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**What are the Effects on Academic Performance and Engagement when
Implementing a Flipped Classroom Model Approach to Teaching in a High
School Algebra 2 Classroom?**

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Abstract

This action research study explored the observed and reported experiences of the academic performance and student engagement of two high school Algebra 2 classes when implementing the flipped classroom model to teaching. Students were first given a pre survey to gain an idea of how students felt about the math classroom and what they thought was an ideal math class. The students were then taught various math topics where for the first half of the action research project, the students were taught with a traditional approach to teaching. For the second half the research, the students were taught using the flipped classroom model of teaching. Throughout the action research project, students were given two additional surveys, various assessments and classroom activities were given, two rounds of interviews were completed, and entries in field logs were taken. Findings resulting from the study suggested that using the flipped classroom model of teaching did not have a significant impact on student academic performance, but it did increase student engagement in and out of the classroom. Results from the post survey and the entries from the field logs indicated that a mixture of traditional and flipped classroom approaches to teaching yielded a more positive result for students.

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Researcher Stance

Math has always been my favorite subject in school. In fact, one can say that I had a healthy obsession with it. If there was any homework that I did not mind having everyday, it was math. I would even do extra problems because I wanted to challenge myself. When I sat down to do all my homework, math was always the subject I wanted to do last because I enjoyed it so much. I would rush through my other homework just to work on it. Outside of my schooling, I participated in the Math 24 competition for five years in a row, four of those years I won a silver medal in the regional championship, and the last year I won a gold medal and qualified for the state championship. Even today, as I am driving and there is a car in front of me with a license plate with four numbers on it, I will try to make 24 out of it. Basically, no matter how it was taught or where I was, I found math interesting and engaging. Many of my friends would tell me that the only reason that I liked math was because I would always receive A's. While this is true that I never received anything below a 90% in any math assignment, I also received A's on my assignments in other subjects. However, for those other subjects, I did not have the enthusiasm that I did for math. I had a passion for math and saw it in the world around me. To me, it was the most useful subject in school.

I cannot say that my fellow classmates had the same enthusiasm as I had when it came to math class. Actually, most of my friends dreaded going to math class, even those that were in the Honors and AP levels. They would tell me that they did not know what the purpose of math was and most of the time, they would be falling asleep during class. Even though I enjoyed math and had a difficult time understanding why my fellow classmates were so bored during class, I did see their point of view many times during class. The majority of the teachers that I had would do the same thing everyday. They would stand in front of the classroom and lecture for about 45 minutes, then have us practice a couple problems for 15 minutes. The teacher would pick students to put the problems on the board. We would go over these problems, and then the teacher would assign us at least 20 problems for homework. Even as a student, I thought maybe this is not the way to teach math. However, I was not sure what that was because I did not have a teacher that seemed to model an exciting class. Fortunately, this finally happened when I was in my 11th grade Honors Pre-Calculus Class.

Initially, my 11th grade math teacher had us do an icebreaker activity. It was not the normal icebreaker where you said your name, likes and dislikes. It actually had to do with math and something that pertained to the real world. Right then, I knew that this class was going to be different. While the teacher did use traditional teaching methods to have us learn new material, this was not his

standard way of teaching. Most of the time, he would utilize inquiry based on learning. He had the classroom set up into groups so that when we were doing practice problems, we would be able to help each other and bounce ideas off each other. In addition, he rarely told us how to do a particular topic. Many times we had to discover the formula or reason for a certain topic. I would notice my fellow classmates who used to be disinterested in math actually start to enjoy it. They would be engaged in the classroom and would be doing their homework more. Even some of my friends who would be normally shy during class would participate during the lesson.

This was also the year that I realized what I wanted to do when I went to college. I always knew from my early school days that I wanted to do something with math. However, math was a very broad subject to me because many things utilize math. Therefore, the question was what field did I want to go into to use math. Towards the end of 11th grade, my math teacher had us doing a final project. This project consisted of picking a topic that we did during the year and teach it to the class. The only things that he required was that we showed clear knowledge ourselves of the topic, and we represented the information in some form. Seeing how our teacher taught most of the lessons throughout the year, I took it upon myself to copy what he did. The topic that I chose was Imaginary Numbers. Using that topic, I created a lesson where I first taught to the students

the basics of Imaginary Numbers and then had the students work on more challenging problems together in their groups. Granted, this was not a very detailed lesson since we only had a short amount of time, but it mimicked what our teacher had done throughout the year. After class, I remember my friends telling me that they enjoyed the lesson and actually understood the topic better than when the teacher explained it. From that day forward, I knew that I wanted to be a high school math teacher.

Today, I am still trying to implement what my 11th grade teacher did for us in my classroom. My philosophy since starting to teach math is that students need to practice what they have learned and apply it to something that is meaningful to them. In addition, I also want my students to think at a critical level. I want them to be able to analyze things that are given to them and come up with their own opinions and conclusions. While I am not expecting to have my students fall in love with math, I am trying to have my students appreciate math more and not see it as the worst part of their day. In addition, I implement real world examples into my classroom to show students that math is not this arbitrary thing that just happens in school. Unfortunately, trying to implement my philosophy into my classroom has always been a struggle. It is not because I do not want to do it, rather it is because of the politics that one has to follow. As with any subject, I too have to follow a curriculum. While I am lucky enough to

be in a school that does allow freedom for the teachers, I still have to make sure that everything is accomplished within the curriculum. In addition, since I work at a Charter School for the Arts, many students miss class because of practice for upcoming performances. I find myself having to repeat lessons to catch up these students. This wastes time in the classroom. As a matter of fact, time is an issue with many teachers at our school including myself. I unfortunately find myself trying to implement the teachings from my 11th grade math teacher only to realize that I do not have enough time to do all the inquiry that I want. I find myself reverting to traditional teaching of what I experienced most in the classroom, where I am lecturing for about 30 minutes, having the students practice the material, go over the problems, and then only have maybe 5 minutes left in class. While I know this is a needed practice for teaching, I feel that I am doing this more often than I would like. I do implement inquiry based learning into my lessons, but it is only for a few topics for the next class. However, I realize that the following class time I need to move on no matter the results of the inquiry based lesson.

The frustration not only occurs with myself, but I also see it with my students. While I am lecturing, even though I am being engaged with my students by asking questions and having them be a part of the lesson, I do observe more students than I would like drifting away. However, when we would move to the

activities associated with the lessons or even when I have the students working on problems in groups, I can feel the energy difference in the classroom. The students are more energetic and engaged with the material. The students are not bored, and even those that are normally quiet during class are engaged with their fellow classmates. I had students tell me that they enjoyed these activities and wished that we could do more lessons like those. The students mentioned that they understood they must learn the topic first, but they wished that we could do more of the activities. For example, for one particular lesson we did on scatter plots, I had the students do an activity where they needed to figure out how many rubber bands were needed so that when they dropped their Barbie doll, the doll would survive but would reach as close to the ground as possible. Students had to create a table, plot points on a graph, and calculate the line of best fit. The students enjoyed the activity and when it came time for the unit test, the students told me that they remembered the things we did in the activity to help them with the test more so than the lecture during class. I knew there had to be something that could have these students be engaged and more excited about math. The problem was, I needed more time. If I had more time, then I thought maybe my students would be more interested in math and maybe have a different perspective of what a math classroom could look like.

While researching online for activities for my students, I came across a method of teaching called the flipped classroom model. In this model, the principle was simple. Instead of the normal lecturing during class and giving students an obnoxious amount of problems for homework, the students would watch a 5 - 7 minute video of the lecture for homework and take notes. When it came time for class, students would have the opportunity to try practice problems and to explore more challenging problems. The teacher would have more time to indicate areas of struggles with students and help alleviate any problems. This seemed like the kind of lesson that I needed for my classroom. I would have more time in my classroom to do inquiry based lessons and could work on more challenging problems. I continued to research how a teacher would implement this model of teaching in the classroom. From my continued research, I liked what I was finding. Other educators not only indicated that they loved how much more time they had in the classroom to help their students, but they also stated that they saw an increase in academic performance and engagement with their students. To me, this just solidified the notion that I needed to implement this plan within my classroom. Therefore, while working with my students, my college classmates, and my fellow colleagues, my action research project will be analyzing the question “What are the effects on academic performance and

engagement when implementing a flipped classroom model with students in an Algebra 2 classroom?”

Literature Review

Introduction

The problem with our education system, especially in the field of mathematics, is that students in the US are behind their fellow peers in other countries. According to Desilver (2017), one of the cross national tests to report this data called the Programme for International Student Assessment (PISA), reported that the United States ranked only 30th overall out of 71 countries in math. This is because the methodology of many classrooms in the United States still modeled the economy of early years such as the 1950s where the workforce was built on the principle of an assembly line. This philosophy was implemented by Franklin Bobbitt and W.W. Charters who approached the curriculum in education through the perspective of functional efficiency (Kliebard, 1975, p.29). The methodology at that time was based on the traditional classroom approach where the teacher is the one holding all the knowledge, and the students receive this knowledge and memorize it. This is known in the education world as transmission teaching where it is teacher centered where the “teacher is the dispenser of knowledge, the arbitrator of truth, and the final evaluator of learning” (Johnson, 2015). Today, according to Careersnz (2018), employers are looking for a different group of people. Employers are looking for employees who have a positive attitude, have strong communication skills, are able to work with a team,

have self management, are willing to learn, and are resilient. Education is not preparing our students for their current workforce. In fact, it does not individualize the student but rather prepares the masses for a standard economy (Kaput, 2018). According to the Association of American Colleges and Universities (AACU), when a group of employers and college students were asked similar questions about career preparation, there was a stunning difference between the different categories. For example, when it came to working with others in a team, 64% of students felt they were prepared for the workforce while employers stated only 37% of their employees were prepared (Jaschik, 2015). The chart on the following page shows the difference of thinking between the students and the employers:

Employers give college graduates low scores for preparedness across learning outcomes; students think they are better prepared.

Proportions saying they/recent college graduates are well prepared in each area*

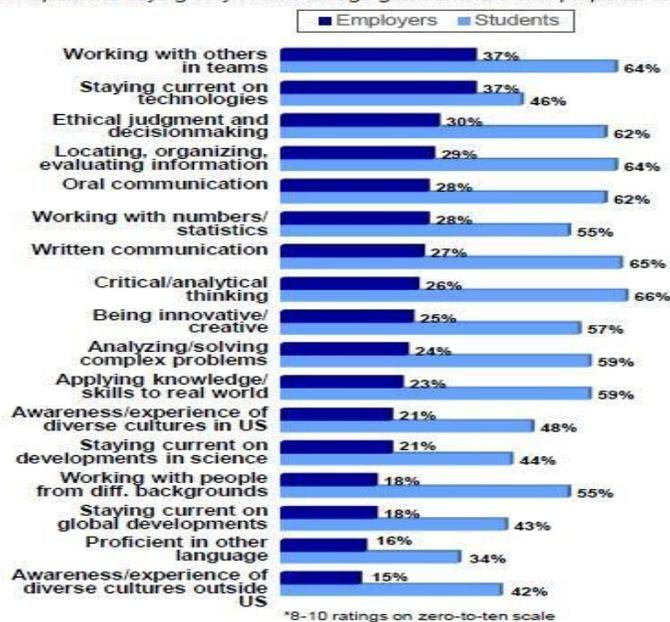


Figure 1. Graph displaying proportions of recent college graduates and employers. Adapted from *Well Prepared in their own Eyes*, by S. Jaschik, 2015.

It is evident that something needs to be changed in the curriculum of our education system to prepare our students for the current workforce and to help them function properly in their lives. Kaput (2018) states that teachers must play a bigger role in developing educational designs and policies within education and must allow for educators to reimagine and alter the design for teaching. One of the answers that kept emerging throughout various researches was having a classroom model that was student-centered through the use of the flipped

classroom model. Studies using the flipped classroom model have shown more engagement in the classroom and an improvement with academic performance.

Student-Centered Learning

As stated previously, one possible solution is to change the design of our educational system from a teacher-centered design to a student-centered design. One needs to keep in mind that this is not the answer to our ever changing economy, but an important shift that is needed in our education system. We need to think about students' interests, their learning styles, cultural identities, and life experiences. After researching and listening to several students, teachers, and academic researchers, Kaput (2018) defines what she calls the seven principles of student-centered learning. She makes sure to indicate that this is not a blueprint but rather a resource for educators to use to have student-centered learning (Kaput, 2018). These seven principles are categorized as positive relationships, whole child needs, positive identity, student ownership and agency, real world relevant, competency progression, and anytime, anywhere (Kaput, 2018). While Kaput (2018) was examining research and literature from the Stanford Center for Opportunity Policy in Education, the learning practices in New England High schools, and the RAND Corporation, she noticed that there were two things missing from the literature: positive identity development and whole child needs (Kaput, 2018). She then gives current, real world examples for each principle

while, along the way in her paper, she makes sure to indicate to her audience that what is mentioned should be used as a resource only and not be considered as a model for teaching because the principles are not necessarily the be all solution to our ever changing economy. As mentioned previously, Kaput (2018) states that teachers must play a bigger role in developing educational designs and policies within education and must allow for educators to reimagine and alter the design for teaching. Barriers must be removed if the policies do not create this kind of space (Kaput, 2018). Many classrooms are moving their methodology to be student-centered learning which addresses “the distinct learning needs, interests, aspirations or cultural backgrounds of individual students and groups of students” (Glossary of Education Reform, 2014, par. 1).

The First Principles of Instruction Design Theory

In order to have this student-centered learning, as defined previously, students must be able to work together and work on real world problems. In order to create an instructional model where the individual students’ needs are met, educators have started using Merrill’s (2002) First Principles of Instruction design theory. In this design theory, there are five components that help a student achieve success with the material. In addition, these five components should be implemented in a lesson plan in order for a student to have a higher chance of success. The five components of this design theory includes problem centric,

activation, demonstration, application, and integration. This design theory states that educators start students with a problem that they need to solve. This real world problem should be something that is relevant to the students and, at first, cannot be solved with the knowledge that they already have. Educators then promote learning by activating new knowledge that students already know. Next, the educator demonstrates the new knowledge that students will be learning. Through working individually and in groups, students then apply and integrate their knowledge into more advanced real world problems (Lo, 2017). For example, in a math classroom, students would be given a real world problem that they will be able to solve at the end of the unit. Along the way, the teacher would have the students recall knowledge that they have previously learned. Using this previous knowledge, the teacher would demonstrate the new material to the students. Through working together and/or individually, students will practice the new material. Finally, students will return to the original problem and solve it. In addition, students will be given additional real world and challenging problems that they will work together and/or individually to solve. This design theory lines up well with exactly what employers are looking for in the current workforce model. Students would not only be self advocating for their own learning, but they would also be working together in order to learn and apply the knowledge. Since we live in a world that utilizes technology, the next step would be to

determine how can this principle be incorporated into the classroom and line up with the First Principles of Instruction design theory.

