day were, specific instructions to follow the flipped lesson, and links to assignments (Appendix D). Most assignments were given in a digital format for the students to work on using their Chromebooks (Appendix E). These digital assignments allowed students to get immediate feedback if they were

completing the work outside of the classroom or if the instructor was busy helping other students during the class period. As students had questions on their results, the instructor helped to point out where the mistakes occurred and how to avoid them in future problems. Another benefit the digital assignments had were the extra practice problems that would be given if students struggled at first. This allowed them to practice the correct strategies after receiving help during the class period.

Each class period was set up in a similar way. The period started with a short review of concepts that had been taught in the video assigned the previous day. One or more examples were shown on the board for each type of problem and concept. This quick review allowed some students to get directly into the assignment for that day, while others had a few more questions. Most class periods involved direct contact with about half the class who had questions on various portions of the lesson. The other half of the class was self-motivated and enjoyed the chance to get right at their work without needing to wait for direct instruction of the lesson. Walking around the classroom while students worked allowed the instructor to give just-in-time feedback to students that appeared to be struggling or confused. With this immediate assistance, students demonstrated more persistence in learning concepts in the class than if they had been on their own. Assessments were given in class to help avoid the possibility of cheating. These assessments matched assessments given in previous years.

All four sections of Algebra 1 were taught using the same flipped lessons, so the effectiveness of teaching in a flipped format was found using two different sets of data. The first set of data used compared results from a pre-test and post-test (Appendix F) to evaluate how much of the content students learned during the semester. The second set of

data used compared the semester exam scores of the students who participated in the flipped classroom to those who took a more conventional course during the previous three years. A survey (Appendix G) was also administered at three different points during the semester to gather meaningful data about student participation and perception of the flipped classroom.

Artifacts

At the beginning of the semester, all students took a pre-test (Appendix F) to show their starting knowledge of the learning targets for the course. Throughout the semester, all lessons were posted to Google Classroom. The topics for each chapter were broken down into learning targets (Appendix B). The day-to-day assignments were designed to introduce students to the new material and then to practice the skills taught. Assessments were given regularly in the form of quizzes to determine if students understood the learning targets (Appendix H). At the end of each section, a test would be given as the final assessment of those learning targets. All assessments were aligned with the Common Core State Standards (Appendix C).

At the conclusion of the semester, the students completed the post-test (Appendix F), which was the same as the pre-test given at the beginning of the semester to show the growth in knowledge by the students. The students also completed their semester exam that was used to compare how well students from the flipped classrooms this year to students from previous years.

Results

Overall, students appeared to enjoy the flipped classroom setting. In the survey (Appendix G) given at the end of the semester, nearly half of the students felt there were

no changes needed to the way the course was taught to better meet their needs or help them understand the concepts. One student commented, “I liked that there was time in class to ask questions and there was always enough class time to answer all my questions.” This was echoed by many others both in the survey and from comments made in class. Other students liked the video aspects of the lesson. One student shared, “I liked being able to go back and rewatch the videos over and over again if needed instead of having to keep asking in class or wait until the next time you meet in class.” Some students really liked the independence that the flipped classroom allowed them. One student commented, “You can be independent. You can ask questions whenever you want, and in a way work at your own pace.” Overall, comments showed a lot of positives about the flipped classroom. The other survey questions showed a positive overall experience, but there was a slight downward trend in students watching the videos ahead of time. This was especially noticeable when comparing the summary of data from the September survey (Appendix I) to the data from the November survey (Appendix J) and December Survey (Appendix K). While there was a decline in how many videos were watched ahead of time, the confidence of students in the material went up (Table 1).

After the semester was complete, the results of the pre-test, post-test, and semester exams were analyzed. The results were similar to those found in previous research done on flipped classrooms that were mentioned in the Literature Review (e.g. Bergmann & Sams, 2012; Slavin et al., 2008). Students showed growth across all learning targets when comparing the pre-test data to post-test data. Sixty-eight of the 73 students showed growth on the complete post-test with an average increase of 25% (Figure 1). The data indicated larger student growth in the learning targets of chapters

Table 1

Average Scores of Student Responses to Survey Questions

Survey question	September results Average score	November results Average score	December results Average score
How often... [a]			
I watched the lesson video before class.	3.52	2.99	2.97
I enjoyed watching the lessons on video.	3.52	3.34	3.19
I used the online resources provided. (practice problems, review games, etc.)	3.82	3.62	3.48
I had opportunities to communicate with peers about the lessons.	3.66	4.24	4.20
I felt comfortable doing the assignments.	4.38	4.51	4.38
I feel that the teacher or others answered my questions in the class.	4.52	4.51	4.50
Confidence [b]			
I felt confident about the material after watching the lesson videos but before coming to class.	2.34	2.36	2.41
I felt confident about the material after coming to class.	2.76	2.78	2.61
Effort [c]			
Describe the amount of effort you have been putting into the lessons at home.	3.08	2.88	2.78
Describe the amount of effort you have been putting into the lessons in class.	3.45	3.41	3.34

Note. This table represents the responses from students in a numerical format to help compare the results from all three surveys given. Each survey contained the same questions in the same order.

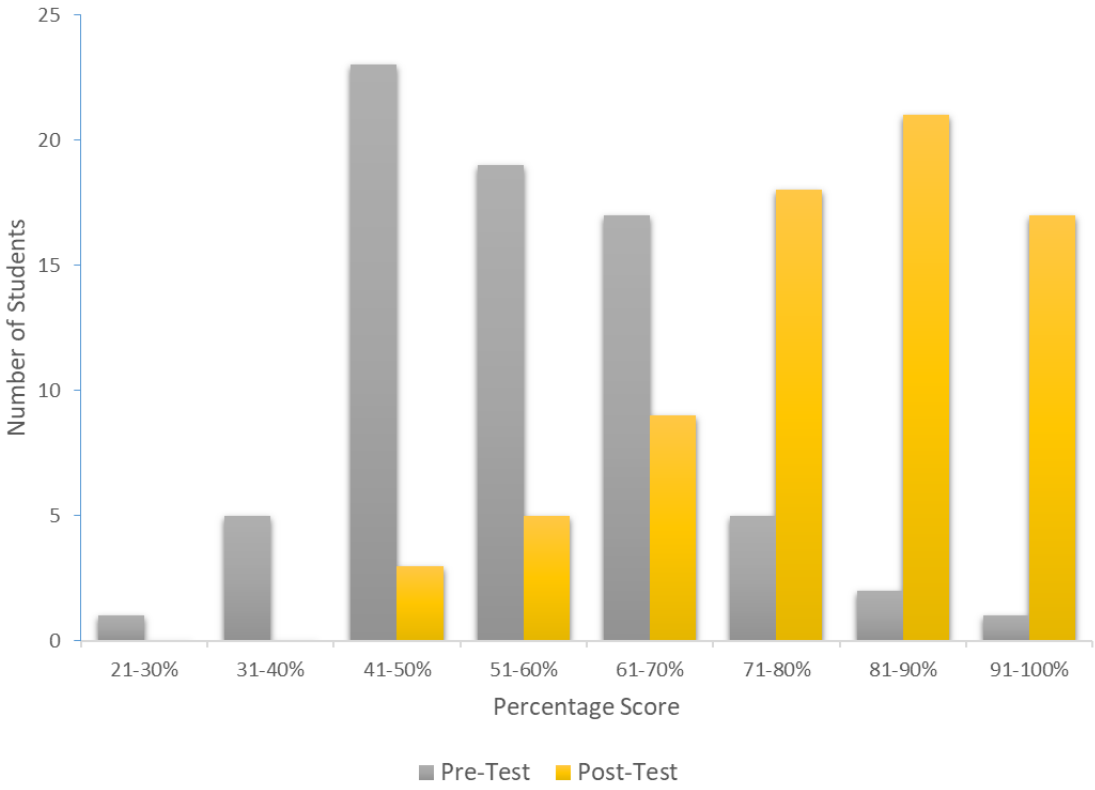
[a] Responses for how often were given values of 1 (Never) to 5 (Always).

[b] Responses for confidence were given values of 1 (Not very confident) to 3 (Very confident).

[c] Responses for effort were given values of 1 (No effort) to 4 (Maximum effort).

Figure 1

Comparison of Pre-Test and Post-Test Scores in the Fall Semester of 2020

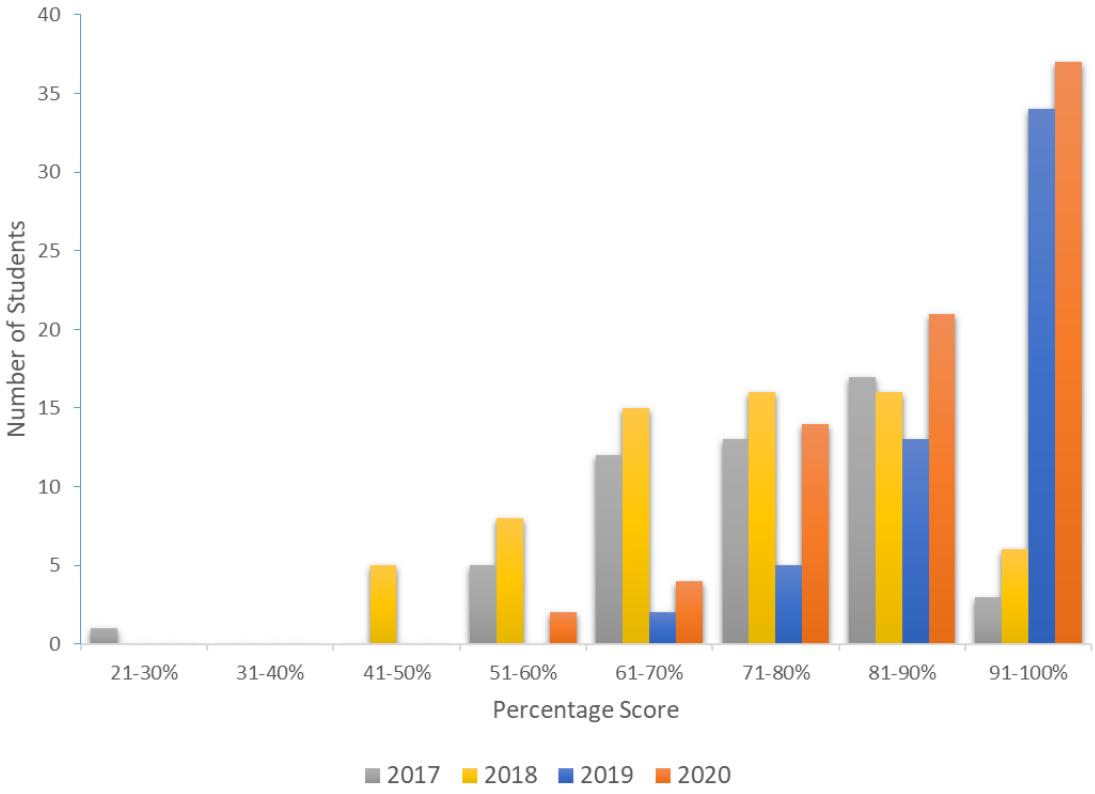


four, five and six where 70 out of 73 showed an average growth of 43%. Many of the learning targets in the first three chapters were reviewed from previous courses, so most of the growth was found in the second half of the semester.