Cognitive Theory of Multimedia Learning

Today, many educators are using technology in the classroom to promote learning and to discover knowledge. Many people wonder if technology, though, actually does improve learning in the classroom. Much research has indicated that technology use with teenagers actually has a negative impact. Students are on their cell phone on average 5 hours a day (Stage 2018). In addition, research has indicated that cell phone use with social media can contribute to depression in teenagers (Stage 2018). However, research has also indicated that technology has and does benefit students in the classroom, as long as such use is guided by sound educational theory. One such theory is Cognitive Theory of Multimedia Learning (CTML). Proposed by Mayer (2001), (as stated in Bhagat, 2016, p. 124) , the theory has three assumptions about how the human brain goes through new knowledge: dual channels where humans have separate channels to process information, limited capacity where humans have limited ways of processing informations, and active processing where humans actively seek to store information for long term (Bhagat, 2016). With these assumptions, the design of CTML is based on three principles. These principles include multimedia where students learn better through words and pictures than words alone, modality

where students learn better through narration, and individual differences where all design principles have a great effect on low-knowledge learners (Bhagat, 2016, p. 125), or students who have basic skills which are not sufficiently developed and have a difficult time processing new connections. Using the theories of the First Principles of Instructions and CTML, the model of the flipped classroom model was born (Desjarlais and Willoughby, 2007).

Inverted Learning (Flipped Classroom)

By utilizing student centered learning with the First Principles of Instruction design theory and the Cognitive Theory of Multimedia Learning, three individuals, Maureen Lage, Glenn Platt, and Michael Treglia (2000) developed a new model of learning. In their article called “Inverting the Classroom: A Gateway to Creating an Inclusive Learning Environment” they suggested a model of what they called inverting the classroom (Lage, Platt, Treglia, 2000). The researchers wanted to test this method because their research indicated that there was a mismatch between an instructor’s teaching method and a learner’s learning method (Lage, Platt, Treglia, 2000). While instructors strive to meet every students’ needs, it is impossible with the time constraints and the curriculum that teachers must follow. By inverting the classroom, things that are traditionally done in the classroom, such as direct instruction, are now done outside of the classroom by the student such as students watching a video on the lesson.

Classroom time now became a place where students did their “homework”. Extra practice was given to the students, and teachers were able to identify individual student problems and address them. In addition, since more time was available in the classroom, teachers were able to give students more challenging problems and have their students think more critically (Lage, Platt, Treglia, 2000). At the end of the research, the students and the instructors from Miami University were asked to give their perception of the inverted classroom. The students stated that they preferred this method of teaching over the typical traditional classroom model. In addition, the students stated that they enjoyed working together in groups and learning from each other (Lage, Platt, Treglia, 2000). The instructors also had a positive attitude with the inverted classroom stating that they saw an increase in student motivation and engagement. The instructors theorized that this may be because the students took ownership for their own learning and, therefore, felt that what they were doing was important (Lage, Platt, Treglia, 2000). The instructors, along with the three authors, also concluded that the inverted classroom helped a wide range of students who had different ways of learning, and that it closed the learning gap between genders (Lage, Platt, Treglia, 2000). Certainly, if we wanted to prepare the students for the future, the research done by Lage, Platt, and Treglia (2000) has shown how powerful the inverted

classroom, or what we call now the flipped classroom model, can be for our students.

The Four Pillars of F-L-I-P

It is important to note that there is a difference between the flipped classroom and flipped learning. Anyone can utilize the general principle of the flipped classroom which is having students watch videos at home of the lesson that would normally be done in class and then having the students practice what they supposedly learned in the classroom the next day. In the flipped classroom, students are actively learning by working at their own pace and working towards mastery of the topics instead of the traditional approach where the teacher dictates the time frame for the different topics (Muir, 2016, p.153). However, this model of teaching does not necessarily mean that the environment of the classroom is student-centered. In order for the flipped classroom model to be student-centered, educators must implement a curricular approach with it called flipped learning. According to the governing board and key leaders of the Flipped Learning Network (FLN) (2014), the definition of 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” (par. 2). In

other words, flipped learning is the methodology while the flipped classroom is the model in order to accomplish this.

In order for the classroom to be student-centered, or flipped learning to occur in the flipped classroom, there are four pillars that the FLN states that educators must incorporate. The four pillars are flexible environment, learning culture, intentional content, and professional educator. The first pillar, flexible environment, is where the educator observes his or her students and makes changes as necessary and for students to reflect on their learning. The second pillar, learning culture, provides an area where students are participating in meaningful activities where the teacher is not the center of the information or the one that holds all the knowledge. Instead, the knowledge is more student centered while the teacher, who still provides formative feedback, also has to decide when and how instruction should be whole group vs when instruction should be individualized. The third pillar states that the teacher provides intentional content for learning where students can have access to topics that are prioritized for them, are relevant to the students, and the content is differentiated so that all material is relevant to the student. The last pillar is for the teacher, or the professional educator, to make themselves available for students for real time feedback, perform ongoing observations and record data, and to “take responsibility for transforming practice” (Granzanio, 2017, p. 6-7). In fact, the teacher seems like

he has more of a role in instruction in order for this to occur. The role of the teacher is to determine “when and how to shift direct instruction” (Muir, 2016, p.153). By incorporating these four pillars into the flipped classroom, the FLN states that flipped learning or a student centered environment will occur.

The flipped classroom model or sometimes called the flipped learning, also parallels with the design theories of the First Principles of Instructions and CTML. With CTML, the flipped classroom model utilizes technology that has visualization and narration (multimedia and modality principles) and is a new type of design for many students and will help all learners (individual differences principle). The theory indicates that it will help all students in some shape or form. In terms of the First Principles of Instructions, the video lectures will have the students recall previous information (activation) and use it for the demonstration of the new material. To check for understanding, the teacher will have the students answer a few questions after the video (application). Previously, this was done during class but will now be done at home. When the students arrive the next day, the teacher will have the students explain what they watched (activation) and then apply the information to a couple of practice problems. Again, this is just to make sure the students understand the basics while not using a big chunk of instructional time as one would use in the classroom. The majority of the time for the flipped classroom model, and the heart of The First Principles

of Instructions, is to utilize the information that the students have learned and integrate it into a more advanced and real world problem. By combining The First Principles of Instruction and the flipped classroom model, it will allow more time for students to explore the topics instead of skimming the material as happens in most of the cases when we teach something in school. However, with the negativity of technology and the fear of teachers not being the head in the classroom, many educators wonder if the flipped classroom is worth it.

Is the Flipped Classroom Right for Everyone?

Moran and Young (2015) introduce five questions that educators should ask themselves before implementing a flipped classroom. These questions include questions that ask the educator if he or she is modeling the flipped classroom for his or her students, how many classes the educator is flipping, whether or not the content is appropriate for the subject, how well students are able to demonstrate what was learned on the videos, and if the educator is taking a proactive approach to classroom management both online and in the classroom. When an educator analyzes and reflects on these questions, then he or she will have a better understanding of how to build an online curriculum. Following this line of questioning, a researcher would want to model the approach, like the flipped classroom model, with the students by showing them what is expected of them. A researcher would not want to implement the study with all his or her classes but

instead, implementing it with one or two classes so that the research would be more effective. The researcher would need to make observational notes on what the students have learned, whether they are engaged, and what needs to be improved and/or changed to better the research. By following these methods, researchers would be like Moran and Young (2015) who were able to use their findings to implement their own flipped classroom and have an effective environment.

The flipped classroom approach has also had a positive effect in schools located in a low-socioeconomic population. A study done by Fulton (2012) explored how their school district could use such an approach. Their district did not have enough resources to supply students with the necessities for their learning such as the most recent textbooks that aligned with the curriculum. Fulton (2012) researched other schools that have done flipped classrooms and wanted to implement an online curriculum for his students. Fulton (2012) and the administration compared the students' academic performances and engagement from the previous year with the traditional classroom setting to now the flipped classroom. Studies showed an increase for both achievement and engagement in and out of the classroom. Students were actively learning the material by having discussions in the classroom and having conversations with one another about the curriculum. The administration within the school district also interviewed the

teachers on why having this approach was successful for their poor school districts. The teachers created a top ten list of reasons why it worked as listed below:

1. Students move at their own pace.
2. Doing “homework” in class gives teachers better insight into student difficulties and lifestyle.
3. Teachers can customize and update the curriculum, and provide it to students 24/7.
4. Students have access to multiple teachers’ expertise.
5. Teachers flip professional development by watching each other’s videos and learning from each other.
6. Classroom time can be used more effectively and creatively.
7. Parents have a window into the coursework.
8. Student achievement is increasing, so is interest and engagement in higher-level math.
9. Learning theory supports the new approaches.
10. The use of technology is flexible and appropriate for 21st-century learning (Fulton, 2012).

Fulton (2012) hoped to improve on the flipped classroom the following year and continue to see growth in academics and engagement. He is hopeful that his

research will help other school districts create a flipped classroom model for their students. These reasonings are important for my action research because the students at my school have a reputation of not performing well in mathematics. In addition, the parents of the students are always interested in what is going on with their children, and the flipped classroom model will give them a window to what is happening.

Different Flipped Learning Methods

Even though the notion of a flipped classroom is not new to educators, there are still different ways of approaching it. One approach is discussed in “How to Flip the Classroom - "Productive Failure or Traditional Flipped Classroom" Pedagogical Design?” by Yanjie Song (2017). Song (2017) discusses the idea of the traditional flipped classroom where students watch videos and then discuss and do “homework” the next day in class. In contrast, a productive failure flipped approach is where students try a problem that they may or may not know how to do, watch videos for homework, and then discuss the lesson the next day in class. Research was similar to the previously mentioned articles where there were surveys and assessments. As with the other research, both methods showed significant improvement with engagement in the classroom. However, between the two flipped classroom models, the productive failure approach had a

significant increase in academic performance than the traditional flipped classroom approach and therefore, the traditional/lecture classroom method.

This notion of productive failure is not something new in education. There has been research conducted that looks into the notion of having students struggle with an idea prior to a lesson. Manu Kapur (2016) looked at the effects of not only a productive failure approach in the classroom, but also three other classroom approaches, productive success, unproductive failure, and unproductive success. Unproductive failure and unproductive success can be categorized as the direct/traditional instruction that most students are used to in the classroom.

Research indicates that short term, students show comprehensive knowledge of material. However, long term, students do not retain deep thinking and only retain memorization information. Productive Success can be thought as Problem-Based Learning (PBL) where students are working on enriching problems and collaboration that promote deep thinking. Productive Failure has a problem solving phase followed by instruction where students look back on their problem solving. From the study, Kapur (2016) speculates that having this failed approach beforehand has students learning better prior to the instruction because they are already formulating ideas. There was no significant impact on procedural knowledge compared to the other approaches, but students had a deeper

understanding of the material and retained the information for a longer period of time.

Using Technology in the Flipped Classroom

Of course, to have an effective flipped classroom, it is still necessary to employ 21st Century skills (having students think critically, promoting collaboration and leadership skills, etc.) that one would have in a traditional classroom and to have a constructivist approach towards mathematics. It is also necessary to use technology effectively in a flipped classroom model to have the same learning styles as it would be in the traditional classroom. The research done by Jamie Hill (2012) on Problem Based Learning (PBL) will still need to be utilized in the flipped and traditional classroom approaches to have effective teaching styles and to not have biased results. The research needs to show the change with academics and engagement while still having a constructivist approach, or constructing “their own understanding and knowledge of the world, through experiencing things and reflecting on those experiences” (WNET, 2004, par. 1). In mathematics, according to WNET (2004), there should already be a constructivist approach when teaching mathematics. If one is to implement another method of teaching, like the flipped classroom model, it should still follow the constructivist approach of teaching and if anything, enhance the learning. In terms of technology, a flipped classroom approach has always had

the difficult task of still having that inquiry based learning as is used in the traditional classroom because students are not used to this approach and creating the knowledge on their own. In addition, creating videos for every lesson is time consuming for educators and much planning is needed that might affect the learning in the flipped classroom. One of the ways to help is to use various math apps as a supplement for the flipped classroom. Meilan Zhang (2015) researched the effects of math apps in the classroom by looking at the difference of fourth grade students. Half of the student population were classified as students who were at risk and/or with disabilities. Students were given pre and post-surveys after using the apps. The results showed that the gap between the typical and the low achieving students was reduced and that the students overall had more confidence in math.

The other way to make sure that students were still engaged in a flipped classroom was to find easy ways for students to discuss and collaborate. Besides having discussion boards and using sites like Padlet, research done by April McMeans (2015) has shown that using social media created a more positive outlook for students and therefore, created more discourse among the students. She saw her students using Twitter and Facebook to reach other people about problems they had in the classroom and becoming excited when someone responded to them. This excitement was brought into the classroom where

students had discussions about their findings and what they had learned. Jeffrey Carpenter (2016) researched the app called Voxer and its effectiveness among educators. Educators were surveyed on their use of Voxer and participants were tracked on their use. The study showed that the participants were able to continue their professional development with other like minded educators inside and outside their state. In addition, the research indicated that the participants stated that their use of Voxer changed the way that they taught, their access and awareness of material, and their willingness to try new things within their schools. However, the research did not indicate its effectiveness between educators and students, but there is nothing that says this logic cannot be incorporated within the classroom. The study had the participants engaged with each other which seemed to be the common theme among literature with the flipped classroom model.

Learning Outcomes in the Flipped Classroom

Current research from the articles for flipped classrooms has focused on two primary outcomes for students. This includes the students' academic performances and their engagement inside and outside the classroom. Kevin Clark (2015) discussed how he looked at the effects of a flipped classroom in both the academics and the engagement of the students. Clark (2015) used "two Algebra 1 classes at the research site, a rural 9-12 high school with an average

enrollment of 450 students” (p. 96). These two Algebra 1 classes consisted of 42 ninth grade students. Clark chose these students because the students would be taking a state assessment at the end of the course. The research had the students take a pre and post-survey, random interviews, focus group observations, and a few assessments. The results of the research showed that students had more engagement in the flipped classroom than the traditional classroom. Moreover, there was significant impact when it came to the academic performance. These results were also shown in the research done by Chung Lo (2017). The research was done to compare two levels of students in a flipped classroom. The one group was considered to be high achieving students while the other group was considered to be low achieving students. Following the same principle of Clark (2015), students were given surveys and assessments to compare their academic performances and their engagement. While there was growth in both classrooms, the growth with the flipped classroom model was determined not to be statistically significant. What was more interesting and beneficial to Lo’s (2017) study were the responses from students and teachers. He indicated that there was more engagement and more optimism with math. In addition, the responses from the interviews were used to better the experience for a flipped classroom model.

In a research study conducted by Betty Love (2013), the method of collecting data was completed with a college level linear algebra class that was a

part of the STEM program in the college. The research had a total of 55 sophomore students where 27 were in the flipped classroom approach while 28 were in the traditional setting. The research again compared the academics and participation of the students in a flipped classroom and traditional/lecture classroom. The students were given the same homework problems and the same assessments along with surveys along the way to ask about their viewpoints of the teaching methods. The research indicated that the students in the flipped classroom showed more engagement and willingness to do problems together and on the board than in a traditional/lecture class where students were afraid of being wrong and ridiculed in front of their peers. Students in the flipped classroom had a more pleasurable experience and had a better outlook with math than their peers in the traditional/lecture classroom. They were more confident in their math abilities after experiencing a flipped classroom approach. Unlike other research articles which indicated little improvement with achievement, the study done by Love (2013) showed that there was a noticeable difference of academic performances between the two methods of teaching. Throughout the study, the teacher used the same three assessments for both classroom approaches. When the second assessment scores were compared, students in the flipped classroom scored significantly better than their peers in the traditional classroom. This trend

continued with the third assessment where, again, students in the flipped classroom scored significantly better than those in the traditional classroom.

Engagement

Through the research that has been done in the classroom about the flipped classroom model, there has been much discussion about engagement in the classroom. As will be discussed in more detail later, researchers have indicated that engagement in the classroom increased with the introduction of the flipped classroom model. However, as an educator, one must ask himself or herself what it means to be engaged in (and in this case out) the classroom. Even though many educators interchange the two terms, it is important to note that engagement in the classroom is not the same thing as motivation in the classroom. According to Appleton (2006), motivation is the underlying psychological processes while engagement is the energy in action and the connection between the person and the activity. The two terms may be separate, but they are independent of each other. A student can be motivated to do an activity to achieve an end result, but may not be engaged in the activity (Appleton, 2006). As well put by Appleton (2006), “motivation is thus necessary, but not sufficient for engagement” (p. 428). Therefore, when one looks for engagement in the classroom, one needs to make sure that it is not motivation that is occurring with the students.

Engagement with students has been linked with student academic achievement (or lack thereof) in their schooling. To look at this, engagement is broken into four components, behavioral, cognitive, affective, and psychological. The behavioral component looks at the participation and effort of the student in the classroom. The cognitive component looks at the student's investment in his learning and the goals that he wants to achieve with the activity to tie in with motivation. The affective component observes the student's interest of the activity, his attitude of how school is relevant to his life, and his attitude about learning. Finally, the psychological component observes the student's involvement of the school and the feeling of belonging (Appleton, 2006).

Measuring engagement in the classroom depends upon the kind of engagement one wants to examine. A commonly used tool to measure engagement is the Student Engagement Instrument (SEI) which has shown to be reliable and valid (Wang, 2014). However, the SEI is used more to measure engagement at a school wide level rather than a classroom level. If the purpose of measuring engagement is at the classroom level, an educator needs to make sure that he or she is evaluating the effectiveness of an intervention at the classroom level, providing feedback to the teachers on student's perception of the intervention, investigating what a teacher can do to improve engagement in the classroom, and looking at the link between engagement and academic

performance (Wang, 2014). Another tool that has been known to be reliable and valid is the Positive and Negative Affect Schedule Extended form or PANAS-X. However, the tool has been mostly used in emotional research. Nevertheless, the questions that are used in the tool can be changed to fit the needs of the intervention that is used at the classroom level (Wang, 2014).

Engagement in the mathematics classroom has typically been defined as a subject where one needs a special talent to understand and enjoy it. By just completing the assignments correctly, educators assume that the students are engaged with the material. Otherwise, it is perceived to be a difficult subject and students have a disinterest with it (Kong, 2003). Today however, it is clear that this is not a valid form of engagement. According to The National Council of Teachers of Mathematics (NCTM) (2013), research indicates that discussion is an integral part of the classroom that increases student learning and motivates students. Few studies have looked at the engagement in the mathematics classroom because there is not one tool that is considered to be reliable and valid. Nevertheless, Kong (2003) developed an instrument that measured engagement in the mathematics classroom. He observed nine types of student behaviors that he then categorized into the four components of engagement that have been mentioned previously. He looked at the students answering the teacher's questions, asking teacher questions, listening to the teacher, reading textbooks,

discussions with classmates, doing exercises, doing other tasks as asked by the teacher, irrelevant behavior, and other (Kong, 2003). To insure that his results were reliable and valid, Kong (2003) performed an exploratory factor analysis. He used the reliability index Cronbach alpha to validate the findings. The results were a median of 0.86 which was strong evidence that the engagement tool can be used at the classroom level (Kong, 2003).

Where Are We Today?

According to an article presented in *Educational Leadership*, the flipped classroom model is catching on with teachers. However, there is no direct scientific research to indicate that the flipped classroom model increases students' learning (Goodwin, 2013). Nevertheless, this should not be an indication that teachers should not try the flipped classroom model. There has been a lot of indirect research performed with the flipped classroom model that indicates students' academic performance and engagement has increased with their students. Teachers and students from these researches according to *Educational Leadership* stated that there was improved student-teacher interaction, opportunities for real time feedback, increased student engagement, and more meaningful homework (Goodwin, 2013). The idea of the flipped classroom model may not just be about flipping the classroom, but it may be actually about flipping the model of what is traditionally being taught in the classroom. With the

increase of membership in the FLN from 2,500 teachers in 2011 to 9,000 teachers in 2012 (Goodwin, 2013), teachers have indicated that they want to move “away from a traditional model of teachers as imparters of knowledge and towards a model of teachers as coaches who carefully observe students, identify their learning needs, and guide them to higher levels of learning” (Goodwin, 2013, p. 80).

Conclusion

In order to have an effective and engaging classroom, a teacher should construct his or her classroom to be student-centered. However, being student-centered is not enough in order to have an effective classroom that will prepares for the workforce. A teacher needs to follow the design theories of the First Principles of Instructions and CTML. Using the design theories with the combination of technology, the inverted or flipped classroom model has been shown to be one possible solution for our students in terms of helping to better our students in their learning. Research has indicated that the academic performance and student engagement increased when implementing the flipped classroom model compared to the traditional approach. Nevertheless, student centered learning (Kaput, 2018) and The First Principles of Instructions (Merrill, 2002) are key components that need to be implemented into the flipped classroom model in order to be effective in the classroom.

Research Design and Methodology

Rationale

In any classroom, time is one of the most important elements that a teacher can have. Unfortunately, it is also one of the things that teachers do not have much. In a math classroom, being able to practice what was taught is important to help students understand the material and for teachers to see what areas need to be discussed more. In addition, it is important for students to connect with the material. Without some sort of connection or meaning for students, the students are just doing the work because the teacher said so. With the implementation of a flipped classroom approach, according to Clark (2015), the research has indicated that students will have more practice in the classroom. By having more time in the classroom, a teacher is able to connect the material with the students. In addition, teachers can check for any struggles that the students may have. Research indicates that a flipped classroom approach has improved engagement in and out of the classroom which is also a positive effect when it comes to mathematics. My research parallels with both post-positivism and critical pedagogy since I am looking at both quantitative and qualitative data which are the results of student observations and questions.

Setting

My study was conducted at a small, urban, artistic charter high school in Eastern Pennsylvania. The school is considered a Title 1 school and receives state funding. There are 640 students currently enrolled at the school comprising 44 different school districts in the state. The student body population consists of 74% White, 13% Hispanic, 7% African American, 5% two or more races, and 1% Asian. In addition, 79% of the total student body is female. The school is far above average in standardized test scores where 90% are Proficient in Biology (state average 66%), 98% proficiency in English (state average 77%), and 83% proficiency in Algebra 1 (state average 68%). The school has a 99% success graduation rate. The school runs on a modified block schedule where the day consists of ten periods where courses meet every other day for a full school year. Of those ten periods, three to four of those periods consist of the students going to their artistic classes; one period is for lunch, and the rest of the periods are for academic courses.

Participants

The study consisted of two Algebra 2 College Prep (CP) classes, one class (Period 1) containing 20 students of 9th and 10th graders and the other class (Period 2) containing 21 students of 10th graders. In my Period 1 class, three students have an Individualized Education Plan (IEP) or 504 plan while my

Period 2 class has five students with an IEP or 504 plan. From analyzing averages for these students from the previous year, fifteen students from Period 1 had an average of 85% or above while five students from Period 2 had an average of 85% or above from the previous year. These students have already taken the standardized state tests (Keystones) since they have completed Algebra 1 the previous year. Of the 41 students, five students, all from Period 1, scored Proficient on the Keystone exam. In Period 1, eleven students were within 20 points of scoring Proficient on the Keystone exam while in Period 2 only 6 out of 21 students were within 20 points of scoring Proficient on the Keystone exam. Since the nature of the Algebra 2 CP class is to prepare the students for the Keystone retakes during the winter, the curriculum of the class follows a mixture of Algebra 1 and Algebra 2 topics for the first half of the year followed by only Algebra 2 curriculum topics in the second half.

The classrooms are used by other teachers in the school. I had to travel to another classroom for my Period 2 class. Therefore, the general seating placement for Period 1 was to have the desks in five rows of five desks while for Period 2 the desks were placed in groups of four with a total of five groups. It is important to note though that during the study, desks were moved so that students could collaborate within their groups. Period 1 had two teacher desks placed along the large windows on one side of the room. Even with a large amount of

students in the room, the room itself was large enough for the students and teacher to walk around and to have conversations within the groups without having a hard time hearing what was discussed. The classroom for Period 2 was smaller with only one teacher desk, two windows, and a large counter alongside the one wall. With everyone present, it was difficult to move around freely in the classroom without tripping over backpacks. In addition, it was more difficult to have conversations in this space because everyone was so close together.

It is important to note that since this is an artistic charter school, although the academics are important, if there are rehearsals for performances where students are needed, the students will miss the academic classes and are expected to make up the material. There were a few instances where this happened during the school day that affected both my Period 1 and Period 2 classes. Three-quarters of the class was missing, negating what was planned for those days during class. However, students were still expected to check online what was missed in order to keep current with the material.

Pacing Calendar

Below is a timeline showing the pacing for the action research study. It is important to note that this was a guide of what was to be completed for the study. Knowing the nature of the charter school and reviewing my different data

resources throughout the study after each day, I allowed myself to modify the pacing calendar as needed.

Month of August

- Students will be introduced to each other and to the teacher.
- The teacher will give the students an about me sheet.
- Students will be given the Parent/Student consent form to indicate what research will be done within the class.
- Students will be given the Pre Student Questionnaire asking them about their various views of math, so no bias is perceived.

Month of September

- Week 1 - Students will be working on Unit 1 with combining like terms. During this time students will be introduced to various portions of the flipped classroom so that there is no obstacles when the research is done.
- Students will be introduced to Google Classroom in the beginning of the unit where students will explore the areas that they can find assignments, files, and other material in case they are absent. The teacher will indicate that for one of the units, the students will be doing most of their work online while doing practice problems in class.
- Week 2 - Students will be introduced to my Youtube channel, where the teacher will have students click on the link found in Google Classroom.

Students will watch a video on combining like terms, and the teacher will model for them how they should watch a video and take notes.

- Week 3 and 4 - Students will have homework with watching a video on combining like terms with exponents to show students what they will be doing in a future unit with the flipped classroom approach.

Month of October

- Week 1 - The teacher will choose a group of students to interview for both the traditional and flipped classroom approach. Students will start learning how to solve one step equations and be given a quiz at the end of the week.
- Week 2 - Students will be learning how to solve two step equations through traditional learning. Students will be given a quiz at the end of the week on solving one and two step equations.
- Week 3 - Students will be using their prior knowledge of combining like terms and solving equations to determine how to solve multi step equations. They will work on various problems during the week and have a quiz on all forms at the end of the week.
- Week 4 -The teacher will interview a select group of students and have them answer questions regarding solving an equation. Students will work in their groups on various word problems, and we will be discussing

together how each group would proceed in solving these problems.

Students will have a mini quiz on word problems at the end of the week.

- Week 5 (and possibly lasting into first week of November) - Students will be given a study guide for the unit and a test. Students will also be given a mid research survey asking them what they thought of the idea of a flipped classroom approach and what they thought of the traditional approach.

This will be used to see the students' mindset of both theories.

Months of November and December

- Week 1 - Students will be told that we will be doing the flipped classroom approach. Based on the introductions the first month, the teacher will only be there to remind the students how to do the work online. Students will be given the homework problems of solving absolute value equations. The next day, the class will discuss their findings and do at least 5 practice problems. The following day, students will be working on more problems and clear up any misconceptions. For homework, the students will be watching a solving inequalities video, and the next day do practice problems.
- Week 2 - Students will have a review on both topics and then take a quiz on both topics. For homework they will be watching a video on solving

compound inequalities. The following days, practice problems will be done in class referring to the video.

- Weeks 3 and 4 (before Thanksgiving break into December) - Students will work on an online activity to visually understand how compound inequalities work. The following week, students will watch a video on solving absolute value inequalities. Practice problems will be done within their groups.
- Week 5 - Students will apply their knowledge with real world problems and justify their answers and how they are setting up their approach. Students will have various word problems to complete at home while working with their groups. During this time, the teacher will select a group of students to interview and ask how they feel about the flipped classroom approach and give them a couple problems for them to solve.
- Week 6 - Students will be given a study guide for unit 3 and a Chapter 3 test on Solving Absolute Value Inequalities. Students will also be given the post questionnaire survey of their thoughts of a flipped classroom versus a traditional classroom.

Data Resources

Upon submission and approval by e-mail of my study from the Human Subjects Internal Review Board (HSIRB) from Moravian College, I obtained

approval from my school principal (Appendix A), parental consent (Appendix B), and student assent forms (Appendix B). I received permission from all participants and, therefore, was able to collect the various data from each of the students.

For this action research study, I used various methods of collecting data including surveys, interviews, student artifacts, and field logs. The study took note on how students were engaged with the material which included, but was not limited to, students volunteering to do problems and their attitudes throughout the lessons. The study also looked at the students' academic performances through the use of various assessments. These included classwork assignments that were given throughout the action research study and mini quizzes. Grades were stored in an online grading system and students received their assessments back within a timely manner.

Surveys. Students were given surveys prior to the start of the action research project. They were asked about their opinions on mathematics including how they felt about their experiences in their math classes. Students were also asked to rate their viewpoint on math and how comfortable math was to them (Appendix C). Even though from previous experience I had a good idea of how the majority of the students felt about math at the school, I wanted to start with a baseline for my students. Once students experienced a couple lessons using the

traditional classroom approach and one lesson with the flipped classroom model, students were given another questionnaire asking how they felt about the traditional classroom approach, if what they experienced was any different from what they were used to, and if they would want their teacher to use this method of teaching. Again, students were asked to rate their motivation and confidence with math (Appendix D). At the end of the study, once the students experienced a total flip in the classroom model, the students were given a final questionnaire asking to describe their experience with the flipped classroom model, describe their experience between the traditional classroom approach with the flipped classroom approach, and if this method would be something they would use in their own classroom. The students were asked to rate their motivation and confidence with math (Appendix E).

Interviews. Two rounds of interviews were performed with the students. Each time, four students were randomly chosen from each class to answer two interview questions. In the first round of interviews when using the traditional method of teaching, the students were asked how they felt the class was running and to list any positive and/or negative experiences they had. In the second question, students were given a problem to solve dealing with the unit (Appendix F). I did not provide any help or give any indication to the students if they were doing the problem correctly, because I did not want to introduce any bias into the

data. For the second round of interviews, towards the end of the action research project, the students were asked the same first question of how they felt the class was running and if they experienced anything that was positive and/or negative. The second question however dealt with students solving a different problem from the unit that was currently being studied using the flipped classroom model (Appendix G).

Student Artifacts. Throughout the study, students were given various graded classwork assignments that tested their knowledge on the material. The unit on solving equations utilized the traditional model of teaching. The unit on solving absolute value equations and inequalities was utilized the flipped classroom model of teaching. Each assignment was graded using a teacher generated answer key and each assignment was graded based on the student's knowledge of the material. The scores for each student were then recorded in an online gradebook. All these collected artifacts helped me guide and modify anything that was needed for the action research project. The assignments would also be analyzed to see if academic performance changed because of the use of the flipped classroom model.

Field Logs. Field logs were used every time there was class to record classroom observations and to write any important dialogue that was overheard through classroom discussions (Appendix H). By using these classroom

observations and student quotes throughout the study, the data would be analyzed into keywords that would give an overview of the atmosphere in the classroom and how the students felt about the subject matter with the different approaches of teaching.