The semester exam scores showed some positive results when compared to students in previous years. The average score on the exam in 2017-2019 was 79.2% (171 students) while the average score in 2020 was 87.2% (78 students). The compared test data can be seen in Figure 2. Also, when these scores were compared using a two-sample t-Test assuming equal variances, $t(72) = 4.42$. $p < 0.001$, the difference is found to be statistically significant.

Figure 2

Comparison of First Semester Algebra 1 Exam Scores for 2017-2020



Chapter IV: Reflective Essay

Introduction

The main goal of this project was to create one semester of a flipped Algebra 1 course for high school students. This flipped classroom model would be used to help free up classroom time to meet the needs of struggling students and to enhance the learning of those who already have a firm grasp on the basic content of algebra. This course was designed to fit current curriculum and standards in place at Lakeside Lutheran High School. Students coming from a variety of schools and backgrounds in a federation of Area Lutheran High Schools will benefit from the extra one-to-one time a flipped classroom can offer.

Conclusions

There were a few limitations for this project. First, this was a quasi-experimental study, as all students were not randomly selected. Rather, they were from my current school year and were compared to students in previous years. A second limitation was that some students did not have a background in using the digital tools necessary for the flipped classroom, while others had used some of the digital tools in past classrooms. A third limitation was the short introduction to what a flipped classroom actually was, since the course started on day one as a flipped classroom. Some students had already seen a flipped classroom, while others did not understand the concept in the early stages of delivery.

I learned that developing lessons for a flipped classroom took more time to prep than I had anticipated. I also learned that smaller sets of learning targets were essential to increase learning. When too many learning targets were included, students had a harder

time understanding the objectives of the lesson and were more confused during the assignment. I used survey feedback in September and November to adjust the size of lessons and assignments to make the most of our time each class period. A few students struggled to keep up with the work outside of class, but with the flipped classroom I was able to spend more time directly instructing them while others worked and even helped each other out.

A major advantage I found in using the flipped classroom was how much the students learned to help each other. The students who understood the concepts were willing to help explain concepts in ways that they understood. I feel this added to the overall success of the flipped course because when students work with skills and content in more ways than just practice it often leads to deeper understanding. In looking at the students' surveys, I see that the students enjoyed the freedom that the flipped classroom allowed them. Some students that had class in the afternoon were able to get started on the day's assignment before class since I posted them every morning at 7:30 AM. Many students had morning study halls before they received any work to complete. I found this kept students' attitudes positive as they had that extra time to start an assignment and knew they still had a chance to talk to me during class if there were any questions.

While most students excelled in the flipped classroom, there were some who struggled. I noticed that the students who struggled most had poor backgrounds in basic mathematics skills, poor work habits, or just struggled with algebra concepts in general. These students were referred to our Extended Learning Center during study hall to receive extra help besides what I was able to give in class. Considerations should be

taken for these students when setting up a flipped classroom to give them every opportunity to succeed.

Recommendations

I enjoyed developing and teaching Algebra 1 as a flipped classroom. As the research suggested, there is quite a bit of work that needs to go into the planning of a successful flipped classroom. I was encouraged to see the students succeed and stay positive in a class that some students do not see the point of needing to complete.

I encourage other teachers to pursue flipping their classroom if they feel comfortable with the technology required to do it. Introductory courses at the high school level may be the easiest to implement, but caution should be used with lower level students that take those courses. Higher level courses may work, but the time and energy needed to create materials could make it difficult to see the overall benefits.

I plan to try flipping my classroom again in the future for other courses, but I would plan to consider these changes and modifications:

- Limit the number of online digital sites for assignments, so students are not confused by where their assignments are located.
- Require an online submission of notes and work for students to keep digital resources and for the teacher to easily review.
- Plan to use more class time to review past concepts.
- Raise expectations above what a typical classroom would have. I feel I held some students back from their full potential by not expecting more.
- Force myself to check in with every student at some point each class period, so that those that do not ask for help are supported more regularly.

- Post a more detailed outline of assignments for each chapter or unit when it starts to let students know what to expect.

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Appendix A: Algebra 1 Course Outline

Semester 1	**Chapter:** 1) Expressions, Equations, and Functions 2) Properties of Real Numbers 3) Solving Linear Equations 4) Graphing Linear Equations and Functions 5) Writing Linear Equations 6) Solving and Graphing Linear Inequalities
Semester 2	**Chapter:** 7) Systems of Equations and Inequalities 8) Exponents and Exponential Functions 9) Polynomials and Factoring 10) Quadratic Equations and Formulas 11) Radicals and Geometry Connections 12) Rational Equations and Functions 13) Probability and Data Analysis

Appendix B: Scope and Sequence

Chapter	Learning Targets
Chapter 1: Expressions, Equations, and Functions	a. Evaluate expressions b. Apply order of operations c. Write expressions d. Write equations e. Write inequalities f. Represent functions as rules and tables g. Represent functions as graphs
Chapter 2: Properties of Real Numbers	a. Use integers and rational numbers in basic operations (addition, subtraction, multiplication, and division) b. Add real numbers c. Apply properties of addition (associative, commutative, identity, and inverse) d. Subtract real numbers e. Multiply real numbers f. Apply properties of multiplication (associative, commutative, identity, zero property, and the property of -1) g. Apply the distributive property h. Divide real numbers i. Apply the inverse property of multiplication j. Find square roots k. Compare real numbers
Chapter 3: Solving Linear Equations	a. Solve one-step equations b. Solve two-step equations c. Solve multi-step equations d. Solve equations with variables on both sides e. Write ratios and proportions f. Solve proportions g. Solve percent problems h. Rewrite equations and formulas (literal equations)
Chapter 4: Graphing Linear Equations and Functions	a. Plot points in a coordinate plane b. Graph linear equations c. Graph using intercepts d. Find slope and rate of change e. Graph using slope-intercept form f. Graph linear functions
Chapter 5: Writing Linear Equations	a. Write linear equations in slope-intercept form b. Use linear equations in slope-intercept form c. Write linear equations in point-slope form d. Write linear equations in standard form e. Write equations of parallel and perpendicular lines f. Create lines of best fit
Chapter 6: Solving and Graphing Linear Inequalities	a. Solve inequalities using addition and subtraction b. Solve inequalities using multiplication and division c. Solve multi-step inequalities d. Solve compound inequalities e. Solve absolute value equations f. Solve absolute value inequalities g. Graph linear inequalities

Appendix C: Common Core State Standards

The Common Core State Standards for this first semester algebra course are listed below. The complete list of the Common Core State Standards for Mathematics can be found on pages 57-83 in the document found at https://dpi.wi.gov/sites/default/files/imce/standards/pdf/common-core-math-standards.pdf.

A.CED.1: Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.

A.CED.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

A.CED.3: Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.

A.CED.4: Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law V = IR to highlight resistance R.

A.REI.1: Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.

A.REI.3: Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

A.REI.10: Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).

A.REI.12: Graph the solutions to a linear inequality in two variables as a halfplane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

A.SSE.1: Interpret expressions that represent a quantity in terms of its context.

F.IF.1: Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes

the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x).

F.IF.2: Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.

F.IF.4: For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.

F.IF.5: Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.

F.IF.6: Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.

F.IF.7: Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.

F.IF.7a: Graph linear and quadratic functions and show intercepts, maxima, and minima.

G.GPE.5: Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).

N.RN.3: Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.

N.Q.1: Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

N.Q.2: Define appropriate quantities for the purpose of descriptive modeling.

N.Q.3: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

S.ID.6: Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.

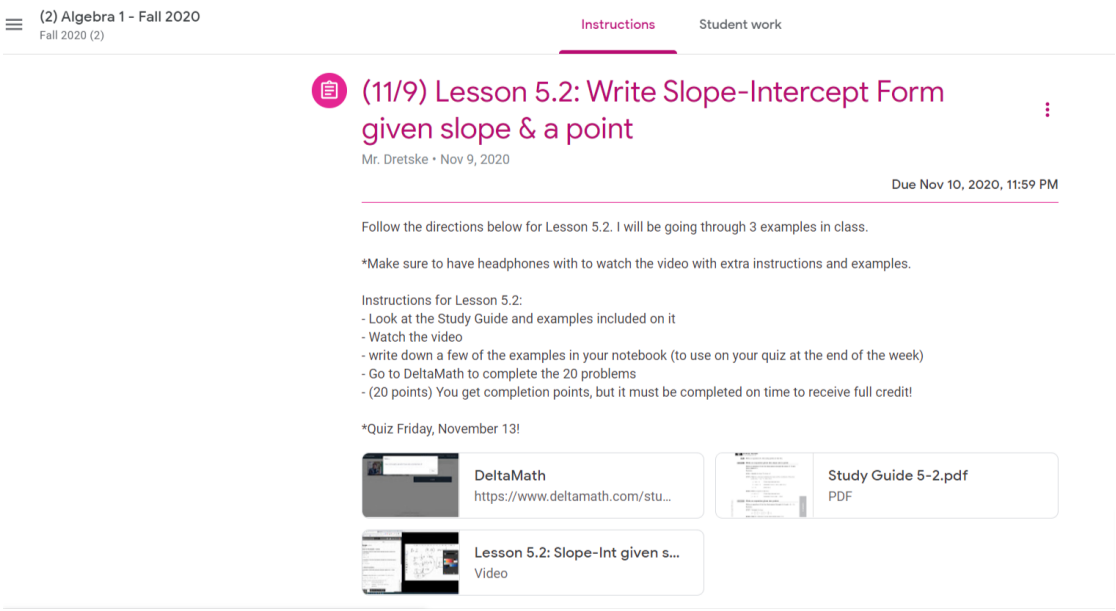
S.ID.6a: Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.

S.ID.6c: Fit a linear function for a scatter plot that suggests a linear association.

S.ID.7: Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.

Appendix D: Sample Flipped Lesson

Screenshot of Google Classroom post for Lesson 5.2



Study Guide from lesson 5.2

LESSON 5.2 **Study Guide**
For use with pages 292–299

GOAL **Write an equation of a line using points on the line.**

EXAMPLE 1 **Write an equation given the slope and a point**

Write an equation of the line that passes through the point (2, 5) and has a slope of 3.

Solution

STEP 1 **Identify** the slope. The slope is 3.

STEP 2 **Find** the y-intercept. Substitute the slope and the coordinates of the given point into $y = mx + b$. Solve for b.

$y = mx + b$ Write slope-intercept form.

$5 = 3(2) + b$ Substitute 3 for m, 2 for x, and 5 for y.

$-1 = b$ Solve for b.

STEP 3 **Write** an equation of the line.

$y = mx + b$ Write slope-intercept form.

$y = 3x - 1$ Substitute 3 for m, and -1 for b.

EXAMPLE 2 **Write an equation given two points**

Write an equation of the line that passes through (3, 9) and (−2, −1).

Solution

STEP 1 **Calculate** the slope.

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-1 - 9}{-2 - 3} = \frac{-10}{-5} = 2$$

STEP 2 **Find** the y-intercept. Use the slope and the point (3, 9).

$y = mx + b$ Write slope-intercept form.

$9 = 2(3) + b$ Substitute 2 for m, 3 for x, and 9 for y.

$3 = b$ Solve for b.