Trustworthiness Statement

In order to make sure that the action research project was valid and could be trusted, there were certain protocols that needed to be followed. The first step was completing the Human Subjects Internal Review Board (HSIRB) for Moravian College. The board members at Moravian College needed to approve my project before any research could be completed. In the HSIRB form, I outlined the objectives and design for my project. I stated how data would be collected and how to reduce risks with the students involved within the study. I needed to provide the board members in HSIRB the documents that were needed for the project including the student assent form (Appendix B), the parent consent form (Appendix B), the signed principal consent form (Appendix A), the pre and post-surveys (Appendix C - E), the interview questions (Appendix F - G), and the form that will be used to collect observations (Appendix H). This first step in the action research project is also echoed by McNiff (2017) who states that one “must negotiate and get formal permission for your research, in writing, from your university ethics committee and from your organisation” (p. 126). As also stated

by McNiff (2017), the parent consent form and student assent clearly state that all information will be kept confidential and any names that are given in the action research project will be pseudonyms. All participants were able to withdraw at any time without any repercussions. In addition, I also verbally stated in class the outline of the project and what it entailed. I stated how all material would be kept in a safe location, and at the end of the action research project, all data would be destroyed. I iterated again that at any time, the students were able to withdraw from the project without any repercussions.

After obtaining the approval from the board members at Moravian College and receiving permission from parents and students, I began the action research project by collecting and analyzing data. The project itself followed McNiff (2017) by looking at any pitfalls that may occur during the action research project such as the use of technology in and out of the classroom. The number of participants was relatively small so that it would be manageable. The project focused on my own area of practice of mathematics, and I worked with my other colleagues within the field. The data was collected by giving the students pre and post-surveys, randomly selecting students for the interviews, keeping observational notes throughout the research and reflecting on my study and changes that were needed (Hendricks, 2017), and collecting hard copies of student work which included classwork and various assessments. The majority of the

questions that were asked of the students were open ended, allowing the students to freely respond without being restrained to an answer. In addition, the open ended questions allowed my action research project to be open too and not be forced to go a certain path. The data allowed me to go to a more appropriate direction for my research so that it would be a better quality and valid project (McNiff, 2017). In addition, having open questions allowed me to deeply analyze and code the students' answers so that I was able to have a strong conclusion for my action research project. The surveys, interviews, observations, and various assessments provided me multiple resources "to corroborate findings" which increased the credibility of my action research project (Hendricks, 2017, p. 65).

The conclusions of my action research project followed three forms of validity as stated by McNiff (2017), construct validity, face validity, and ironic validity. I looked to see what the effects were on academic performance and engagement with students when utilizing the flipped classroom model (construct validity). The results that were analyzed and coded were looked at face value to see what the effects were when utilizing the flipped classroom model (face validity). Finally, while the research was being done, I made sure that what I observed would not be analyzed at face value. I analyzed from every possible direction to see if there were any other conclusions that could be drawn (ironic validity) (p. 208).

I needed to triangulate the evidence that I collected from my data and test the validity of my conclusions. In order to accomplish this task, I needed to have others critique and analyze my conclusions. During the research process, groups were created at Moravian College with my fellow educators so that we could collaborate with one another and critique our findings. We made sure to be open to our fellow educators who did not agree with us and to think again about our findings. We realized that these critiques were not about us but rather about the ideas in our conclusions, and we welcomed the comments (McNiff, 2017). The peer groups of my fellow educators at Moravian College, along with my professors, were also my validation groups. The groups met every week to discuss each others' research observations and data collections and then to offer our "emergent claims to knowledge and offer critical feedback" (McNiff, 2017, p. 212).

My other critique group were the five members of my math department including our department chairperson. We met once a week to look and analyze the findings of my project to see if my conclusions were valid. If any conclusions were not valid, I would go back to my project and change anything that was needed. I would look at the project with a new set of lenses and be open to future analysis. This aligns with Hendricks' (2017) ways of increasing the validity of my action research project. The members in my groups helped reduce the bias of

my research and increased the credibility by looking if the “responses and experiences have been accurately, truthfully, and fairly captured” (p. 65). By using the input that my professors, my critique group, and my validation group gave me, I was able to increase my trustworthiness and validity with my action research project.

My Story

Roller Coaster Teaching Career

As stated earlier, I have always had a passion for math. No matter what we were doing and what we were learning, I always enjoyed it. This passion continued when I became a teacher. No matter the lesson, I always taught my classes with excitement and pushed it so much to my students that there came a time during my first year of teaching when I had a student ask me, “Mr. Kieszek, how can you be so excited for something that has no meaning?” This statement has haunted me to this day. How can anyone not see that math is important, that math is all around them and can be interesting if done correctly? I started to incorporate more activities into my lessons including review games. The students enjoyed those days because I was not in front of the room teaching, and they were able to play a game. However, that only lasted for that one day, and, soon after, the students became bored knowing that they had to come to math class.

A few years later, the same problems were still there with students not being engaged in math and students not being responsible with their learning. In fact, at the school I was teaching, with the population of students that I had, and with the lack of support that I received from administration, I contemplated about changing careers. We did not have much in terms of supplies, the majority of the students were living below poverty, and many students were being arrested. It

was a bleak time for me. Nevertheless, this was my first contract position, and I knew I needed to try something to make a difference. I implemented more discovery activities with my lessons where students had to take more responsibilities in their own learning. I structured my classes so that with these activities we could have more discussions and more collaborations. I remember my students being confused by this structure.

Having students excited about mathematics was not the only thing that bothered me with teaching the subject. In addition, I felt that my job as a teacher was to prepare my students for life outside of the classroom, life after high school. Even though the age difference between my students and myself was less than 10 years, I observed a significant difference with the mindset of my students compared to the mindset of my friends and I when we were in high school. Perhaps I was oblivious to my surroundings when I was in high school, but after talking with coworkers who were about the same age as me, we did conclude that a majority of students today do not take responsibility for their own learning as we did when we were in school. We collaborated when teachers taught us in high school, we knew that not everything would be taught to us, and we knew that we would have to take it upon ourselves to further our knowledge. Many of the students that we taught today, including our Honors classes, expected the teacher to do everything for them, and if there was anything that was not exactly

discussed in the classroom, then the students would not take the opportunity to challenge themselves and try it on their own. I thought to myself is this maybe why students are not engaged with the subject I am teaching? Do I first need to teach the students responsibility and collaboration, and by doing that, would it lead to the students being more engaged?

The students were not used to this kind of learning and did not know how to handle it. The majority of the students tried to rebel. They would sit in their chairs and not do anything hoping I would just do the work for them. I did not budge. Unfortunately, neither did my students. I thought ok, I will teach to them because I do not want my students to fail. Surprisingly, the students still did not want to do anything and would just sit there talking and going to sleep. This made me more frustrated and made me start to give up on teaching.

Luckily for me, there was hope. A position opened at an artistic charter school in the area. Even though it felt like a long shot, I applied for the position. Within a month, I was offered the position and I quickly grabbed the opportunity. However, my mindset was still at the previous school where I worked. Happily, that quickly changed when I stepped into the classroom. The students were respectful. The students were eager or at least willing to learn. There were supplies at the school that teachers and students could use, and the administration supported its teachers. I felt that I could try any teaching method at this school.

So, I did. I started researching ideas that would have students excited about learning mathematics and having them be responsible for their own learning. Little did I know how important this would be.

Life at an Artistic School - The Flipped Classroom

Besides the fact that I had never been at a school where the students were willing to learn and the staff was so positive, I also never experienced a schedule like the one at this school. If the students are freshmen or sophomores, they have their academic classes in the morning while their artistic classes are scheduled in the afternoon. For juniors and seniors, their schedules are the opposite. In addition, for all grade levels, the classes meet every other day. I thought that this could be a problem for students. I wondered how it would affect students who missed my class, and I would not see them for an entire cycle. After all, many times math builds upon itself and what was learned one day in class would be needed for the next time we have class. In addition, for that amount of time to pass, students can tend to forget what was taught. My thoughts and worries became even more of a concern when I learned about student performances and practices.

When there were artistic performances, students would be in their artistic areas for the entire day and would miss their academic classes. In addition, these practice sessions sometimes lasted for a couple of days. My worries of the

students just missing one class became worried of them missing a few classes which, with our schedule, meant missing two weeks worth of class. For both students and teachers, this is a huge problem. The students start to fall behind and have no idea what is going on in class. Teachers have to find time to review the material with these students or to at least have them be on the same pace as the rest of the class. I found myself stopping my classes so that I could catch up the other students. This wasted not only my time but also the other students' time who were in class and wanted to move forward. This is when I started making videos for the students so that they could catch up on the material. However, I thought why should I just make videos for the students who are missing class. Why shouldn't I make videos for all the students to have and watch whenever they wanted? I started making videos for my students to be available in case they missed class or needed to review the lesson that we did.

I was so excited about doing this project, I told one of my coworkers about it. I remember my coworker looking at me and saying "Chris, that's the flipped classroom. You should look it up; it really is not anything new." Even though my coworker made me feel a little silly thinking I was the cool teacher using technology, I took her advice and researched it. After doing my little research, I remember saying to myself, *wow, this is exactly what I am looking for! I can utilize technology to have the students learn, the students can be more engaged, I*

did not have to waste class time to catch up other students, and I will be having the students be more responsible in their learning. What is not to love about this?

Through more research, more structure, and working with faculty at Moravian College during my Master's program, I was eager to try this model of teaching my last year as a graduate student.

Preparing the Flipped Classroom Model

“Good morning class. I hope that you enjoyed your first day of school the other day. Today, we are not going to be doing any math, but rather, we will be discussing what math means to you and discuss in more detail how this class will run for the first half of the year,” I smiled to my Algebra 2 class when they entered.

“Mr. Kieszek, will you be giving us our books today? I got all my books yesterday and you never gave us ours,” one of my students stated.

“As I mentioned last class, I do not have my students learning and reading from a textbook. We will be doing something different this year, but before we delve into that, let's have a general discussion about math. Can someone tell me how they feel about math?”

Everyone looked at each other with no one being daring to raise their hands. “Really, you guys can be honest,” I said. “Trust me, I have heard it all

before where students have said to my face that math is the worst thing ever. So please, be honest.”

Students started to raise their hands one by one and started to tell me their thoughts and opinions.

“Math is really boring. I mean I get it sometimes and sometimes I don’t.”

“Yeah, I agree with her. I mean, math is ok for me. I just find it very boring and not engaging. I really do not see the use for it.”

“I like math Mr. Kieszek. I enjoy coming to a math class, but I do understand why others are saying it is boring. I sometimes find it boring too, but I like it better than all my other academic classes.”

These were the overall statements I was hearing from my students.

“Thank you everyone. Do the rest of you feel the same way?” I asked my students. I noticed the majority of my students nodding their heads.. “What would be something then that you would like to see in a math classroom?”

One of the female students raised her hand, “Why can’t math be more like history class where we can have discussions? That is why I love history!”

Another student chimes in, “I agree. Math needs to have more discussions. It is always just one way and that is it. You are either right or wrong.”

The student who stated that she likes math chimes in, “That is why though I like math. There is only one possible solution and one possible way of getting the answer. What is there to discuss? You just do it.”

A student responded, “True, but what gets me is that a lot of times I do not see math in my life. I think if it pertained to me, I would enjoy it.”

The majority of the students in my class exclaimed, “Oh my gosh yes!” followed by a student stating “Like when am I ever going to have to solve for x when I am walking down the street? I do not think like that.”

I smile looking at the students in my class stating “I appreciate the responses you guys had. I do agree that in order to do well in math, you need to be more engaged and there needs to be collaboration. You cannot be afraid to be wrong. In fact, that is when you will learn the most. This actually leads me to what I want to mention today. With this class, it will not be what most of you guys are used to which is me standing in front of the room teaching for 45 minutes, and then you guys having a small amount of time to practice. That is called the traditional model of teaching. Instead, we are going to be doing something different called the flipped classroom.”

To my surprise, I heard a bunch of groans from my students. “My one teacher did the flipped classroom model. He had us watch videos and sat back and did nothing.”

“I hate watching videos. Do we have to?”

“Let me explain to you guys what a flipped classroom model actually is,” I stated to my students. I explained to them the actual process which was not just watching videos. It involved also collaborating with one another and connecting the material to their real life. “We are going to be doing a dry run for a week or two so that you are prepared when we dive deeper into the flipped classroom model. I want to show all of you, but especially those that have had a bad experience with it, that the flipped classroom model can be helpful. We will see how it goes. Deal?”

“Fine Mr. Kieszek. I will keep an open mind,” a student stated. From that day on, I did a dry run with both my Algebra 2 classes right into a full fledged flipped classroom. The story will now split between the two Algebra 2 classes because little did I know then, I would have two completely different stories.

The Everyday Life of the Flipped Classroom Model - Period 1

Before any teaching occurred, the students were given the Pre-Flipped/Traditional Classroom Model Survey (Appendix C). The majority of the students had the same response which included the following:

Name	Do You Like Math?	Describe Previous Math Classes	How Would You Teach Math?
Julie	“I never liked it from the start.”	“We would get a packet about the topic and then do some problems in class and then have homework.”	“Try and make it fun for the students, but still try and let them fully grasp the lesson I’m teaching.”
Ilene	“I’m mostly indifferent about math as a whole.”	“I’ve had some fun and some boring teachers. They put problems on the board, we solve it, they go over how to do it, we get homework. That’s always been the same routine.”	“I really do feel the more enthusiastic the teacher the more exciting the class.”
Catrina	“Math frustrates me when I can’t grasp or remember something. When I understand it, although it is not my favorite subject, it doesn’t bother me.”	“My math experience has been similar from middle school to now. The teacher would explain the lesson, we would practice, and lastly get a reasonable amount of homework.”	“I would teach at a fair pace, be very interactive with my students (to learn their concerns), and give a reasonable amount of homework.”

Figure 2: Table of some student answers from period 1 with the pre survey questionnaire.

I thought to myself, *these responses did not surprise me*. After all, this is what the majority of students have experienced. To be sure though, I started with the first couple of lessons on solving linear equations with the traditional method of teaching where I was in front of the classroom teaching the lesson and then giving the students some time to practice problems while I walked around trying to answer questions. When I would pause to observe my students, it was what I expected. Students were not engaged with the material. Students would just be staring at their papers blankly afraid to ask questions. When I asked for volunteers to come to the board, only 4 out of the 20 students eagerly raised their hands.

When I decided to call a student that did not raise her hand, she responded “But Mr. Kieszek, I do not want to come to the board. I am afraid to be wrong!”

When I asked the class if this is this the reason they do not volunteer, the rest of the class chimed in agreeing. One of my students raised her hand and said,

“I had a teacher who made you feel really dumb if you were wrong. Plus, I do not like when I am wrong cause then others judge me, and you know I feel more dumb than I already am.”

This response stuck with me and made me have high hopes for the flipped classroom model of teaching. However, what did surprise me a little were the scores the students received on their assessments during this time. The students

were given two assessments during the traditional classroom approach as indicated in Figure 3:

	Expressions and Operations (20 points)	Solving Equations (24 points)
Mean Score	17.95	22.35

Figure 3: Mean scores of assessments for Period 1.

While I was not expecting low scores, I also was not expecting these scores to be quite high. Yes, there were some students that did worse and some students that did better than others. However, these already high averages made me think about the research that I read where the academic performances did not change when utilizing the flipped classroom approach. Only time would tell if this was the case.