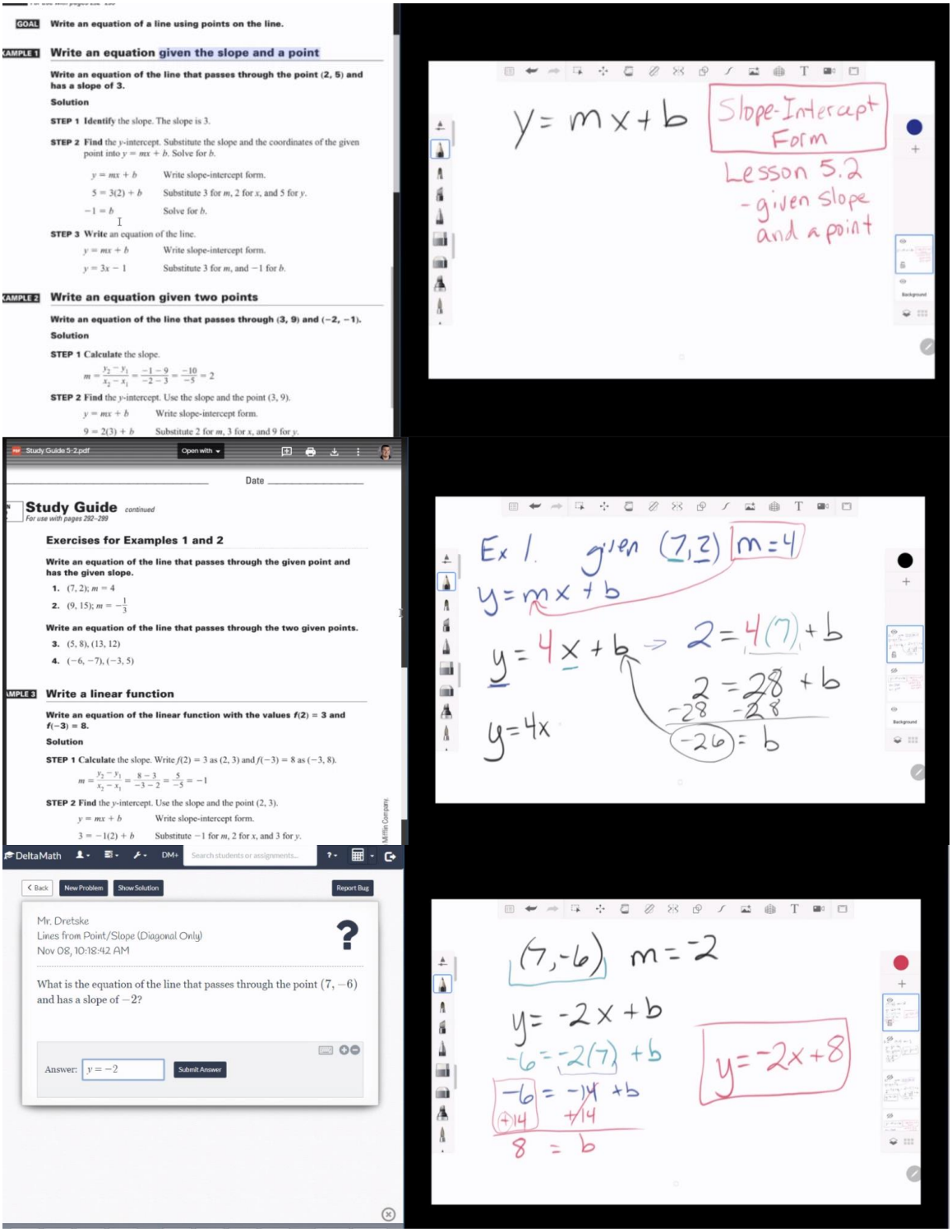
STEP 3 **Write** an equation of the line.

$y = mx + b$ Write slope-intercept form.

$y = 2x + 3$ Substitute 2 for m and 3 for b.

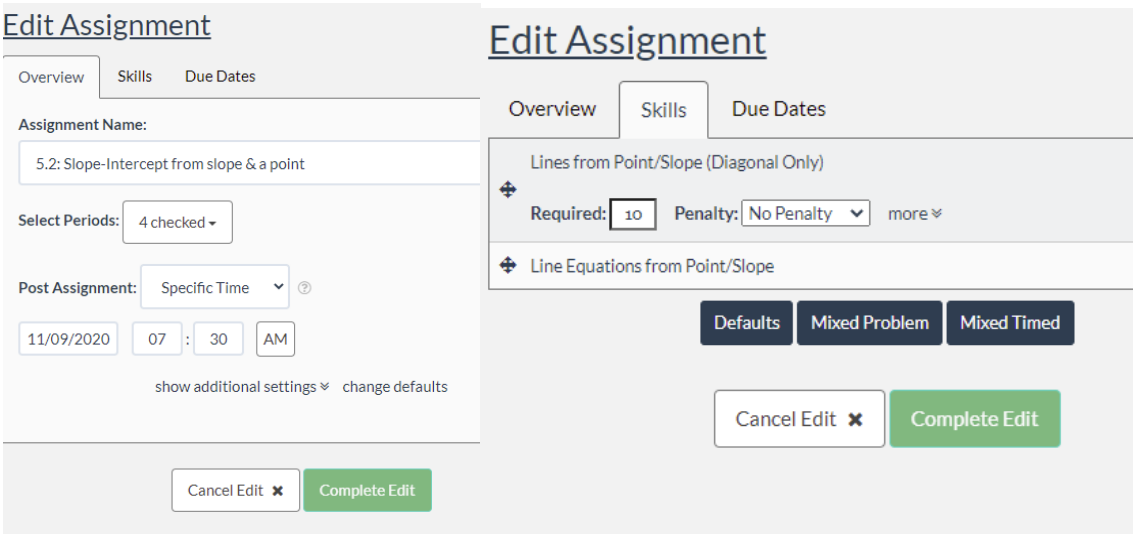
LESSON 5.2

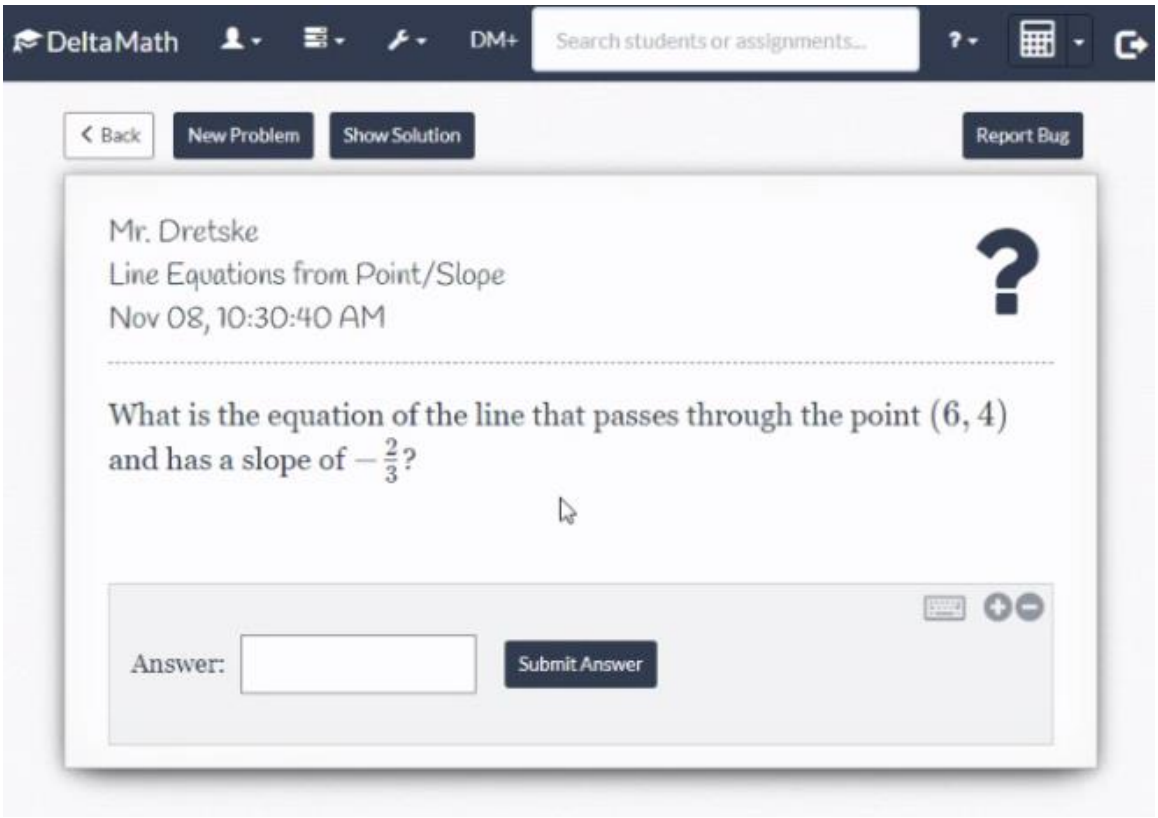
Screenshots from the video for Lesson 5.2



Appendix E: Sample Daily Assignments

Assignment at Delta Math - Teacher set up & Student example





Homework example for Lesson 1.4 using Infinite Algebra and KutaWorks

Algebra 1 Name_____ ID: 1

Lesson 1.4: Writing Equations & Inequalities Date_____ Period____

Practice Set (Included in video) - Write each as an algebraic equation.

1) the product of n and 9 is equal to 49

2) x squared is 29

Practice Set (Included in video) - Write each as an algebraic inequality.

3) w decreased by 18 is less than 13

4) n squared is greater than 24

Write each as an algebraic equation.

5) the sum of q and 9 is equal to 36

6) 3 less than w is 42

Teacher view of assignment for Lesson 5.3 on KutaWorks

Write the point-slope form of the equation of the line through the given point with the given slope.

through: $(1, 5)$, slope = 4 — Time: 0s

through: $(1, 3)$, slope = 7 — Time: 0s

through: $(-2, -1)$, slope = $\frac{1}{2}$ — Time: 0s

through: $(-2, -5)$, slope = 5 — Time: 0s

through: $(-5, -4)$, slope = $\frac{2}{5}$ — Time: 0s

through: $(-2, -1)$, slope = -1 — Time: 0s

Write the point-slope form of the equation of the line through the given points.

through: $(-4, 2)$ and $(-1, -5)$ — Time: 0s

through: $(-1, -5)$ and $(0, 5)$ — Time: 0s

through: $(5, -5)$ and $(0, -3)$ — Time: 0s

Appendix F: Comparative Assessment

Part 2 of the PreTest/Post Test given to all students in the Fall semester to show growth of knowledge during the course of study in the Flipped Classroom.

Algebra 1 Name_____ ID: 1

Pre-Test (#31-60) - Fall 2020 Period____

For all problems: If you do not know how to do a problem, please mark choice E on the answer form.

Solve each equation for the indicated variable.

1) $u = k - a - b$, for a

A) $a = -u - k + b$ B) $a = -u - k - b$ C) $a = u + k - b$ D) $a = -u + k - b$

2) $xc = r + d$, for x

A) $x = \frac{r+d}{c}$ B) $x = r + d - c$ C) $x = -\frac{c}{r+d}$ D) $x = cr + cd$

Solve each proportion.

3) $\frac{10}{2} = \frac{4}{m}$

A) $\{1\}$ B) $\{7\}$ C) $\left\{\frac{4}{5}\right\}$ D) $\left\{1\frac{2}{3}\right\}$

4) $\frac{a-9}{10} = \frac{9}{6}$

A) $\{10\}$ B) $\{-2\}$ C) $\left\{-\frac{11}{9}\right\}$ D) $\{24\}$

Write the equation in function form.

5) $3x + 2y = 8$

A) $y = -\frac{3}{2}x - 4$ B) $y = 4x - \frac{3}{2}$ C) $y = -4x - \frac{3}{2}$ D) $y = -\frac{3}{2}x + 4$

6) $4x + 5y = 15$

A) $y = x - \frac{4}{5}$ B) $y = 3x - \frac{4}{5}$ C) $y = -\frac{4}{5}x + 3$ D) $y = -\frac{4}{5}x - \frac{4}{5}$

Find the slope of the line through each pair of points.

7) $(14, 20), (-3, -1)$

A) $-\frac{21}{17}$ B) $\frac{21}{17}$ C) $-\frac{17}{21}$ D) $\frac{17}{21}$

8) $(4, 0), (-18, 9)$

A) $-\frac{9}{22}$ B) $\frac{9}{22}$ C) $-\frac{22}{9}$ D) $\frac{22}{9}$

Write the slope-intercept form of the equation using the information or graph given.

9) Slope $= -2$, y-intercept $= 0$

A) $y = -4$ B) $y = -4x$ C) $y = -2x$ D) $y = 2x$

10) through: $(2, -1)$, slope $= \frac{3}{2}$

A) $y = \frac{3}{2}x + 4$ B) $y = 4x + \frac{3}{2}$ C) $y = -4x + \frac{3}{2}$ D) $y = \frac{3}{2}x - 4$

11) through: $(2, 2)$ and $(3, -2)$

A) $y = -x + 10$ B) $y = -5x + 10$ C) $y = 4x + 10$ D) $y = -4x + 10$

12) through: $(4, 3)$, perp. to $y = -2x + 2$

A) $y = -\frac{1}{2}x + 1$ B) $y = \frac{1}{2}x + 1$ C) $y = x - \frac{1}{2}$ D) $y = -\frac{1}{2}x - \frac{1}{2}$

Solve each equation.

13) $-5 + |10n - 1| = 66$

A) $\{11, -1\}$ B) $\left\{\frac{36}{5}, -7\right\}$ C) $\{11\}$ D) $\left\{-2, -\frac{1}{4}\right\}$

14) $|10x + 5| = -95$

A) No solution. B) $\left\{-\frac{4}{5}, -1\right\}$ C) $\left\{-\frac{4}{5}\right\}$ D) $\{-6, 12\}$

15) $7|2 - 6x| + 2 = 114$

A) $\left\{-\frac{7}{3}, 3\right\}$ B) $\{0\}$ C) $\{0, -12\}$ D) $\left\{-\frac{7}{3}\right\}$

16) $|9 - 9a| - 4 = 23$

A) $\left\{-\frac{1}{3}, -1\right\}$ B) $\{-2, 4\}$ C) $\left\{2, -\frac{5}{2}\right\}$ D) No solution.

Solve each inequality.

17) $|6 - 6n| \leq 12$

A) $-3 \leq n \leq 7$ B) $-1 \leq n \leq 3$ C) $n \leq -3$ or $n \geq 7$ D) $n \leq -1$ or $n \geq 3$

18) $|6+5x| > -14$

A) $x \geq \frac{11}{2}$ or $x \leq -8$ B) { All real numbers. }

C) $-8 < x \leq 8$ D) $x \leq 3$ or $x \geq 4$

19) $|2r+4| \leq 14$

A) $-9 \leq r \leq 5$ B) $r < -8$ or $r \geq 3$ C) $r < 8$ or $r \geq 10$ D) $1 < r \leq 10$

20) $|x-8| < -9$

A) $x > 8$ or $x < -\frac{14}{3}$ B) $x < -6$ or $x > \frac{9}{2}$ C) No solution. D) $-\frac{14}{3} < x < 8$

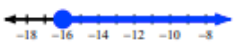
Write the slope-intercept form of the equation of the line through the given points.

21) through: $(4, 2)$ and $(5, -3)$

A) $y = 22x - 5$ B) $y = -5x + 22$ C) $y = -5x - 5$ D) $y = 5x - 5$

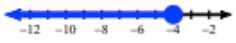
Solve each inequality and graph its solution.

22) $5 \geq \frac{m+4}{3}$

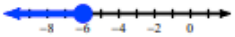
A) $m \leq -16$: 

B) $m \leq 11$: 

C) $m \leq -27$: 

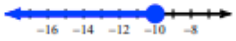
D) $m \leq -4$: 

23) $-8(6n-2) \geq -5n + 16$

A) $n \leq -6$: 

B) $n \leq -6$: 

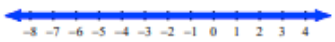
C) $n \leq 0$: 

D) $n \leq -10$: 

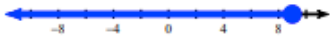
Solve each compound inequality and graph its solution.

24) $9m - 10 > 26$ and $9m - 6 \leq 75$

A) $4 < m \leq 9$: 

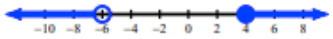
B) $-8 < m \leq 10$: 

C) $m \leq 10$: 

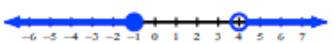
D) $m \leq 9$: 

25) $6n - 5 < -35$ or $2n + 9 \geq 29$

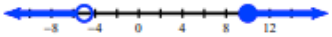
A) $n < -6$ or $n \geq 4$:



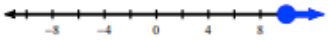
B) $n \leq -1$ or $n > 4$:



C) $n < -5$ or $n \geq 10$:



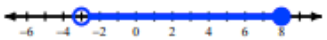
D) $n \geq 10$:



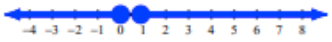
Solve each inequality and graph its solution.

26) $9\left|-9n + 4\right| + 10 \geq 46$

A) $-3 < n \leq 8$:

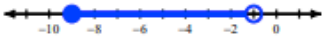


B) $n \leq 0$ or $n \geq \frac{8}{9}$:



C) $4 \leq n \leq 7$:

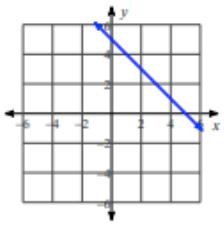
D) $-9 \leq n < -1$:



Sketch the graph of each line.

27) $y = x - 5$

A)



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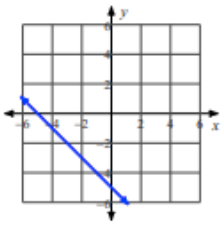
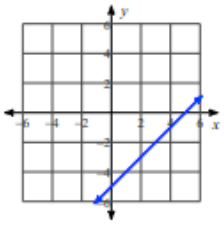
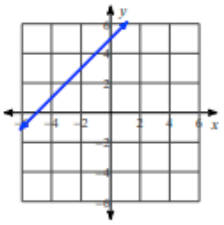


C)

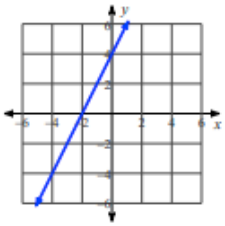


D)

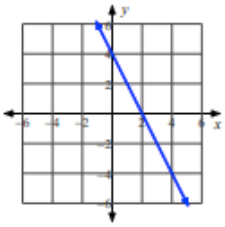


28) $x - 2y = -4$

A)



B)



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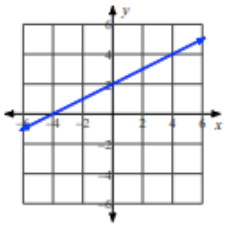

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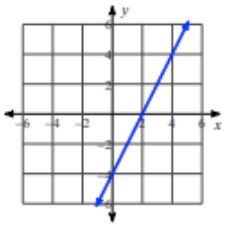
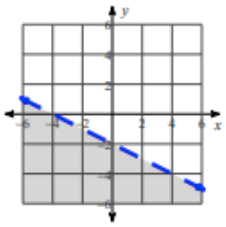


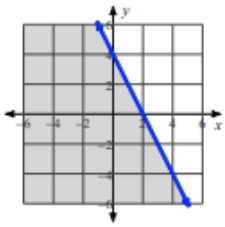
Sketch the graph of each linear inequality.

29) $y \leq \frac{1}{2}x - 2$

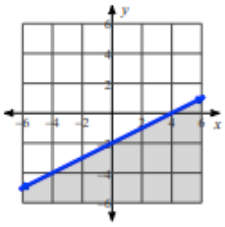
A)



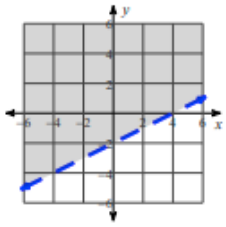
B)



C)

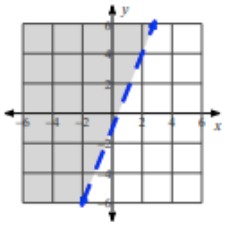


D)

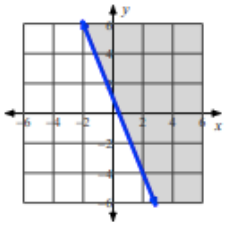


30) $5x + 2y < 2$

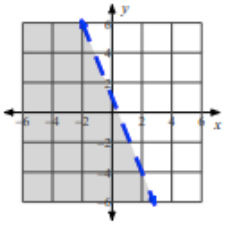
A)



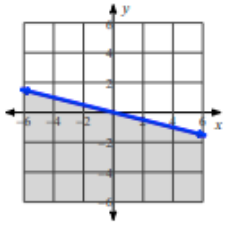
B)



C)



D)



Appendix G: Flipped Classroom Survey

This survey will be given to students using Google Forms.

Questions 1-6: Students select one choice (Never, Rarely, Sometimes, Most of the time, Always).

1. I watched the lesson video before class.
2. I enjoyed watching the lessons on video.
3. I used the online resources provided. (practice problems, review games, etc.)
4. I had opportunities to communicate with peers about the lessons.
5. I felt comfortable doing the assignments.
6. I feel that the teacher or others answered my questions in the class.

Questions 7-8: Students select one choice (Extremely Confident, Somewhat confident but needed more help, Not very confident).

7. I felt confident about the material after watching the lesson videos but before coming to class.
8. I felt confident about the material after coming to class.

Questions 9-10: Students select one choice (Max effort, Good effort, Little effort, No effort).

9. Describe the amount of effort you have been putting into the lessons at home.
10. Describe the amount of effort you have been putting into the lessons in class.

Questions 11-14: Short Answer

11. What have you liked best about the flipped classroom?
12. What would change about the flipped classroom in the future?
13. What could the teacher do to help support you more in the flipped classroom?
14. Please add any other comments you have about the flipped classroom.

Appendix H: Sample Summative Assessment

Quiz from the first three lessons of chapter 4

Algebra 1 Name_____ ID: 1

Quiz: Lessons 4.1 - 4.3 (Graph Linear Equations) Date_____ Period____

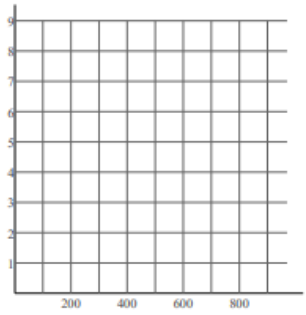
Match the Table to the correct graph with points plotted.