I decided that now was a good of time as any to have my students experience the flipped classroom model. From looking at all the research, I did not want to just dive right into this new model of teaching. I wanted to model for the students an effective way of utilizing the flipped classroom. I gave the students a homework assignment where they had to watch a video on solving absolute value equations. The students had to watch a video on the topic, take notes about it, and then try a couple problems given in the video.

When the next day arrived I stated to my students “Okay class. For homework you had to watch a video on solving absolute value equations and take notes on it. Here is a problem on the board. With the people around you, I want you to discuss how to solve the problem.”

You would have thought I just asked the class to do the impossible. All I received in return were blank stares from my students.

“But Mr. Kieszek, aren’t you going to show it how to do it?”

“That was the idea of the video,” I answered , “you were supposed to learn the material on your own. I understand however that not all of you understood the lesson 100%. That is where discussing among your group comes into play. I can guarantee that if you did not understand something then there was at least one person in the group who did.”

“What happens if no one in the group understands it?”

“Trust the process. Go ahead guys discuss within your groups.”

I walked around the room to mostly silent group. I say mostly because there was one group of three girls and a boy who were actually discussing what was in the video and helping each other. The one girl Christine took charge of the group and was discussing things that I discussed within the video in great detail. They talked about getting the absolute value by itself, splitting the equations in two, checking if their solutions were valid, and drawing on the number line. I was

so amazed what was happening that I stopped the class and had this one group model for the rest of the class. As the rest of the class listened to their conversation, one of my students chimed in and asked, “So wait, you basically just want us to talk to each other and help each other out if need be? Don’t we do that already?”

I looked at the student and responded, “True we do help each other already, but do you guys really go into great detail like this group just demonstrated?”

“I guess not that much. I mean I just usually ask my friends if they got the same answer and if so move on. If not, I just ask you.”

“That is exactly what the flipped classroom model is all about. Those of you that have stated that you had experienced the flipped classroom did not really. Yes, part of it is watching videos at home, but , the main part of the flipped classroom is having these deep and critical discussions. You know what we are going to do guys,” I stated to my class as I was standing in front of the room thinking, “We will obviously continue doing our math topics.” I continued, “However, instead of just doing problems, let’s take the next couple of classes to learn what constitutes a good discussion. Sounds good with you guys?”

I observed my class as they all nodded their heads yes. For the next couple of classes, we talked about what makes a good and a bad math discussion

and practiced with a few more problems. By this time, we were going full force into the flipped classroom model.

[A couple weeks into the flipped classroom model...]

“Mr. Kieszek I want to put #1 on the board.”

“Aw man I wanted to do that one. Can I do the next problem then?”

“I want to put up #5 on the board, but I am not sure it is right.”

“Don’t worry I can help you with the problem and guide you in the right direction.”

“You see in the video Mr. Kieszek said break it apart like this so you should do the same thing too.”

These were just some of the statements that could be overheard from my students when walking into the classroom the next day. During this time, students were watching videos on solving multi step inequalities/compound inequalities and solving absolute value inequalities. The students would come in the next day with their questions and would work on two or three problems within their groups and discuss the problems among one another. We would then come together as a class and determine if what each group did was correct. Since we started this approach to teaching, the majority of the students stopped asking me for verification on their problems. They asked their group members who were eager to help them. Students started to be more confident in coming to the board to

show problems. I even had a student mention that she did not feel bad for coming to the board anymore and being wrong because from being in their groups, she realized that others had their own frustrations, but when working together, each problem was able to be solved.

During this time of the flipped classroom model, I was able to incorporate two activities within the lessons. One was having the students look at incorrect student work, identify what area was incorrect and why, and then redo the problem correctly and present their information to the class. A type of problem that was given to one of the groups is shown in Figure 4.

Problem	Explain Mistake Made	Correct Work and Answer
Solve: $2 5x-9 +4 < -8$ Student Work: $2 5x-9 +4 < -8$ $2 5x-9 \overset{-4}{-4} < \overset{-4}{-4}$ $2 5x-9 < -12$ $\overset{2}{2} 5x-9 < \overset{2}{2}-6$ $ 5x-9 < -6$ $-6 < 5x-9 < 6$ $\overset{+9}{+9} \overset{+9}{+9} \overset{+9}{+9}$ $3 < 5x < 15$ $\frac{3}{5} \quad \frac{3}{5} \quad \frac{3}{5}$ $\frac{3}{5} < x < 3$	<hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>	Answer: _____

Figure 4: Example of problem students had to solve within their groups.

With this activity, I did not have to help any groups with any part of their activity. The second activity was that I had the students create on their own a

real world inequalities word problem that they would have to solve. I gave them an example of something in my life about budgeting money.

When I was finished, I had a student in the back named Karen who looked dumbfounded and quickly raised her hand, “Woah woah woah wait. So I have a budget within the theatre tomorrow, and I need to get so many different things of items and try to use as much as the budget as possible. Are you telling me that I am actually using something we are learning in math and has a name to it?”

I smiled back at Karen and nodded, “Essentially yes that is what you are doing. You have the amount of money that you can spend. You said that you have to buy certain items and be as close to the budget as possible. So yes, you are basically solving for variables with an inequality.”

Karen was able to create her problem in Figure 5:

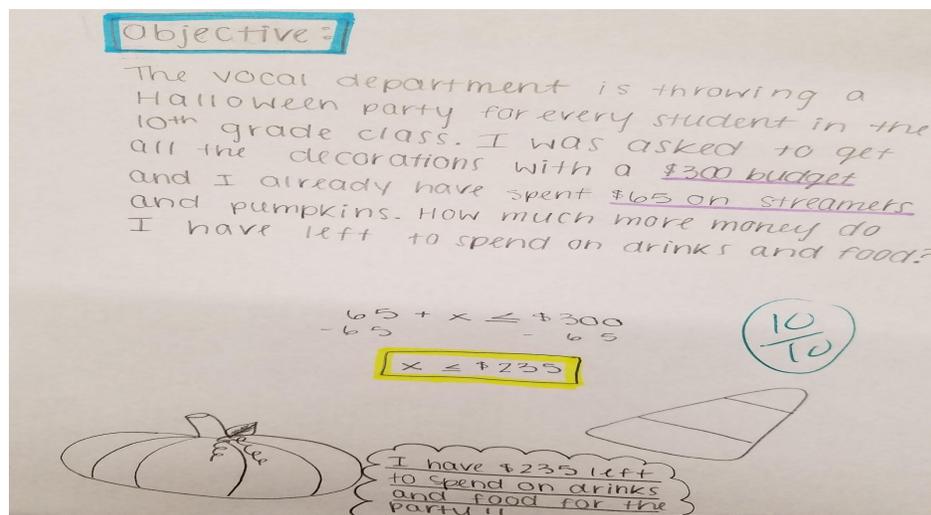


Figure 5: Karen's work on the inequalities word problem.

The rest of the class looked at each other in amazement because they had always thought math was separate from everything in their life.

“Well,” said Bob, “I guess I have to go back to my middle school teacher and apologize to him because I told him that I guarantee I have never used math in my life.”

The rest of the class chimed in with agreement.

At last, I said to myself, I have finally reached the holy grail for every math teacher. The students have seen how this applies to their lives!

[Last week of the flipped classroom model research...]

“I am tired of watching videos.”

“I had some questions, Mr. Kieszek, at one part of the video but I could not ask you it right then and there so I did not finish watching it.”

“It is so much work taking notes and watching the videos.”

Yes, you the reader have read those dialogues correctly. Trust me, I was taken a step back as you were. Here I have my class whom I have seen grown and portray liking the flipped classroom model to all of a sudden disliking it. Granted, this was a new topic on solving absolute value inequalities, and from previous experience, it is a difficult topic for students. The mini discussion was as followed:

“Alright guys I hear you. I will admit that this surprises me because up until now, you guys have said you liked it. Is it because the topic is harder than what we have been doing?”

“I mean yes the topic is hard. I had to watch the video a couple times to get a better grasp of the material. But, it just feels like a lot of work to watch AND take notes.”

A girl named Rose, one of my higher achiever students chimes in, “As you know Mr. Kieszek we have had rehearsal all week and after school. I did not get home until 11 last night. I like that the video was there because I know I did not miss a lesson. But, the last thing that I wanted to do was watch a video and take notes on it. I mean I did it though but I don’t know really what I saw or wrote.”

Christine, another high achiever student, raised her hand and started to speak, “In my opinion, I really do like the videos because I get to watch them whenever they want how many times I want. I am actually learning more now. But, I can see why others do not like it. It has become a little too repetitive.”

Her friend behind her added, “I just do not like that I cannot ask you questions right then and there. I just need to know now! Plus, I like listening to music while doing homework and if I am listening to your video how can I listen to music?”

I sat there for a moment taking in everything the students had just said. I carefully gathered my thoughts and said to the class, “I just want to let you guys know my observations, and I want you to be totally honest if my conclusions were valid or not.”

I discussed with them how their confidence had increased since day one and how they seemed to be not as afraid anymore of being incorrect.

“Would this be a correct conclusion?” I asked my students as I looked around seeing their heads nod up and down.

“So is it really because you do not like the model of teaching or is it because there is so much going on in your lives right now?”

The students looked at each other probably hoping one of them would be brave and answer for all of them. Julie raised her hand and said “Honestly Mr. Kieszek, it is a little of both. With all our rehearsals, everyone is getting home late, and we are just tired and cranky right now. Plus, it has become repetitive. I liked it in the beginning because I felt in charge of my group when we had discussions. But, it is too routine now.”

The rest of the class chimed in agreeing. I looked at my students and said “I really do appreciate this honest feedback. I heard from some of you, and, eventually, you all will be doing the last questionnaire for me so you can let me know there too. Today, let’s discuss as a class what was taught in the video and

for the next few classes, we will not have any videos and instead just a couple practice problems to solve.”

We moved on together as a class, but what the students said really made an impression and has been something that I have reflected on greatly with this action research project.

While what the students said was important, I also wanted to look at the assessments the students took while I implemented the flipped classroom model. *Even though it was more work for the students, maybe the academic performance increased and what the students are saying is kind of invalid* I said to myself. Therefore, I looked at the two assessments that were given to the students which are shown in Figure 6:

	Multi-Step and Compound Inequalities (24 points)	Solving Absolute Value Inequalities (18 points)
Mean Student Score	19.917	16.825

Figure 6: Student mean scores for Period 1 during the flipped classroom approach.

Hmm, these scores are still pretty good too. Granted, these may be a little lower averages than during the traditional classroom approach, but these are also harder topics and good for these students I was saying to myself as I looked at these scores. As of right now, the research was proving to be true that academic performance really is not different with the flipped classroom model.

The Everyday Life of the Flipped Classroom - Period 2

I will not go into great detail on everything that happened with my Period 2 Algebra 2 CP class. Most of the procedure and results were the same as for my Period 1 class except there were a couple of big differences. Nevertheless, the table on the following pages shows what students stated in their first questionnaire (Appendix C):

Name	Do You Like Math?	Describe Previous Math Classes	How Would You Teach Math?
Amy	“It makes me feel dumb.”	“In middle school when I would ask questions the math teacher would say I wasn’t listening but then said I needed to ask more questions.”	“I don’t know.”
Terra	“My view on math is it’s useful yet useless. Math makes me feel like I have a lesser quality. It makes me feel frustrated sometimes.”	“With most of my math classes there would be a warm up on the board. We would do the warm up then we would pick up on what we’ve been studying. Then the teacher would give us our homework.”	“If I was a math teacher I would do all of what I said in question 2 except for the warm up.”
Eliza	“Math makes me feel anxious and it gives me a headache.”	“So before high school all my math classes were textbook based. It was here’s a calculator, do these pages in your book and turn it in. Because of that I didn’t often do homework because I was confused.”	“Personally, I am a very visual person so I think notes are the way to go. It makes it easier to study because you can look back at it. Visuals are good too, like the equation sheets we get during state tests.”

Figure 7: A table of some student responses from period 2 on the pre survey questionnaire.

As expected, I had the same results as in my Period 1 class. Students were used to the traditional model of teaching and viewed math as something that was difficult and had no meaning in their lives. When utilizing the traditional approach of teaching, I observed my students looking around or tapping on their

phones. In addition, only a few of my students were willing to volunteer answers or to come to the board to do problems. *Was the way the students were acting transferring over to their grades?* I decided to look at their scores for their assessments during this time frame. Figure 8 indicates the students' mean scores during this time frame of the traditional classroom approach.

	Expressions and Operations (20 points)	Solving Equations (24 points)
Mean Scores	16.887	20.1

Figure 8: Period 2 mean scores during the traditional classroom approach.

I thought to myself well, this is what I expected with this class. I knew they were going to be lower than my Period 1 class. However, I did not expect them to perform this high so soon. Since the scores are lower than Period 1, maybe the flipped classroom model will make a difference with some of the students.

Therefore, I was intrigued to see what the flipped classroom approach would hold for these students.

When it came time to model the flipped classroom approach for the students solving absolute value equations, one girl Richelle raised her hand, “so wait, we are not going to do notes anymore in class? We have to watch a video and take notes? How are we supposed to learn?”

“Well Richelle, I do not expect you to understand everything that is discussed in the videos. The idea is that you try to understand what you can and whatever you do not understand we will discuss next time in class either as a whole group or in your own group.” I could tell Rose did not like my response so I added “Think of it like this. In what you are used to, I basically tell you what to do, and you do not have room to think and discuss. If you have any questions, there usually is not much time to ask them during class, and you go home confused. With this new method, we now have an entire class period to discuss and talk with each other about what was confusing.”

Mark quickly stated “so basically we are doing your job for you. That doesn’t seem fair while you sit back, and we do all the work.” I quickly responded, “On the contrary, as research states, I will be doing more work. I need to figure out good, quality videos, plan and guide the discussions, and develop activities that go beyond what was taught in the videos.” Mark and Rose responded, “well that’s your job anyway to do that. Making us watch the videos just frees up more time for you during class while we do your job of teaching.” At this point, the bell had rung, and I was left thinking about what was said. I thought *what just happened here?*

Little did I know what was to come.

[A couple weeks into the flipped classroom approach...]

“Are you going to teach us yet or are you going to have us keep watching the videos?”

“I did not understand what was said in the video. Can you just explain it to us instead of going in our groups?”

“I did not know to take notes while watching the video. I just watched it.”

“I’m sorry Mr. Kieszek I forgot to watch the video for homework.”

Unfortunately, this was the common theme through the research study. I would come into class with about half of the students not watching the videos or complaining that they did not understand what was discussed in the videos. When I had the students talk within their groups about either the videos on solving inequalities or solving absolute value inequalities, only two out of the six groups were actually on task and discussing the videos. I had to redirect the other groups multiple times to stay on task, or I had to give a lot of instruction to the groups to the point that I felt like I was teaching the lesson to them. I had one of the students within these groups say “see Mr. Kieszek shouldn’t you just teach it to us if we are having this much trouble?” Without saying a word and feeling a little defeated, I walked to the front of the classroom. Luckily, I had one of the students, Victor, seeing me looking a little down, say to me “In all honesty Mr. Kieszek if it makes you feel any better I really like the videos. I am learning at my own pace, and I am understanding things better. Don’t listen to those other

people. You have seen how they are in class so I would not take to heart what they say.”

His comments did help me a little and it kept me with a positive attitude that the flipped classroom model might turn around the views that the majority of the students did not have.

[Last couple weeks of the flipped classroom research...]

Unfortunately, what could go wrong did go wrong within the last couple of weeks of my research. Since the nature of our classes runs on an every other day schedule, it was just bad luck that several incidences happened on the days I had my Period 2 class (see *The Struggles are Real* section). Nevertheless, I was still able to squeeze in the activities that I did with my Period 1 class by looking at incorrect student work and having the students create their own inequalities problems. While students were analyzing the problems that they received in their groups, I walked around the classroom and observed a difference in the way that the students were interacting with the math than what was the norm throughout the year. The same two groups that were interacting with the math were still interacting with it as before using the videos as guidance for their work. However, this method of interacting with each other filtered into two more of the groups within the class including a group that was initially extremely against

using the flipped classroom model. Part of the conversation that was overheard included discussing about the problem in Figure 9:

		
		Name: _____
		Period: _____ Date: _____
Error Analysis: Solving Absolute Value Inequalities		
<small>Directions: Read the problem below. The problem was solved incorrectly. Find the error that was made and explain it. Then answer the problem correctly.</small>		
Problem	Explain Mistake Made	Correct Work and Answer
Solve: $-3 2x-4 \leq -18$ Student Work: $-3 2x-4 \leq -18$ $\frac{-3}{-3} \frac{ 2x-4 }{-3} \leq \frac{-18}{-3}$ $ 2x-4 \leq 6$ $-6 \leq 2x-4 \leq 6$ $+4 \quad +4 \quad +4$ $\frac{-2}{2} \leq \frac{2x}{2} \leq \frac{10}{2}$ $-1 \leq x \leq 5$	_____ _____ _____ _____ _____	Answer: _____

Figure 9: One of the groups working on an incorrect problem in Period 2.

“I don’t really know what this kid did wrong. Looks right to me.”

“Yeah, me too. I don’t understand what to do.”

“No wait! Remember in the video Mr. Kieszek said when the inequality is less than, it is like a compound ‘and’ inequality. So you get the absolute value by itself. We need to do that first and then set it up like that.”

“Oh yes I remember that too! Then, you just solve for it like an ‘and’ inequality.”

“It really is that easy? Why did I think it was so hard before?”

Listening to this conversation and then watching the group of students progress from there, the students were able to fix the error and complete the problem. I felt content that this group, after complaining about the flipped classroom model, was incorporating the videos that they had to watch and referring back to it when solving their problems. My feeling of content soon diminished though when I arrived to the last two groups. Both groups were struggling with their problems, and I had to help them numerous times to guide them with their problems as shown in Figure 10.

Problem	Explain Mistake Made	Correct Work and Answer
Solve: $ 4x+5 \leq 7$ Student Work: $ 4x+5 \leq 7$ $-7 \leq 4x+5 \leq 7$ $\begin{array}{ccc} -5 & -5 & -5 \\ -2 \leq 4x & \leq 2 \end{array}$ $\begin{array}{ccc} 4 & 4 & 4 \\ -\frac{1}{2} \leq x & \leq \frac{1}{2} \end{array}$	_____ _____ _____ _____ _____	Answer: _____
Solve: $-5 7x+8 -15 > -20$ Student Work: $-5 7x+8 -15 > -20$ $\begin{array}{ccc} +15 & +15 \\ -5 7x+8 > -5 \end{array}$ $\begin{array}{ccc} -5 & -5 \\ 7x+8 < 1 \end{array}$ $-1 < 7x+8 < 1$ $\begin{array}{ccc} -8 & -8 & -8 \\ -7 < 7x & < 7 \end{array}$ $\begin{array}{ccc} 7 & 7 & 7 \\ -1 < x & < 1 \end{array}$	_____ _____ _____ _____ _____	Answer: _____

Figure 10: Two problems that two groups during period 2 were struggling.

When I asked these students what they remembered from the video, the majority of the students indicated to me that they did not watch the video because they did not have time or forgot. In addition, some of the students indicated that they did watch the video once but that they did not take any notes and was hoping that I review what was discussed in the video during class.

Again, Richelle and Mark stated to me while I was in their group, “It’s your job to teach us Mr. Kieszek and have us learn, not for us to do the learning for us.”

To be honest, I felt defeated at this point with the class overall since many students did not enjoy what we were doing. When we did the inequalities activity, things were about the same. Some students did not even know where to begin with their problem. Some students did not even see the connection when I showed them the budgeting example I gave them.

When I finished, one student exclaimed to me, “That is not really math. That is just life.”

I remember going home and having really mixed feelings about the flipped classroom model. How could the same method applied to the same types of classes have such different results? I sat on the couch looking at the rest of the emails I missed during the day. I noticed that there was an email indicating that someone made a private comment on Google Classroom. I opened Google

Classroom to check what the comment.. It was a comment from Emily who had voiced her opinion in the beginning on how much she thought the flipped classroom model was stupid and that she did not see the value of it.

I prepared myself before I read the comment.

As I read it though, I was pleasantly surprised. She wrote on Google Classroom “I have observed that trying to learn and figure things on my own is helpful. It gives me better understanding being dependent on myself to have the motivation to want to learn.”

At last, there was someone from Period 2 who appreciated what I was doing. I was so excited that the next time we had class, I told her that I really appreciated her comment to me. She then said to me, “You know Mr. Kieszek as you know I did not like it because it seemed like a lot of work, but then I realized this is what I am going to have to do when I am in college to be self motivated. Plus, I am actually learning! The reason why I did not say it the other day when you were in our group is because I knew the majority did not like it, and I did not want to be that one that was proven incorrect.”

A light bulb just went off in my head. *Could this be the reason why so many students dislike the method so much because they are afraid to be different?*

Unfortunately, with losing time with this class, I was not able to have a big discussion with my Period 2 like I did for Period 1. I handed the students their

final questionnaire and looked forward to seeing their responses. In addition, I analyzed and looked at the students' scores of the assessments that they took during the flipped classroom approach. Figure 11 displays the results for the class:

	Multi-Step and Compound Inequalities (24 points)	Solving Absolute Value Inequalities (18 points)
Mean Scores	19.65	14.94

Figure 11: Student mean scores from Period 2 during the flipped classroom model.

At first, I was happy with what I saw. After all the negativity I experienced, I was expecting lower averages. Students that I expected to do well did well, and those that I expected not to do well did not do well. However, when I compared the scores to my Period 1 class, what struck me the most was the difference in mean scores with the Solving Absolute Value Inequalities Assessment. I was not surprised that Period 2 scores in general were lower than Period 1. However, what struck me was how much lower the scores were; a difference of 1.885 points. While this may not seem like a big difference at first, to me, it was a big difference when the curriculum was the same for both classes, and the way the flipped classroom was taught was also the same for both classes.

Could the difference be just because of the types of students I have in this particular class? Or, could it also be a little bit more?

The Struggles are Real

Overall, each day I went home feeling that implementing the flipped classroom model with my students was more and more successful. At least, that is how I felt with my Period 1 class. I saw the majority of my students growing each day and starting to think critically when given problems that were not explained in the videos or discussed in class. Once we began solving absolute value inequalities, which from previous experience had always been a challenge for students, I observed my students talking to each other on how to do the problem, respectfully correcting one another if someone did something wrong. I also started observing students that normally would back down from a challenge to all of a sudden walk into class and ask me if they could put up a problem on the board. Granted, the opinions of my students seemed to change as we neared the end of the research, but, as we discussed together as a class, the students realized that they were just exhausted and a lot was going on for them.

Now, Period 2 was a struggle each and every day. I became the bad guy in the class because I was having my students do something that they would tell me they did not like or that they just did not want to do. Granted, I would never let my students suffer and just fail so of course I would make sure they had a

basic understanding of the material during class. However, I never gave them the full picture like I did on my videos because the idea was to have my students think critically and not just be fed the knowledge. Still, the students persisted that I teach them and “do my job.” No matter what was done, no matter what was said, the majority of the students did not like the flipped classroom model.

In addition, during the last couple weeks of the research, several events occurred that made me miss my Period 2 class. I was sick the one day so I missed school altogether, and I was not able to guide the conversations in the lesson. Another day, there was a meeting scheduled during that Period 2 so I had to create a lesson that did not have the students as involved as I would have liked. During this same time, our school had a 2 hour delay schedule due to weather while many of the other school districts in the area were closed. Due to the nature of our school, if a student is from a certain school district, and that school is closed while our school is still open, the student did not have to go to school and would not be penalized. That day, I found out what school districts many of my students were from because I only had 4 out of 21 students.

Finally, to end the last couple of weeks, there was picture day at our school for the different art majors. During Period 2, two of the art subjects were having pictures. A majority of those students were from those majors so I only had five students in class that day.

As one can see, when you have a chaotic schedule like that, it is difficult to get any real, authentic work done with your students. Even though the flipped classroom model did allow the students to continue with lessons by watching the videos and having mini discussions outside of the classroom, the most important part of the flipped classroom of discussing problems inside the classroom and applying the knowledge through application and more challenging problems, was happening much within my Period 2 class. The students were supposed to discuss what they learned in the videos in the next class, but either the class did not meet or I was not there to help guide the discussions in a critical manner. With this missed time and wanting to make sure that my students did understand the material, I had to review the material with them again and step away from the flipped classroom model for a bit until the students in the class were back on track. By the time I got the students back on track, the timing of the action research project was coming to the end, and retakes for the Keystones were approaching. I needed to complete other topics in order for the students to be prepared. Even though the flipped classroom model was supposed to help with time concerns, no method of teaching can alleviate the time-sucking problems that I faced with my class.

The Aftermath

From analyzing all the data and hearing the concerns from my students, it was apparent that there was similarity between both classes. Too much of something is not good. Whether it was the traditional approach or the flipped classroom approach, the students were tired of doing the same thing everyday.

In addition, even though the students are in high school and should be learning to be responsible for themselves, the students had never really experienced this approach in the past. The new method of “self learning” was a scary new concept for them, and many students were repelled by it. The lesson here then was to mix how the class was taught.

After the official end to my action research project, I began doing a mixture of traditional and flipped classroom teaching. The students seemed to be in better spirits, and I did not have any student state to me during class that I was, “not doing my job.” In fact, after teaching a couple difficult lessons on quadratic functions, a student in my Period 1 class raised her hand and asked, “Mr. Kieszek, I have a question.”

“Yes Stacey, what’s up?” I asked.

“Do you have a video on this because even though you have explained it a few times, I still don’t understand it. I want to look it over again on my own time at home.”

“Unfortunately, I don’t have a video on this yet. But, if you guys want, I can make a video on this topic and then we can discuss it in the next class. Does that sound good to you guys?”

I looked around the room as the student’s heads nodded yes. I stood there for a moment looking at the students, and I asked the class, “You know what guys? I have not had you all watch a video in a couple weeks now due to things going on at school and having the snow days. Plus, we are a little bit behind with the curriculum. Obviously, none of this is any of your fault. However, would you guys mind if I have you watch videos on what I think are the harder topics and then the next time in class, we will discuss it, just like we previously did?”

I looked around the room and Stacey chimed in again, “You know Mr. Kieszek, before I was not really too fond of watching the videos . I told you that I could not listen to music while listening to the videos, and I always do that with homework, but now I realized it was not about that. Well, mostly not that because I still love music, but I understood all those topics, so I was bored, and it felt like a chore doing them. Now, I have no idea what is going on and nothing to refer to.”

Ilene raised her hand.

“Yes Ilene?” I asked.

“I personally liked the videos, but I do think it would be good to have us watch videos that are more about the difficult topics. This is so hard, and I usually like math!”

“Oh my gosh yes! I did not understand any of this. I’m looking at the notes I take when i get home, and I am totally lost. Videos would help on the hard topics,” Michelle chimed in.

“So, if I am hearing you all correctly, you would not mind videos on difficult topics because you are actually learning and plus there is the benefit of referring to it whenever you want?” As I looked around the class, they nodded their heads in agreement to the idea. Maybe this was and is the key of the flipped classroom model. Therefore, I created this video and had the students, not only from Period 1, but also from Period 2, watch for homework instead of giving them more problems. The next day the students had to come in with questions that they still had and try to solve a warm up problem. When the students walked into class the next time, for both classes, all groups were focused on the warm up problem and were discussing with each other how to solve the problem. There were no complaints, and no help was needed from me. Could this have been the answer the flipped classroom model needed so that there was no flak or negativity? Only time would tell.

Methods of Data Analysis

From the beginning of this action research project, I was trying to answer the questions on how academic performance and engagement were affected when implementing the flipped classroom model. Gathering evidence was important in order to test the acceptable claims from the data (McNiff, 2016). The analysis that was used for the data included both quantitative and qualitative results depending on the type of data that was used. This included for the action research project three surveys, two sets of interview questions, student artifacts, student assessments, and field logs.

Survey Data

To begin my research, I gave the students a questionnaire on their experiences with previous math classes and their viewpoint on math classes in general. Even though I had an idea of what to expect for the students' answers, it was important for me to see where my students' experiences have been with their math classes and their thoughts with math in general. While working at an artistic charter school, I have come to the realization that the majority of the students have not had a good relationship with math and viewed math as unimportant to them. Nevertheless, the first questionnaire was a driving force of how to implement my flipped classroom model with the students because it served as base data and would be utilized to see if there was any growth with my students.

The first questionnaire (Appendix C) had five questions for the students to answer. The first three questions required short answers:

1. Describe your view of math. Explain how it makes you feel.
2. Describe the experiences you have had with teachers in math classrooms. Explain how the classes operated from when you walked into the classroom to when you did your math homework at night.
3. Imagine that you were a math teacher with your own classroom. Describe how you would run a classroom so that students would enjoy math.

When analyzing the responses from these sets of questions, I looked for keywords or themes that kept recurring. After analyzing the data, the student responses from Question 1 were divided into three different categories, Like It/Excited, Dislike It/Anxious, and Indifferent.

When explaining Question 2 with the students, I told them that I wanted them to answer based on what method of teaching was used in their learning. I explained to them the difference between the different methods of teaching. I stated that if they experienced a traditional approach to teaching it would look like something where the teacher was mostly standing in front of the room and the students took notes with little practice of problems or challenges. I also explained that there is a constructivist approach to teaching which is student centered where the students are in charge of their learning and are challenged. Lastly, I explained

to them that sometimes teachers use these approaches 50/50 and that would be considered a mix. I wanted them to answer the question based on what they experienced the majority of the time during class.

For Question 3, I wanted students to picture that if they were the math teacher, what would their classroom look like. Their responses would give me an idea of what the students were looking for in their ideal classroom for math. After analyzing student responses for Question 3, the three themes that occurred from student responses were Teaching in Front of Class, Real World Examples, and Better Pacing.

The last two questions on the survey were the following:

4. When I am in a math classroom, I feel motivated and excited to learn.
5. When I am at home, I feel confident in what I am doing with the homework.

For both of these questions, students were given a number line from 1 to 5 where 1 was NOT AT ALL TRUE, 3 was SOMEWHAT TRUE, and 5 was VERY TRUE.

Figure 12 shows the results of the survey for period 1, and Figure 13 shows the results for period 2. As indicated in both classes, the general overview was that students have a dislike or are indifferent when it comes to math. The majority of students have experienced the traditional classroom approach and

would like more real world examples in their math. This base data that I received informed me that when going into the flipped classroom model, it would be something new for most students and that I would have to model it more for them. In addition, since a third or more of the students indicated that they would do more real world examples in their own classroom, this provided me with the idea that I needed to make sure that real world examples were used in the various math topics in order that it would have more meaning for the students.