1)

X	Y
60	2
280	5

X	Y
500	8
580	8

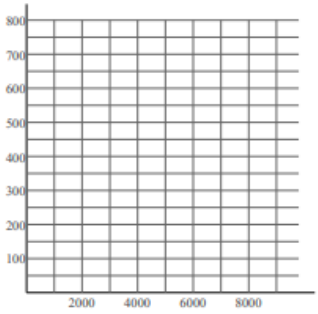
X	Y
670	9
970	8



2)

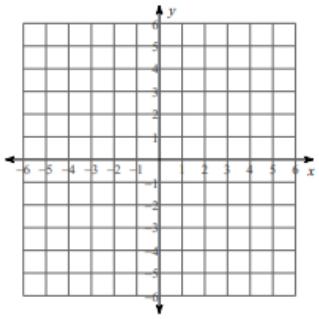
X	Y
800	200
3,000	500
6,000	800

X	Y
7,000	800
9,600	800
9,800	700

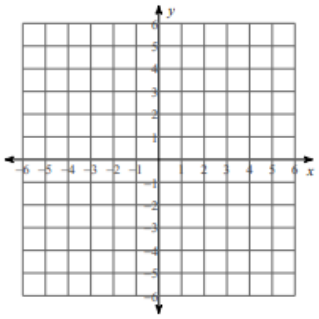


Sketch the graph of each line. (Hint: Plot the y-intercept and then use the slope to find the next point needed to make the graph.)

3) $y = x + 4$



4) $y = -2x + 1$

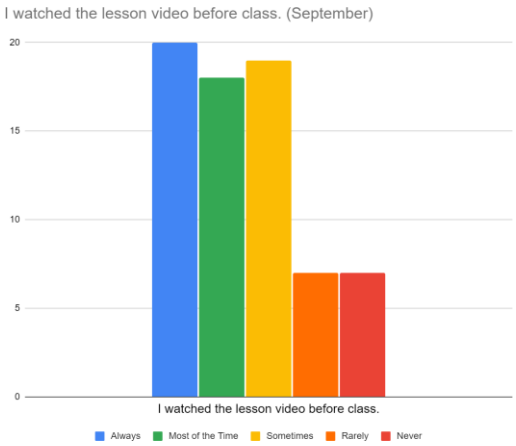


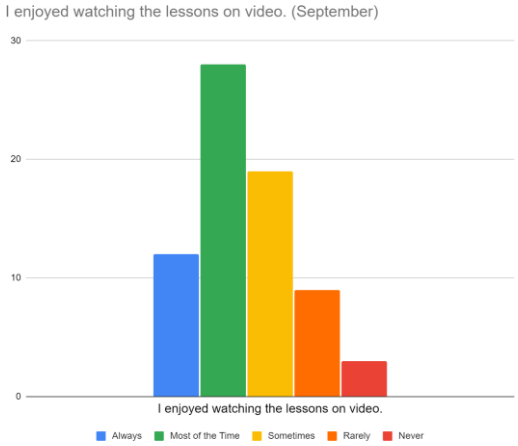
Find the x-intercept and y-intercept for the given equation.

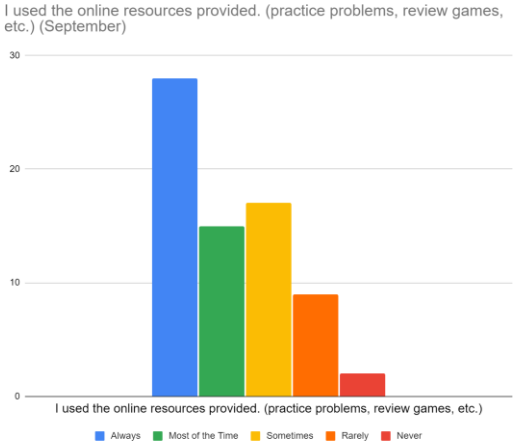
5) $3x - 4y = -8$

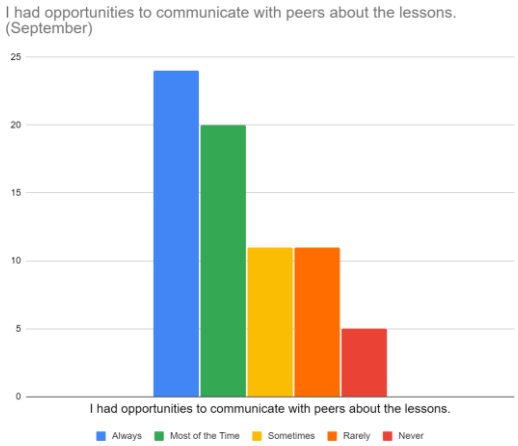
6) $2x - y = -2$

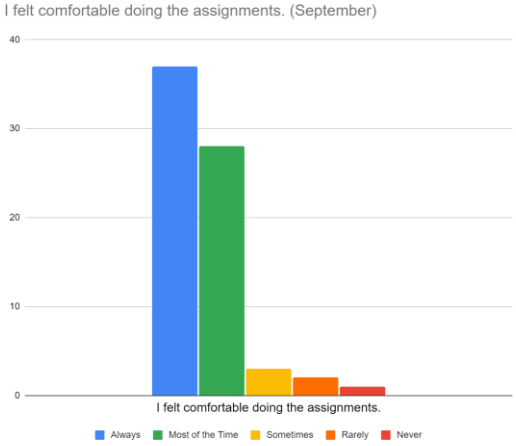
Appendix I: Summary of Data from Flipped Classroom Survey - September

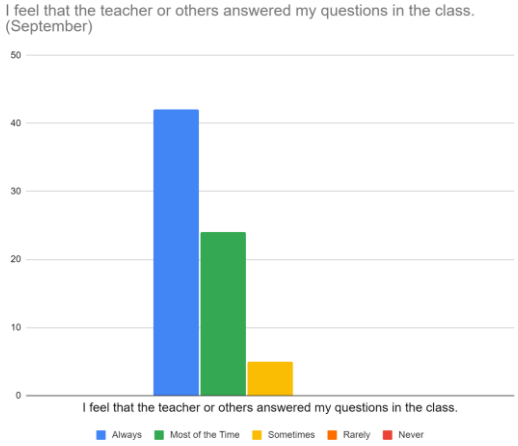


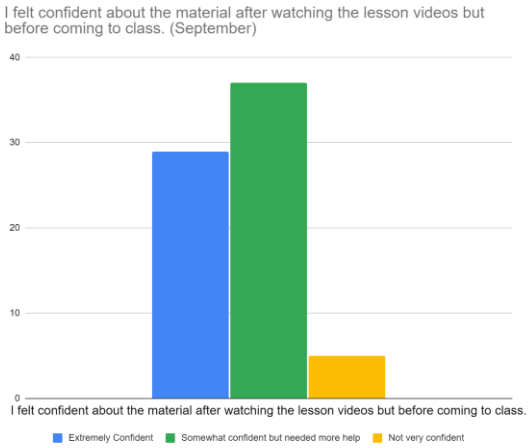


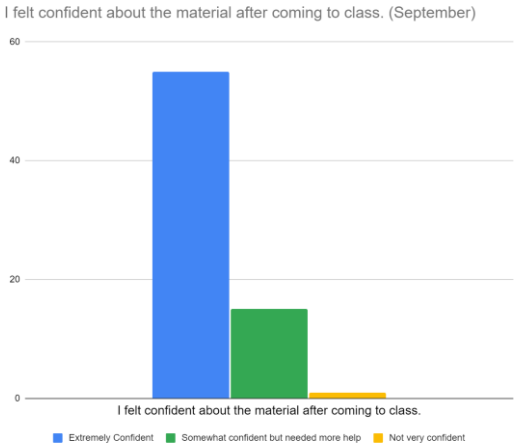


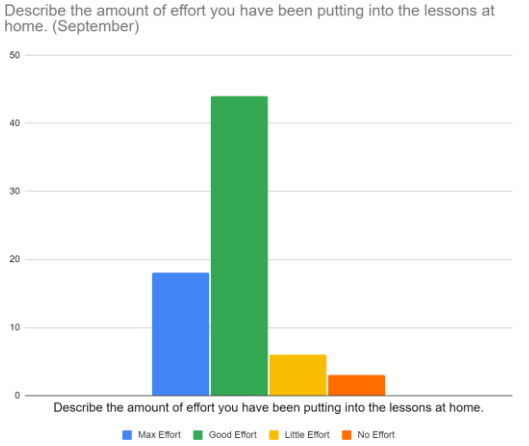












What have you liked best about the flipped classroom?

- I like how you can see how many questions you have left and how you can go at your own pace not not be rushed or slowed down.
- That there is no homework at nights.
- I like that we go through the assignment's in class.
- Having alot of work time in class.
- I usually have less homework, and I feel like I understand the lessons better.
- Being able to get my work done in class
- we don't take up too much time in the class talking about a certain concept.
- That it's all online
- i like it better online then with books
- I like that I have time to study before class, so that I have a better idea of what we are doing.
- It gives me a better idea of how to do the lessons when we have the videos to explain it.
- Being able to finish the work in class
- The way it is taught gives a lot less time spent on the actual work as long as I know how to do the problems, meaning once I learned the lesson and practiced a bit I don't have to waste my time.
- The flipped classroom gives me a good amount of time in class to get my homework done.

- We can do the assignments right away and have time to work on it rather than having the teacher speak for a long time.
- That we learn about it ahead of time and during class we have work time.
- I had it last year with Mr. Matthies at TSL, so I'm used to it and I like it.
- I liked the videos so I could see how to properly do the problems and that I was able to have Mr. Dretske help us figure out the problems.
- That it is easy to do homework before class because the videos are online and that if you have any questions you can ask them in class
- I like that I don't have to take much homework home, if any at all.
- I can work at my own pace and it makes more sense because I can watch the video over again.
- I am able to learn with the video and with the teacher, so i get two points of views on the lessons
- The fact that I can take notes before the actual lesson so I have an idea of what is going on.
- it is much better than my old math class, because whenever i had something wrong it didn't say, "hey, you got it wrong. try again" it was just "WRONG!!!!!!!!"
- I like how he doesn;t just stand up there and teach it to us.
- Watching the videos.
- that there is not a whole lesson that you have to teach us that takes the whole class period.
- I enjoy being able to ask and answer questions freely and comfortably.
- I have liked that we get the lesson and have plenty of time to do It unlike having a lesson taking up the whole period and having to do the work at home.
- The lessons are laid out in a simple way, and it is easy to follow along, whether it be in the classroom or online.
- I just like it because it seems easier
- I like how you can just watch a video about the assignment instead of him explaining in class for a good 20 minutes.
- It does give me more time to work on homework in class rather than at home
- i like all the assignments online
- You get to to do your own thing, and then you can ask questions in class.
- it's easier to learn things on your own and i feel like learning lessons on your own makes it easier to understand.
- That we can still have someone teaching us while we can somewhat teach ourselves in our own way.
- I like the fact that when you are confused or don't understand something, you are able to re watch the videos put out so you can try and understand it better.
- There is usually no homework.
- It is a new way to do stuff and I like trying new things
- less talk more work
- I like how I usually have little to no homework.
- That the homework is less homework than in a normal classroom and that I can get it done during class.
- The less homework. The questions as you have to email every other teacher.
- no homework most nights.
- it has worked well i think

- I like that I can get help with the problems I have trouble with in class and that we have most of the class time to get the work done.
- You do the lesson work in class.
- It seems to work better than other methods.
- I like how its more independent and you can work at your own pace
- You can look back on lessons and replay things
- I liked that it gives us the time we need to learn it, not be rushed, and still ask our parents ab things at home, yet we could also ask things in class w the teacher.
- That I could do my homework before class and by my self.
- Doing all the homework in class
- Doing the assignment in class
- The lessened stress of homework
- it is easier cause we work at our own pace
- It is great that I don't have to write stuff out, it is a little easier to learn.
- It shows us what we did and how to fix it
- We did this with Mr. Matthies at TSL last year so I am used to it which I like. d
- I have time to do other things afterwards.
- I like doing all the assignments online more than on paper.
- we have less homework and I can get it all done in class
- The ability to do the homework at my pace.
- I feel like there is less homework.
- The video lessons have been super super helpful.
- I like that we don't have to sit in class and listen to the teacher that often. Sometimes I drift off so having him do videos and websites for lessons grabs more of my attention.
- Since I know basically everything that is being taught (because I took algebra 1 in 8th grade and i just didnt do well on the placement test because i forgot about the time limit) I can just do my work without having to listen to a lecture I've heard 15 times and I have time to do other things
- You can kind of have the freedom to do it at your own pace.

What would change about the flipped classroom in the future?

- Nothing. (34)
- I honestly don't think anything needs to change. I think it's find how it is.
- I would probably use less videos and more lectures in real life.
- maybe for some students, if they're not completely sure about a concept, maybe continue doing problems with them and helping them along while the other students do the assignment.
- more time to do things
- I would maybe make the pdf lessons a little clearer, as far as what we need to know.
- I would kind of like it more if we could do more practice problems, if need be.
- Having shorter lesson videos
- not really much, mabye just some of the websites used, like baxpax kinda sucks
- Everything is pretty good but it is easier for me to go to class and ask questions during the lesson.
- Give us a chance to get our problems checked so that we can get a better grade.
- There isn't really a whole lot I would change because the videos are starting to help me learn the material better.
- Maybe that we only get one assignment?

- Not a lot of sights to do your math.
- Not having so many websites to do work on.
- I really have had no problems with the flipped classroom, so I really do not have a response
- Not much just maybe take more time on the lessons.
- Use less websites, because it is sometimes confusing to sign into lots of different accounts.
- Have him explain 1 or 2 problem from the video in case someone doesn't get the assignment.
- Personally I like having a textbook so i could follow along more
- On some of the harder lessons we could go through more examples.
- Maybe a few more examples and a little more detail about solving problems.
- In the future maybe add more practice problems that you go through in the video so we can better understand the concept
- I prefer the normal one better, but this is okay
- make videos shorter
- Changes I would make for the future are just focusing on 1 lesson per class (instead of going over the previous day's lesson and then starting the new lesson).
- I think we should do more in class.
- I would change the fact that we have more problems at home, and I would like it if we did a few more in class, that way we know how to do it better w the teacher.
- He explain things a little bit more.
- I think we should explain in the video more how and why we do things instead of doing all the examples.
- maybe learn about it online like in a video or something, but do problems from a book
- Going through the lesson or answering questions the next day.
- Maybe a little more explanation on the lessons.

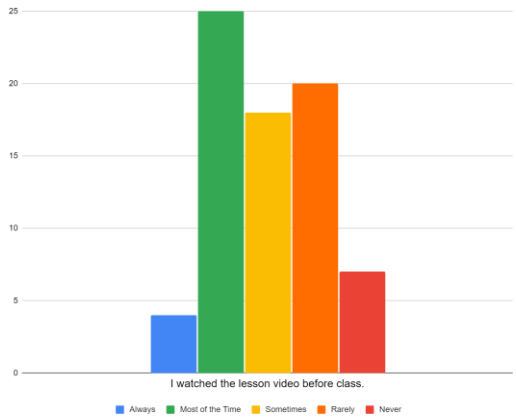
What could the teacher do to help support you more in the flipped classroom?

- Nothing, I think the flipped classroom is great. (28)
- He could do more problems with us in class (10)
- I've struggled in math, so I'd prefer more help. (7)
- Go through the lesson a little more in depth at class time. (2)
- Just fixing the outlet by my desk .
- Nothing Mr. Dretske is good at answering questions through email and in class.
- Make things easier to understand. If we use delta math, we have a chance to correct our answer and see what we did wrong, when Kuta Works shows you the right answer and moves on right away.
- We do have a lot of different sources that we use, sometimes it gets confusing.
- He could maybe slow the teaching down.
- Watch a video and go through some practice problems in class that same day.
- Maybe make the videos a little longer and more describing on how you do the problems
- At the moment I can't think of anything that you could do to help support me in the classroom.
- The teacher could help me by maybe putting subtitles in the videos so that if we forget headphones we can still learn the material.
- I think when it gets harder he should explain in the videos how to do it more instead of all the examples.

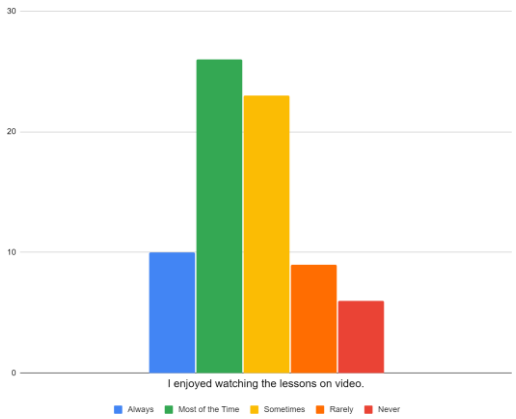
- Go through a problem the next day, about the previous lesson.
- It would be nice to have a pdf of the answers to the other pdfs and how you got the answers because sometimes I struggle with how you were able to get the answer.
- Go through the problems the students got wrong the most on the websites. Just do that so we know what to do if the problem appears on another assignment or a future test.

Appendix J: Summary of Data from Flipped Classroom Survey - November

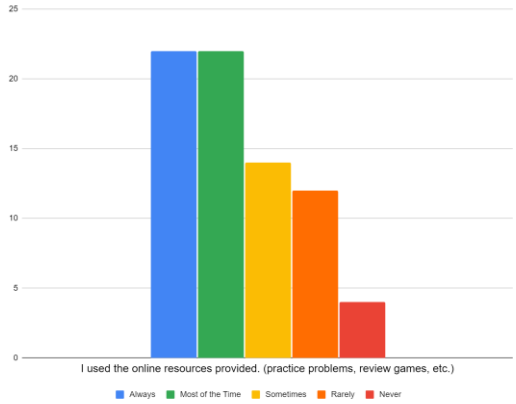
I watched the lesson video before class. (November)



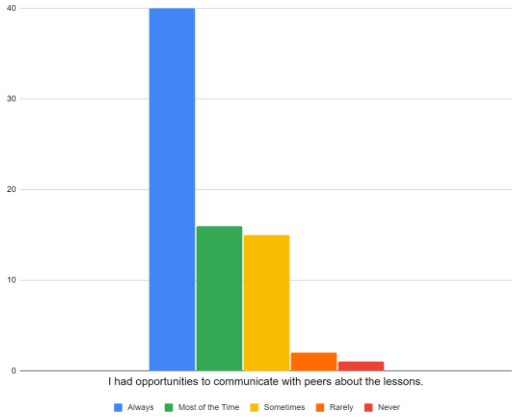
I enjoyed watching the lessons on video. (November)



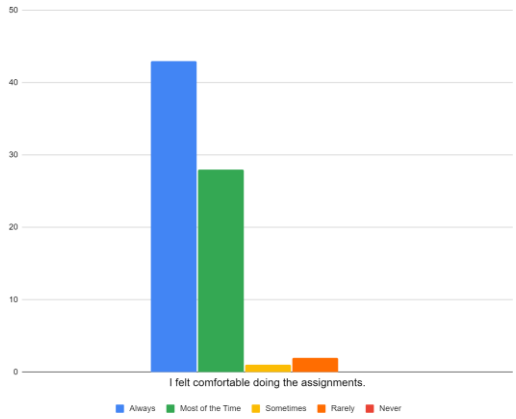
I used the online resources provided. (practice problems, review games, etc.) (November)



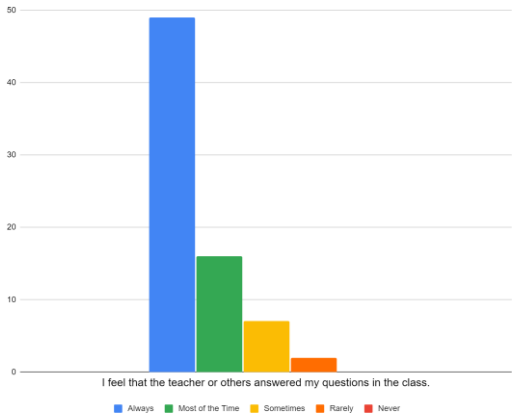
I had opportunities to communicate with peers about the lessons. (November)

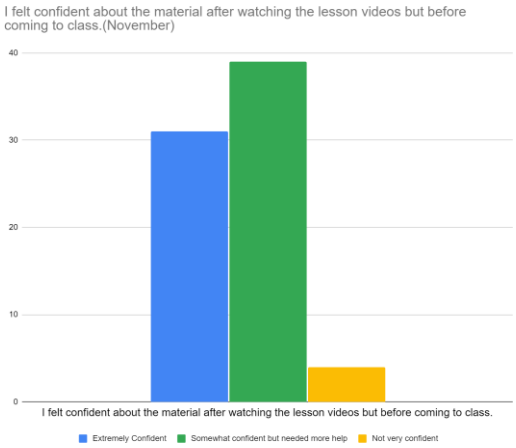


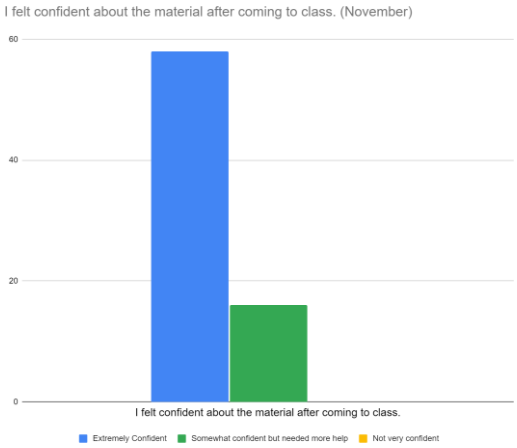
I felt comfortable doing the assignments. (November)

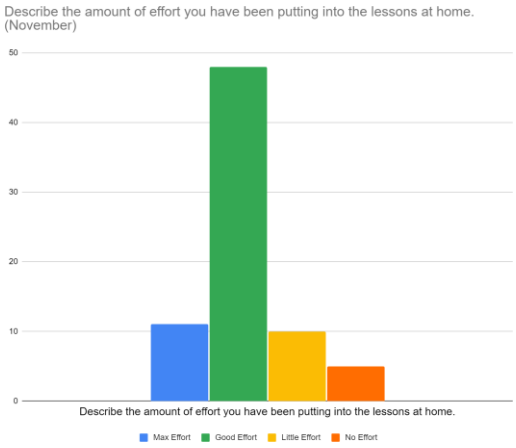


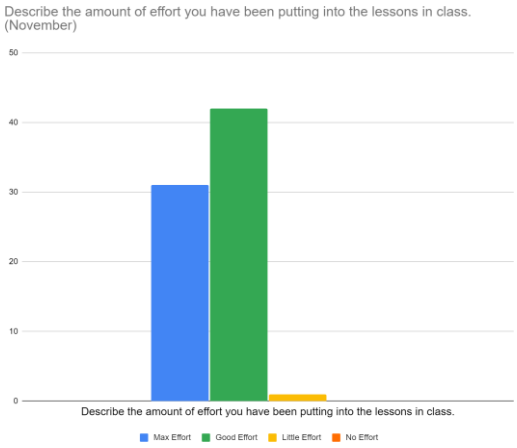
I feel that the teacher or others answered my questions in the class. (November)











What have you liked best about the flipped classroom?