Like math?	Teaching Approach	How Would You Teach Math?	Motivated	Confident
Like It/Excited: 25% Dislike It/Anxious: 50% Indifferent: 25%	Traditional: 90% Constructivist: 0% Mixed: 10%	Teaching in Front of Class: 34% Real World Examples: 33% Better Pacings: 33%	1 - 10% 2 - 10% 3 - 50% 4 - 10% 5 - 20%	1 - 25% 2 - 10% 3 - 30% 4 - 25% 5 - 10%

Figure 12: Results from Survey 1 for Period 1 class

Like math?	Teaching Approach	How Would You Teach Math?	Motivated	Confident
Like It/Excited: 14% Dislike It/Anxious: 62% Indifferent: 24%	Traditional: 90% Constructivist: 0% Mixed: 10%	Teaching in Front of Class: 48% Real World Examples: 47% Better Pacing: 5%	1 - 0% 2 - 14% 3 - 67% 4 - 14% 5 - 5%	1 - 5% 2 - 29% 3 - 37% 4 - 24% 5 - 5%

Figure 13: Results from Survey 1 for Period 2 class.

After the students were given their Traditional/Mid Survey (Appendix D) and their Post Action Research Survey (Appendix E), I analyzed and compared the results for Question 1, Question 4, and Question 5 of the respected surveys because these questions were the same for both questionnaires based on the method of teaching that was utilized. I wanted to see if there was any growth with the students. The questions were:

1. Describe your experience with the _____ approach.
Please include positives and negatives that you may have experienced.
4. When I am in a math classroom, I feel motivated and excited to learn.
5. When I am at home, I feel confident in what I am doing with the homework.

Question 1, Question 4, and Question 5 were analyzed into the same categories as with the Pre-Survey in Figures 12 and 13. However, Questions 2 and 3 from the Post Survey (Appendix E) were different from the rest of the surveys:

2. Describe the experiences you have had with the traditional classroom approach (Unit 2) with the experiences that you have had with the flipped classroom approach (Unit 3).
3. Imagine that you were a math teacher with your own classroom. Describe how you would run a classroom so that students enjoy math. Would your approach be more like the traditional or flipped classroom or both?

Figures 14 and 15 break down the results for the two Algebra 2 classes for Questions 1, 4, and 5. The parts that are highlighted indicate the area where students are stating that it is somewhat true that they are confident and motivated with math, and these results were the only ones used to analyze any increases or decreases between the two methods of teaching. As indicated in both figures, there was an increase in students liking the flipped classroom over the traditional method of teaching. What was interesting to see was that for Period 1, there was no increase in motivation, and there was a decrease in confidence with math. Nevertheless, this was not surprising based on the conversations that I had with the students at the end of the project. For Period 2, there was an increase of 14%

in student motivation and an 18% increase in student confidence when working on math. Seeing how the class reacted during this time through observations and conversations, these results were a happy, unexpected surprise for me.

To analyze Questions 2 and 3 from the Post Surveys, I analyzed the students' responses to see if they felt better or worse with the flipped classroom model and which method they preferred or if they preferred both methods. Figure 16 indicates the results for the surveys for each class. Period 1 was split in half indicating that that the students either had a better experience or worse/no difference experience with the flipped classroom model. For Period 2, while the results in Figure 15 indicate an increase in student motivation and confidence, 67% of students indicated that there was no difference in their learning compared to the 28% who said that their learning had improved. For Period 1 students, 75% indicated that they would prefer the flipped classroom model or a mixture of the two while with Period 2 students, 67% indicated that they would prefer the flipped classroom model or a mixture of the two. Analyzing the data even further, at least half the students in both classes indicated that they would want a mixture of the two which lined up with the conversations and observations as noted in my field logs.

	Traditional/Mid Survey	Post Survey	Increase/Decrease
Question 1: Did you like the approach?	Like It/Excited: 25% Dislike It/Anxious: 55% Indifferent: 20%	Like It/Excited: 50% Dislike It/Anxious: 10% Indifferent: 40%	Like It/Excited: 25% Dislike It/Anxious: - 45% Indifferent: 20%
Question 4: Motivated to do math.	1 - 0% 2 - 10% 3 - 50% 4 - 10% 5 - 30%	1 - 0% 2 - 10% 3 - 40% 4 - 40% 5 - 10%	0%
Question 5: Confident doing math.	1 - 5% 2 - 0% 3 - 35% 4 - 45% 5 - 15%	1 - 5% 2 - 10% 3 - 25% 4 - 50% 5 - 10%	- 10%

Figure 14: Results for Period 1 class.

	Traditional/Mid Survey	Post Survey	Increase/Decrease
Question 1: Did you like the approach?	Like It/Excited: 10% Dislike It/Anxious: 66% Indifferent: 24%	Like It/Excited: 48% Dislike It/Anxious: 23% Indifferent: 29%	Like It/Excited: 38% Dislike It/Anxious: - 43% Indifferent: 5%
Question 4: Motivated to do math.	1 - 0% 2 - 38% 3 - 57% 4 - 5% 5 - 0%	1 - 10% 2 - 14% 3 - 57% 4 - 19% 5 - 0%	14%
Question 5: Confident to do math.	1 - 61% 2 - 10% 3 - 10% 4 - 29% 5 - 10%	1 - 29% 2 - 4% 3 - 38% 4 - 19% 5 - 10%	18%

Figure 15: Results for Period 2 class.

	Question 2: Did you have a better experience with the flipped classroom than the traditional?	Question 3: Which method would you prefer to teach?
Period 1	Better Experience: 50% Worse Experience: 30% No Difference: 20%	Traditional: 25% Flipped Classroom: 25% Mixture: 50%
Period 2	Better Experience: 28% Worse Experience: 5% No Difference: 67%	Traditional: 33% Flipped Classroom: 10% Mixture: 57%

Figure 16: Results from Post Survey for both classes.

Interview Questions

Four students from each class were randomly chosen to be interviewed during the course of the action research project (Appendix F and Appendix G). Two sets of interviews were performed during the action research project, one was when the majority of the class was taught using the traditional classroom approach and the second was when the class utilized the flipped classroom model. Students sat with the teacher one-on-one and were asked two questions. The first question asked the students how they felt the class was running and any positives and/or negatives they had experienced. The second question asked the student to solve a problem based on the current lesson. The students dictated the answers to

the teacher while the teacher wrote down the answers for them. Overall, this method of data collecting was not very informative, and I was able to retrieve the same and better information from the other forms of data collection. Figures 17 and 18 indicate their responses during the traditional approach of teaching in Period 1 and Period 2 respectively. Figures 19 and 20 indicate the student responses during the flipped classroom approach of teaching for Period 1 and Period 2 respectively.

In order to analyze these interview questions, I looked for keywords and themes that came up during the students' responses. As indicated in Figures 17 and 18, during the traditional method of teaching, students overall indicated that they were fine with what they were doing and sometimes would make minor or no mistakes when they solved their problems. With the interviews for the flipped classroom, as indicated in Figures 19 and 20, students from both classes indicated that their struggle was that they could not ask questions right away when watching the videos, and sometimes their group members were not helpful when it came time for collaborative activity. Students had a more difficult time on solving their problems leading to bigger mistakes within the problems.

	Question 1: How is class going?	Question 2: $3(x+5)-7=80$
Student 1	Things are fine, I understand what is going on but just bored.	Problem was solved correctly.
Student 2	Things are fine, the topics have been easy so far.	Accidentally said $15 - 7 = -8$.
Student 3	I am good when I understand it, but sometimes we are going too fast. When will we ever use this?	Accidentally said $15 - 7 = 7$.
Student 4	I don't understand most of the things we have been doing. I am not good with math in general.	Distributed incorrectly and got $3x + 8 - 10 = 80$. The student then preceded to incorrectly subtract 10 on both sides of the equation.

Figure 17: Interview responses for Period 1.

	Question 1: How is class going?	Question 2: $3(x+5)-7=80$
Student 1	Class is going fine, but I am bored because I understand most of it so I do not want to volunteer.	No calculator was available for the student to solve what $3x = 72$ was, but the problem was solved correctly up to this point.
Student 2	I do not want to be wrong in front of everyone because I am not confident in my answers. I like your style of teaching though even though we do not get a lot of practice.	When the student got to $3x + 8 = 80$, the student accidentally added 8 to both sides instead of subtracting.
Student 3	I will volunteer as long as you check my work first. I think I am doing well, but I make silly mistakes. However, when will I use this? Also, the class goes by too quickly.	The student solved the problem correctly.
Student 4	Sometimes I am totally lost with the material. You teach too quickly, but I am not good with math anyway. So, I will not volunteer any answers.	Student was able to distribute problem correctly, but then stated $15 - 7$ was 22, then added 22 to both sides of the equation.

Figure 18: Interview responses for Period 2.

	Question 1: How is class going?	Question 2: $3 6x+2 -2<22$
Student 1	I like that I am able to go back and watch the videos. I also like going at my own pace. However, others are not utilizing asking each other questions.	Student was able to solve the problem correctly.
Student 2	Videos are fine, but I do not like that I am not able to ask any questions. I have to wait until we are in class.	When student got to $ 6x + 2 < 8$, student was not sure if it was an “add” or “or” problem.
Student 3	I don’t like that I am not able to ask any questions with the videos. Plus, my group is not very helpful.	Student distributed the 3 across the absolute value instead of dividing it. Student stopped doing problem because the student did not have a calculator.
Student 4	I don’t like that we cannot ask questions right then and there. I have to wait until class.	Student broke the absolute value problem into an “or” instead of “and”.

Figure 19: Interview responses for Period 1.

	Question 1: How is class going?	Question 2: $3 6x+2 -2<22$
Student 1	My group is not very helpful when we discuss the problems. They do not know anything and I am kind of lost myself.	Student distributed the 3 across the absolute value symbols making the rest of the problem incorrect.
Student 2	I like the videos because I get to take my time doing these problems. I can always go back and see it again.	After student was able to solve the problem, at the very last step, student did not know what $-10/6$ simplified to.
Student 3	I hate the videos. When are you going to be teaching again? I cannot focus while watching the videos because I daze out quickly.	Student distributed the 3 across the absolute value, then proceeded to combine like terms to get $ 18x + 4 < 22$. The student was able to solve the rest of the problem based on this incorrect problem.
Student 4	I cannot ask any questions while watching the video. You know I ask a lot of questions so I think this is actually hurting me.	Student correctly added 2 on both sides. Then, the student incorrectly broke the problem into $3 6x + 2 < 24$ and $3 6x + 2 > -24$ and proceeded to solve the problem this way.

Figure 20: Interview responses for Period 2.

Student Artifacts

Since time was lost due to multiple reasons, students were not able to complete as many discovery activities or real world activities as I would have

liked. However, the students were able to complete two activities that I wanted them to do, looking for student error and creating their own word problem on solving inequalities.

For the looking at student error project, 100% of the groups in my Period 1 class were able to collaborate on what errors the students made with minimal to no teacher help. The students wrote on a big poster paper indicating the area that was incorrect and then they were able to correctly solve the problems with 100% of the groups solving the problems correctly. For my Period 2 class, 50% of the groups (3 out of 6) needed my help three or more times when they worked on the problem whether it was identifying what area the error was or identifying how to solve the problem correctly. One of the groups was reminded multiple times to stay on task since they had their cell phones out the majority of the time. Only two of the groups within the class were on-task and completed the task with minimal help from myself. Since timing was an issue for my Period 2 class, they did not have a chance to present their findings in front of everyone. Nevertheless, I collected each group's work and analyzed it afterwards.

Based on my observation from class, the results were not surprising. The three groups that needed the most help did not complete their problems correctly. The group with the cell phone issue just completed writing down the problem and

indicating what area was incorrect. The other two groups were able to indicate the area that was incorrect and were able to solve the problems correctly.

Through observations indicated in my field logs throughout my action research project and just getting to know my students throughout the year, the results did not surprise me. The majority of the students in Period 1 are higher level achieving students and therefore, have shown that they are more willing to do the work on their own. In contrast, Period 2 consisted mostly of students who were average or below average levels of learning. Many of the students have stated in the beginning of the research project that their teachers in the past would just tell them what to do and not really challenge them or make the topic interesting. This then made the students disinterested with math. Since the students had such a negative viewpoint on math and found little interest with it, this made the assignment more challenging for the students because this was something that not only they were not used to but also something that was not interesting to them in the first place.

The other critical thinking assignment that students were given was to develop a word problem that involves solving an inequality (see *My Story*). In addition, the students had to solve the problems themselves, and they were graded based on their accuracy of the assignment. Overall, the students had a good understanding of what an inequality word problem looked like. There were a

few minor, yet important pieces of information that some students failed to get correct when they wrote their problems. This included some students writing the inequality incorrectly, writing down the wrong numbers that they used, or writing a word problem that was more based on an equation than a linear inequality.

While it seems minor, it was something important that needed to be addressed with these students so that they knew why what they wrote was not totally correct. Nevertheless, the mean score for Period 1 was 9.225/10, and the mean score for Period 2 was 9.194/10. These scores indicated that the majority of the students did have a firm grasp of what a real world linear inequality word problem would look like.

Student Assessments

Figure 21 compares the results of the student assessment scores during the traditional method of teaching and the flipped classroom method of teaching. It is important to note the following for the given data in Figure 21:

- Two students from Period 1 were not included for the Multi-Step and Compound Inequalities assessment
- One student from Period 2 was not included for the Solving Equations assessment
- One student from Period 2 was not included for the Multi-Step and Compound Inequalities assessment

- Two students from Period 2 were not included for the Absolute Value Inequalities assessment

The reason why these student were not included in the data below was because these students received a zero for their assignments. The reason for these zeros was because the students had extended absences and/or the students failed to complete any part of the assignment. Therefore, if I included these students, it would skew the data and would not be an accurate representation of how the class performed with each assessment. This was the only area that the results of these students were excluded from since they did participate in the other methods of data collection.

	Expression and Operations (Trad: 20 pts)	Solving Equations (Trad: 24 pts)	Multi-Step and Compound Ineq. (Flip: 24 pts)	Abs. Value Inequalities (Flip: 18 pts)
Period 1	17.95	22.35	19.97	16.825
Period 2	16.887	20.1	19.65	14.94
Standard Deviation (Period 1)	2.63	4.06	2.88	2.73
Standard Deviation (Period 2)	3.11	3.67	3.58	3.27

Figure 21: Student scores from both periods with the traditional and flipped classroom.

As indicated in the table, Period 1 averages were higher than Period 2 averages which did not come as a surprise considering the level of knowledge of the students from each class and after looking through the notes within my field log entries. In addition, the standard deviation was calculated for each assessment for each class because I wanted to see how far away students' scores were away from the average. Some people may consider the standard deviation to be on the high end because normally, anything above one standard deviation indicates a larger range in the values. However, as discussed previously about the level of knowledge of the students that I have, the standard deviation can be considered to be relatively low for each class because I have students that range from above average levels of knowledge to well below average levels of knowledge. What struck me the most was the higher standard deviation for Period 1 for the Solving Equations assessment. Solving Equations assessment which is usually an easy topic for students had a high standard deviation with a close to perfect score mean. When looking at the data individually, most of the students scored high, but there were a few outlying students who scored extremely low to skew the average. In addition, when analyzing the standard deviation and mean scores for both the traditional and flipped classroom methods of teaching, the academic performance for each class indicated that there was very little improvement, if any. The mean scores of the students were not closer to the perfect scores, and

the standard deviation did not indicate the gap closed with student scores. These results were in line with other research that was performed with the flipped classroom model.