- I like that I get it done and rarely ever have homework
- wait, we're in a flipped classroom?
- I have time to do my work in class.
- I have my own time to work on homework.
- Its been ok to learn in
- I can do it more so at my own pace, and I have been doing a lot better in math than I did last year.
- I can get my homework done in class and I understand everything the videos have taught and the lessons/
- I can do my work whenever I want and can go at my own pace.
- If you forgot how to do the lesson you can just look back at the video
- I usually get my homework done before class ends.
- You rarely have homework.
- I like that we are able to go at our own pace and we are able to rewatch the videos if needed.
- we dont have as much homework
- I can do the homework in class.
- I liked that Mr. Dretske was always there to answer questions.

- We get to do our homework in class and you let us go to complete it in class and you are there for when we need answers to questions.
- the teacher is right there so i can ask him questions
- I like that we can get help with our assignment in class.
- I'm not nearly as stressed about deadlines with assignments.
- It gives me time to work on my other work at home, not wearing my brain out when I'm trying to get things done
- I like the freedom I get.
- That there is a video on the problems and extra problems on most of them.
- I like that we have an opportunity to get our work done right away and in class because I don't always like having a 30 minute lecture about each assignment every day.
- I liked getting my assignment done in class.
- It takes a lot less time to get work done and gives me a lot more study time with just the videos instead of explaining the entire lesson in class.
- Not having any homework.
- Being able to work on your own time.
- I am able to teach myself the lessons which to me is easier.
- We get the whole class to work and not have to listen to the teacher talk all period and take away our time to work.
- I like that I am not in a class where the teachers is just teaching the whole time, I can learn what I need and then be able to do my assignment, and also ask questions.
- I love not really having homework and getting everything done in class and if I need help with anything i can always just look at the video.
- It's online and we can work at our own pace.
- Getting all my Homework done
- I liked the amount of homework and the time. I also liked the freedom of asking questions in class.
- You do your assignment in class
- Learning videos
- it is nice to be able to ask questions in person on the homework
- I like that you have more free time and you don't have to wait to hear it all if you know it already.
- The amount of homework we get is totally reasonable and not stressful. I am able to work at my pace and I feel that I am learning.
- I like that there is not a whole lesson that the teacher has to teach that we have to sit through.
- That there is not as much homework and that I get to go at my own pace.
- If I don't understand a problem I can rewind the video and watch it again.
- That I don't have to bring any homework home. I normally don't have any homework to do in class.
- I can work at my own pace and finish work early.
- That I can sometimes do my homework before class.
- It's all on the chromebook.
- I can get straight to working on the assignment(s) right when they are put onto the website we would use
- I like that we can get out work done and have time after to do other work.
- We never have homework.
- You get plenty of time to work on your assignment.

- I like being able to get to work in class right away and not having to go through the lesson, because I usually understand it.
- I like that I usually don't have any homework and if I have questions you can answer them right there.
- That we don't have to sit through a lesson that the teacher is giving.
- I liked that I could ask questions in class about the assignment and that I had more time to do the assignment and not have homework to do at home as much.
- How we aren't overloaded with information all at once. We have the option of going back and looking at lessons
- it is fun
- The less to none homework
- I get all my homework done before I go home.
- We get to start our assignment before class.
- If you know what you are doing you can do the lesson right away.
- That you can go at your own pace and that you are independent and you can ask questions whenever.
- That you do the homework in class, instead of at home.
- Being able to do math in study hall and then asking questions that I have in class.
- less homework
- We can work at our own pace.
- I have had time to get my assignments done and then work on other homework.
- Almost all of it is online.
- Everything is online.
- I liked watching the videos at the start of the lesson, they were nice and helpful.
- I don't have to wait for everyone else to learn the concept when I already know it and I can just work quickly and have time to do other things.
- Being able to get everything done in class.
- I like that we don't have to write out the assignments.
- How the teacher really does not teach

What would change about the flipped classroom in the future?

- Nothing (35)
- Nothing. I absolutely love flipped classroom
- I honestly think it's completely perfect
- Honestly nothing. I like the way it is.
- i wouldnt change anything, i like it a lot
- I would want a math textbook, because I really like textbooks
- Shorter videos
- A little bit more help
- Maybe a little bit more explanation in class.
- Probably a little more lesson and practice problems in class.
- I would add more practice problems or do more practice problems in the video.
- We might not have as much of flipped classroom when Covid-19 ends.
- I'm not 100% sure I really like how it is right now.
- More examples on the problems.
- I would change the websites that we complete our assignments on. I like Delta math better than KutaWorks because Delta gives you an opportunity to try again and fix what

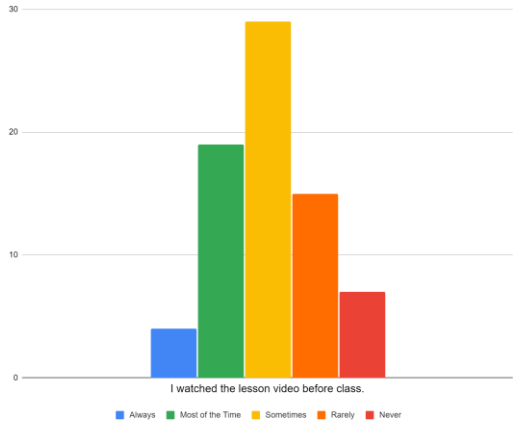
you are doing wrong. I think it helps you learn the concepts better because on KutaWorks the answer is either right or wrong and either way you just move on to the next problem.
- The lesson videos could be shorter.
- There's not really a whole lot I would change. There could be like a game or something involved, but other than that there's nothing else I would change.
- Have a quick review and go over the lesson at the beginning of the class.
- I kind of like going thought the lesson in class a little more.
- I would like to work in groups once in awhile.
- I would make the videos shorter.
- Maybe a little more explanation for the lesson.
- I would change maybe just explaining a little bit more in class and not as much in the video.
- I would make the videos shorter.
- I think to give some more work to do.
- I would like to do one or two problems on the whiteboard together in class.
- Everything is pretty good for me. There might be a problem that I'm stuck on and that you didn't explain in the video, so I get stuck sometimes but usually you help me.
- I don't think that I would change anything, I think that it works well right now.
- I would make the videos mandatory.
- Less homework.
- Have more examples than just the video.
- maybe more examples on the board
- Explain the material in class too.
- More review things like going back and using stuff we used earlier in the year.
- I would change the amount of websites we use for it.
- Maybe still a bit more review provided for the lessons in class.
- I would give us a book or guide with everything so we can look back.

What could the teacher do to help support you more in the flipped classroom?
- Nothing (38)
- I feel that he gives me just enough help where I am extremely comfortable
- Maybe do more five minute lessons in class, just to kind of make sure we know what we are doing and clear up confusion.
- Give us examples and check with us.
- Keep doing what their doing and things will continue to go well.
- go through a couple more of the tricky problems
- Maybe more thoroughly explaining things?
- Take the time to make sure even after explaining something that the kids understand, there has been a couple times where the explanation needed explaining to me,
- I just need to ask more questions.
- I think everything is working out fine for the most part. Maybe explaining things a little better with more depth.
- You could reexplain some of the challenging parts in the lesson videos.
- He could put out a survey of how everyone is doing like this, which he has done.
- At the beginning of class just go through the basics of the assignment and do 1 of the problems from the assignment.
- Go over the lesson really quickly at the beginning of class.
- He could give more examples on how to do the lessons in the videos.

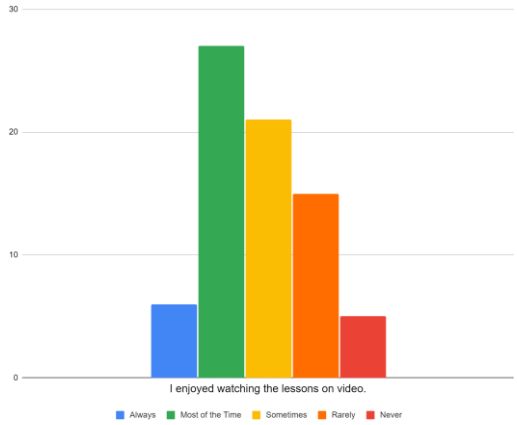
- Not much really, maybe going thought the lesson a little more in class.
- Talk with each student personally
- The teacher could help me more on helping me with the problems that I am struggling with.
- Just kind of explain more to mean in class and not as much in the video.
- He could be more specific.
- Maybe the day after the assignment go through one problem in class.
- Do one or two examples together to make sure everyone understands what we're doing.
- At the end of the lesson have us to a couple of problems to make sure were doing the lesson right.
- Walk the whole class threw it.
- Give us more assignments.

Appendix K: Summary of Data from Flipped Classroom Survey - December

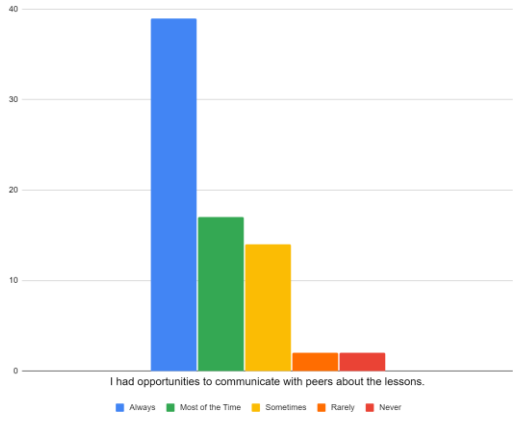
I watched the lesson video before class. (December)



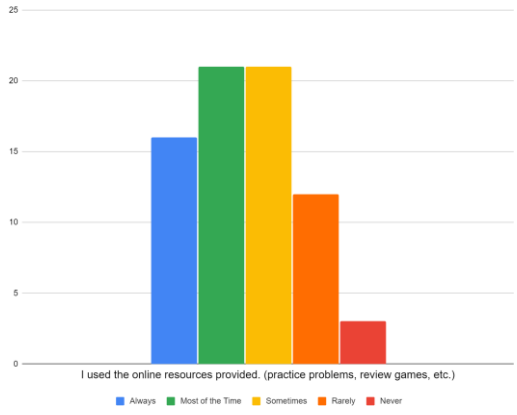
I enjoyed watching the lessons on video. (December)



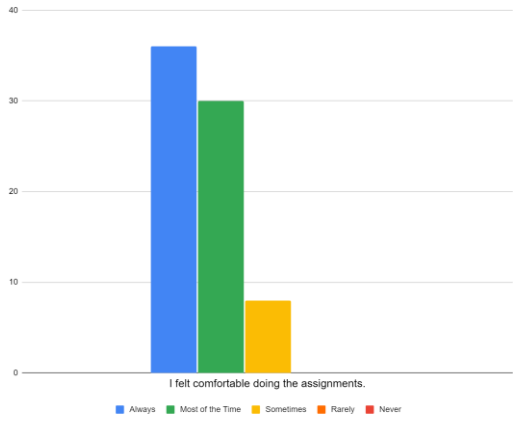
I had opportunities to communicate with peers about the lessons. (December)



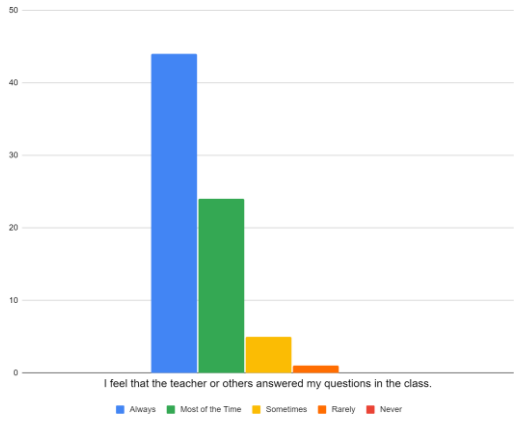
I used the online resources provided. (practice problems, review games, etc.) (December)

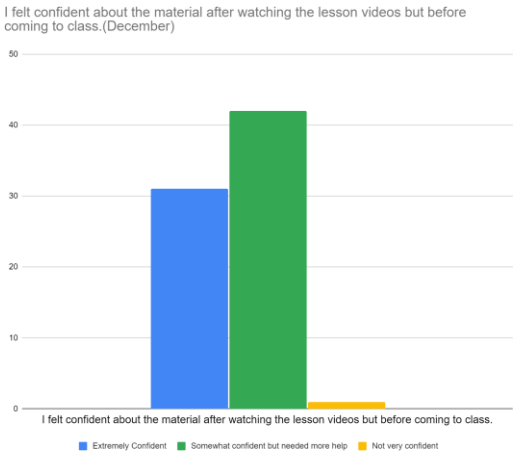


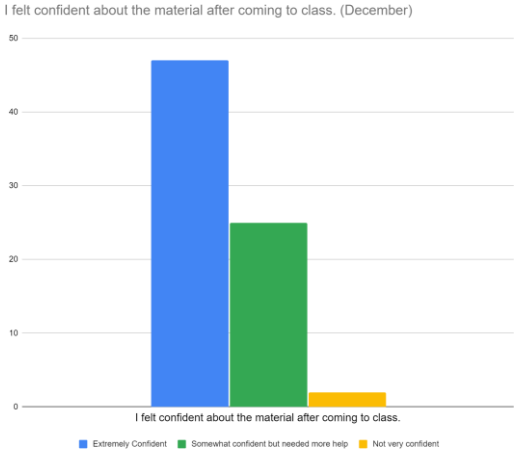
I felt comfortable doing the assignments. (December)

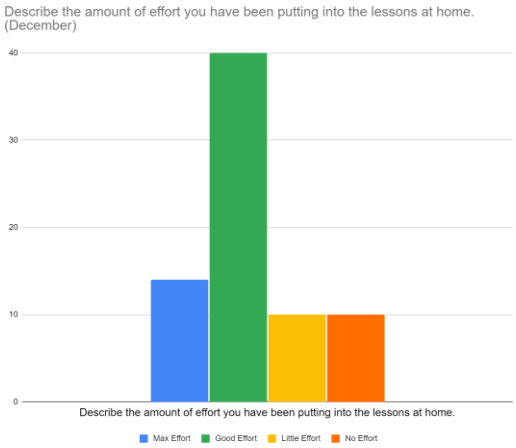


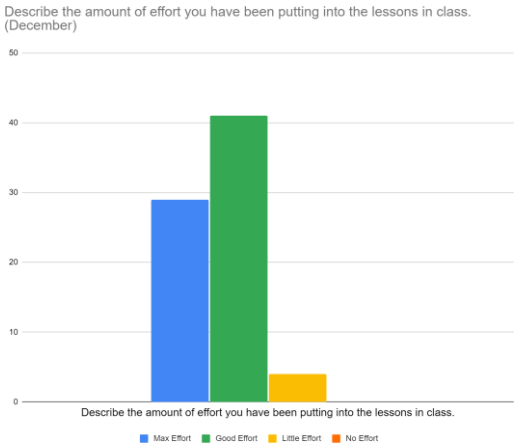
I feel that the teacher or others answered my questions in the class. (December)

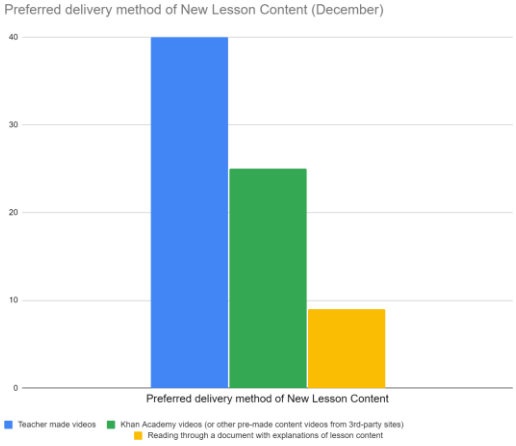












What have you liked best about the flipped classroom?

- I always have time to finish my homework
- I understand all of the assignments clearly and get my homework done in class.
- I like being able to know what I have right when it is posted on classroom
- it was easy

- I liked that there was time in class to ask questions and there was always enough class time to answer all my questions.
- That there is not a big lesson to sit through while the teacher explains the lesson.
- I liked having my questions answered in class.
- I like we get time to do homework and usually don't have homework to bring home
- Probably how eiser it can be to understand and complete the math
- It is easy and don't have to carry a book around.
- We can complete the homework in class and we don't have to sit through a full class lecture.
- being able to watch videos to get my questions answered
- I have liked that you can kind of learn at your own pace.
- I get to do it on my own time.
- I liked being able to go back and rewatch the videos over and over again if needed instead of having to keep asking in class or wait until the next time you meet in class.
- I am able to learn at my own pace
- I get more study time and more time to go through and see what I need help on and ask questions on.
- I can do my homework on my own even when I'm not in school.
- being able to get straight to the assignments
- I like that I can ask questions about work.
- its good for getting work done
- having our grades put in right away
- I can do my work on my own time
- You can be independent. You can ask questions whenever you want, and in a way work at your own pace.
- Watching videos and having lots of work time.
- The little stress of Homework.
- I get free-time after i get my assignments done
- freedom
- The assignments
- we get done with our homework in class
- That there is no homework.
- Getting all the work done in class.
- Having Homework done in class
- its all online
- i liked how everything was online
- We can work at our own pace.
- I liked that we had lots of time to work on the assignments.
- I can work at my own pace and I usually end up with free time.
- I liked that if you knew what you were doing then you can go to the lesson right away
- that I don't have homework when I get home
- That I can do my homework before class.
- Being able to work at my own pace.
- When I was quaratined I could keep up with math
- time to work in class
- It's easy enough but it still challenges me
- I like that the assignments are short and usually done in class because the teacher doesn't have to take a long time to explain the lessons.

- I can do it at my own pace, and I don't have to sit through a lecture.
- Not having much homework
- The videos; they make it easier to understand different topics.
- i get my homework done
- That we have less homework and more work time.
- The videos help a lot when I need them
- I liked the fact that I could work on my assignments if i was bored in another class and everything was just super easy to understand and if i didnt i would just look at the videos.
- Being able to ask questions in class.
- You get videos to watch if you need help
- I can get to my work right away.
- We rarely have any homework.
- More study time during class.
- The freedom of doing what I want in class and working at my own pace.
- Although I do enjoy learning things in class taught by the teacher in person, doing online lessons is a great end to the day for me (I have algebra period 11) and it's a good way to just get your math done. This doesn't really make too much sense but it makes sense to me.
- I am able to get my homework done in class
- less homework, I finish all my stuff in class
- how you can always go back and look at the lessons.
- I did not have as much homework in math and it did not take long to watch videos.
- The online version of the lessons
- I like that we don't have to listen to a teacher talk the entire class period, and we are able to work at our own paces.
- Being able to do the homework in class
- I don't have to keep track of homework because it is all in one place. There is no paper work to hand in.
- we have the opportunity to get work done in class
- That we can start our assignments when ever we want.
- I like that we didn't have to do anything on paper.

What would change about the flipped classroom in the future?

- Nothing. (31)
- I wouldn't change anything (8)
- More examples of problems in class (3)
- I would give more videos
- Not use kahn academy videos
- More explanation on some assignments that are more difficult.
- I would maybe go over the lesson a little more in person.
- I would use more videos of the teacher actually teaching them instead of khan academy.
- I would have more teacher created videos because the examples used for the videos helped more than the examples that were used in other videos.
- I few more demonstrations in the videos
- I wouldn't change anything except he could give us more practice problems but he already gives us enough.
- I like it i think it is fine where it is.
- Less delta math

- Maybe give more work on problems.
- I would change the deliverance of the Material
- I would like to work with partners once in awhile because it gets hard by ourselves
- I wish that Mr. Dreske would make his own lessons everyday cuz maybe I would watch them more.
- I would put subtitles on the videos.
- more explanation before we start
- Maybe it'll have different websites that are used.
- more in class teaching
- I liked the teacher made videos better, because they better explained it.
- Shorter vids
- "More kahn academy
- I really like how it explains things.
- However I don't like the videos. "
- Maybe a little more help in class or more answering questions WITH a group instead of individual, even though we did some of that, a little bit more would be great.
- More practice problems.
- I would change that the there would be more explanation during class.
- I would change the number of questions we get.

What could the teacher do to help support you more in the flipped classroom?

- Nothing. (33)
- Do more examples in in the videos (5)
- Write more examples on the board. (5)
- Maybe talk about each lesson the next day
- Nothing does everything how I like it and explains when we usually need help.
- Sometimes it is hard to learn the lesson with the videos posted but mainly good
- I don't think the teacher could do anything else, I think that flipped classrooms work great.
- The teacher could maybe provide more info on exactly what we are doing.
- Keep answering questions, a little more explanation on new concepts.
- I don't have any suggestions.
- Not much i like where im at
- Have super easy assignments
- Keep doing what your doing.
- I think it's all going well.
- The videos could make the video make more sense.
- Instead of have two lessons a day (one review, one new one), maybe just stick with one lesson a day or give less problems.
- have another lesson if you got a bad grade on the first one, so you can do the problems again and understand them better.
- Nothing, changes have been made and I enjoy it.
- Help with little details
- Nothing. I can come see you whenever through the day or email you.
- He could maybe give me some more notes to write down.
- They could go through the questions slower?