Field Log

All individual and group work observations were recorded in my field log and were used as an ongoing data collection tool. Each day, my notes from the field work were reviewed and analyzed to see how the class lesson went for that day. The field logs that were kept helped me to look at detailed observations from my study. In addition, the field logs helped me to look at my study through informal progress monitoring where I was able to analyze both motivation and engagement with individual students and the whole class. I was able to see the students grow, especially the students in my Period 1 class. Through my observations and through keeping notes in my field logs, I was able to see the majority of my students develop from being students who were hesitant to volunteer in math and being disengaged with the material to the majority of students volunteering to do math problems and students having more confidence when working on various problems. The reason why I know this is related to flipped learning is because this is something that I have not experienced in other methods of teaching. With the other methods of teaching, there was little time to do activities that made the students think critically and there was not enough

opportunities for students to be engaged. With the flipped learning, this allowed more time for engaging activities with students and for students to express their own thoughts and thinking. In addition, many of the students were starting to think more critically with the given problems and were seeing how some of the math can be related to their life. It was enjoyable looking at my field log entries and making note of the transition in a couple of students who in the beginning of the research stated that they would never volunteer to go up and do a math problem. Towards the end of the action research, these students were one of the first ones to volunteer their answers or thoughts for various problems. The mindset of these students went from worrying about others judging their math capabilities to not worrying about how others would judge them and accepting any criticism from their fellow peers.

Theme Statements

Through analyzing the different methods of data collection, the following themes were evident in this research.

1. Given the culture of the students at the school and their past experiences in the math classroom, students may resist when the roles and responsibilities fall more on them. The teacher must model the leadership roles for the students and gradually give more and more responsibility to the students.

2. The flipped classroom model increases engagement in the classroom allowing students to be more involved with the material and therefore, creates a student's zone of proximal development which is essential to the learning process.
3. Even though the flipped classroom model in theory allows for students to learn at their own pace, allows for the students to engage with the material through abstract thinking, and provides more time for the class to try more meaningful activities, this model is not geared towards every student and the teacher may have to employ more traditional ways of teaching to reach some students so that they succeed.
4. While students enjoy that the flipped classroom model allows them to work and learn at their own pace, students struggle with the fact that there is no teacher there with them to answer questions right away during the videos in order to verify their own knowledge and often do not want to rely on other students to answer their questions for them.

Research Findings

The purpose of the study was to design, implement, and analyze how utilizing the flipped classroom model in an Algebra 2 classroom would affect the students' academic performances and engagement with the different math topics.

Given the culture of the students at the school and their past experiences in the math classroom, students may resist when the roles and responsibilities fall more on them. The teacher must model the leadership roles for the students and gradually give more and more responsibility to the students.

As with anything that is implemented within the classroom, a teacher must get to know his or her students to determine what will and will not work. In addition, a teacher cannot just expect students to be all in when it comes to an activity or, in this case, a new method of teaching for most students. From the pre-survey that was given to the students, the majority of students were exposed to traditional approaches of teaching (see Figures 12 and 13). With this method, very little responsibility was given to the students. Add this exposure with the general culture of students not liking math in general (Figure 12 and 13), the flipped classroom model was a culture shock for them. As suggested by Moran and Young (2015), I did model for the students how the flipped classroom approach works. Since all students did have access to internet as stated in a questionnaire that was given with the syllabus in the beginning of the year, I had

the students watch a video on solving absolute value equations for homework and then we worked together the next day on how to discuss what was seen while watching the video. We discussed possible questions that could be asked from the videos and what could be discussed among group members. From this modeling, I felt the students were ready for the flipped classroom model, and we moved onto the students having the majority of the responsibility.

Little did I know that modeling the flipped classroom approach was not enough for my students as was noted through my observations with the field logs and the conversations that I had with my students (see *My Story*). Students had a difficult time coming into class and just starting a discussion with what they watched. Even though students were given a problem that their groups needed to solve, many groups were just trying to solve the problems themselves without bouncing ideas off each other. When asked about these issues, the students indicated that it was not the norm for the class to work together on a problem and that it was always individual. Even though this was modeled and practiced for one day, this quick transfer in responsibility for students was too much for many of them. It came to a point where some students would just shut down and would sit there waiting for me to bring the class together and review the problem, especially in my Period 2 class. Therefore, we had to take a step back with the way the class was implemented. I still gave the students videos to watch for

homework in which they needed to take notes. I also added to the assignment that they needed to write down at least one question that they had from the video.

While none of the literature that was researched mentioned the need for this, I felt that this was needed because it would start to get the students engaged with the material even those students that were usually shy during class. The next day in class, I would give a brief overview of what they watched, but then they had to ask their questions within their groups and try to answer them. When we came together as a class, the groups would share some of their questions and findings. This additional modeling for the students seemed to help them as more responsibility was gradually given to them. This was evident from the surveys (see Figures 14 and 15) where there was an increase in students liking the new method of learning and a decrease in students disliking the new method of learning. In addition, when students were given the activity of analyzing student errors (see Figures 4, 9, and 10), little intervention was given by me and the responsibility of completing the activity was all on the majority of the students. Students started not to need my guidance when they came to class and discussed the problems within their groups. Nevertheless, there were still some students who refused to take the responsibility of learning on their own and some who did not profit from more responsibility being put onto them. As stated earlier, these

particular students felt that they were doing my job for me and they would wait until I explained the material to them.

The flipped classroom model increases engagement in the classroom allowing students to be more involved with the material and, therefore, creates a student's zone of proximal development which is essential to the learning process.

With any new method of teaching, the main focus always seems to be on how it improves the academic performance of the students. While this is important for anything done in the classroom, it is not the only criterion that should be the focus when it comes to looking at the data. With the flipped classroom model, there was little evidence to indicate that there was an improvement with academic performance (Figure 21). This aligns with the research done by Clark (2015) and Lo (2017) where the flipped classroom model did not indicate that there was an improvement in academic performance compared to other methods of teaching. The only outlying research that was done that showed the flipped classroom model did have an increase in academic performance was performed by Love (2017). Nevertheless, as my research, Clark (2015), Lo (2017), and Love (2017) have all indicated, there was an increase with engagement and motivation with the students when using the flipped classroom approach to teaching.

In order to examine engagement, I utilized my notes taken in the field logs and analyzed the observations through suggestions based on the NCTM (2013) and the research performed by Kong (2003) on engagement in the math classroom. While the results from the survey for my Period 1 students did not indicate their motivation or confidence in math improved with the flipped classroom model (see Figure 14), the entries in my field logs indicated that there was a growth of these feelings of engagement in the classroom among the students. As told during the *My Story* section, I had a particular student who in the beginning of the year told me that she hated math with a passion. By the time we finished with the flipped classroom approach to teaching, this same student was volunteering to put problems on the board and volunteering to give answers without a concern if the answers were correct or not. She was willing to do the work and learn from the experience. This effect was a commonality that I saw from other students within this class. Students were being pushed beyond what was being taught to them through the videos and worked together to solve various problems. The students were pushed to their zone of proximal development and had them engaging more with the material. With the traditional approach, as was observed when teaching the students expressions and equations, I would have the same four out of the twenty students that would volunteer to give answers. By the time the action research project was completed, the number of students

volunteering increased to at least fifteen students each class. Students entered the classroom willing to do their work and had smiles on their faces when they completed their work.

Now, when the students had to hand in assignments, they are not hesitant. Instead of asking me if their answers are correct before they handed in assignments, they would look at me and say that they felt confident with what they were handing in to me. The students' change in attitudes is even more important than having the students all score perfectly on their assessments since the feeling of the majority of students in the beginning of the year was that they disliked math, and it made them anxious.

The surveys and the observations through my field logs showed that there was an increase in student engagement for Period 2. Students were 14% more motivated doing math and 18% more confident with the math compared with the traditional approach of teaching (see Figure 15). Similar to Period 1, at the start of the action research project, there were only three or four students that were willing to volunteer to do math problems or give answers as indicated from my observational field logs. By the end of the research, roughly half of the class was engaged in the material without any coaxing from me. Three out of the six groups were able to be pushed into their zone of proximal development and eagerly tried to solve problems that would normally be out of their learning capabilities. As

mentioned in *My Story*, I had a student that in the beginning disliked math and was one of the students that was negatively vocal about the flipped classroom approach. Halfway through the project, this same student messaged me indicating that having her watch the videos forced her to not only be responsible, but also to be more engaged in the material because she knew just enough information to be pushed into the right direction without being told how to do a problem. As in my Period 1 class, my main goal with Period 2 and the flipped classroom model was to increase engagement with the students as past research indicated.

Even though Period 2 was a lower level Algebra 2 class, I observed the students growing in their engagement with the math after analyzing the results from the surveys and observational field logs. After modeling more for these students, they would then take it upon themselves to start the discussions in class, and more students were eager to volunteer to put their answers on the board or just volunteer their answers in general. Groups that I had to assist a lot in the beginning became less and less needy as the action research project continued to the point that a couple of the groups did not need my help anymore.

Nevertheless, there were still some select students since the beginning of the action research project that did not improve much at the end because I was “not doing my job”. Overall the engagement of the students in this class did improve

to the point that, even now, I am not forcing the students to do the assignments as they just naturally do them on their own.

In both classes, since the students were becoming more engaged with the material and were interacting more with their fellow peers, the way the class was flowing created each student's zone of proximal development. For example, this was shown during the activity where the students had to look for errors in problems. With this activity, the students in my class already had the knowledge of how to solve basic absolute value inequalities. Each group was given a problem that was more difficult than what they have seen. As a group, they had to indicate where the error(s) were in the problem and to explain why it was incorrect. Then, the group had to solve the original problem correctly. With this activity, since students already had the basic knowledge of solving absolute value inequalities, they were now challenged to solve a problem that was not only more difficult than what they had seen, but also they had to look at any error(s). The students were not shown how to do this previously, but they still had enough knowledge to be pushed into solving the problem. In addition, since a part of the activity had the students collaborating among their peers, this provided scaffolding for the students which helped the students reach their zone of proximal development.

Even though the flipped classroom model in theory allows for students to learn at their own pace, allows for the students to engage with the material through abstract thinking, and provides more time for the class to try more meaningful activities, this model is not geared towards every student and the teacher may have to employ more traditional ways of teaching to reach some students so that they succeed.

The flipped classroom model provided the students with a video that was done for homework, but it allowed them to go back in the video to rewatch parts that they did not understand. In addition, the videos allowed the students to always have access to the material at any time. As indicated from research done by Muir (2016) and from my implementation of the flipped classroom model, students were able to work at their own pace when we worked on the various materials. This allowed for more activities to be implemented into the classroom that normally would not have been done such as giving the students an identifying the error activity, making their own word problem inequality activity, and allowing the students various collaborations on math problems that were beyond what was discussed in the videos. These activities made the students think beyond what was told to them in the videos while still utilizing this knowledge for more challenging problems. This model of teaching aligned with the four pillars of F-L-I-P (flexible environment, learning culture, intentional content, and

professional educator) as identified by the governing board and key leaders of FLN.

However, this did not mean that the flipped classroom model would be liked by all students. While interviewing a random select group of students as indicated in Figures 19 and 20, a couple students stated that they disliked the flipped classroom model because they had a difficult time learning and were not able to ask any questions during the videos. The students had to wait until the next class to ask their questions. This was also evident through my field logs where students towards the end of the research project indicated that the videos felt like too much work, and the way the class was running was becoming too repetitive. As indicated in Figure 16, for both classes, a total of 50% of the students in Period 1 and a total of 72% of the students in Period 2 stated that they had a worse experience than the traditional method of teaching or they did not feel that there was any difference in the way that they learned. However, this percentage was not bad news for the outcome of the flipped classroom model.

In Figure 16, 50% of the students in Period 1 indicated that they would want a mixture of traditional and flipped classroom when learning a new topic, and 57% of students in Period 2 stated the same reasoning. At first, students in both classes did not exactly know to handle the flipped classroom model especially when the responsibility of learning was placed directly on the student.

However, as I integrated some traditional methods of teaching (such as teaching to the class a problem for the first ten minutes) with the flipped classroom approach, students had a better time collaborating within their groups and working together on the more challenging problems. The reason why modeling was needed so much for the students was because it provided clear skills that were broken down for the students that made it learnable for them. In addition, modeling provided the students direction and support that “enables student to make meaningful cognitive connections” (MathVIDS, n.d.). Class became less repetitive for the students, and the responsibility for learning was not always put on the students. After analyzing the data and the conclusion of the research, it was clear that mixing traditional and flipped classroom approaches to teaching were needed in order to create an effective and promoting environment for learning for students.

While students enjoy that the flipped classroom model allows them to work and learn at their own pace, students struggle with the fact that there is no teacher there with them to answer questions right away during the videos in order to verify their own knowledge and often do not want to rely on other students to answer their questions for them.

As stated before through field log entries and responses from the interviews, students did enjoy the idea of the flipped classroom model where they

were able to work at their own pace and to go back in the videos if there was something that they did not understand. As mentioned in the *My Story* section, a student in Period 2 liked that the videos forced her to learn at her own pace and made her feel more comfortable with the material. However, the main struggle the students were having was the fact that when presented with the material, there was not a teacher there with them to answer any questions they had. The students verbally stated this to me during interviews (see Figures 19 and 20) and through conversations that were had with my class (see *My Story*). Students often indicated to me that it was difficult for them to wait until class to ask their questions when they wanted to know the answers to their questions immediately. At first, during the action research project, when students were told to collaborate with their group members on their questions, some were hesitant to ask for fear that they would be judged. In addition, even after those students did collaborate with their group members, those students were not totally satisfied with their group member's answers because they were not from the teacher.

To help with this struggle that the students were experiencing, I did more modeling for the students. The students would come in the next class, and I would have a student ask a question to the entire class. Instead of me answering it right away, I would ask if there was another student in the class that could answer it. If there was, then that student would answer the question. I then verified if

this student was correct or not in how the question was answered. This seemed to help some students because now I affirmed that there were other students in the class who knew how to answer their questions correctly. Students started to trust the responses that their group members would give. However, it was a slow, gradual process for the students because some of the students still wanted me to verify what was said in the group was true. Only a couple students would utilize our school's Learning Management System (LMS) to ask questions about the videos before the next time we had class. Even after the action research project was completed, about 50% of the students would still want verification from me after they discussed their questions in their groups. The concern of the students of not having their questions answered or verified right away was never mentioned in any of the literature that was researched for this project. This observation led me to wonder if having instant verification or gratification from someone who was supposed to be the keeper of knowledge was something that was generational because, nowadays, answers can be instantly found in an advanced, technological world. This would need to be something that needs to be researched more with students and to see if there is a possible connection between technology and instant verification of problem solving with students.

What's Next?

While the action research study was relatively short, the research done with the flipped classroom model indicated that even though the academic performance of Algebra 2 students did not differ much from the traditional approach to teaching and the overall engagement of the flipped classroom model for the Algebra 2 students showed growth from the traditional model. The mean scores of the assessments aligned with the results from previous researchers such as Bhagat (2016) and Lo (2017). However, I, along with other researchers, observed my students grow within themselves and become more engaged with the material. I had the majority of my students in the beginning of the year not wanting anything to do with math. Most students did not want to volunteer to put problems on the board or to share their responses or thinking. I always had the same four or five students from each class that would be engaged with the material. However, after the flipped classroom approach to teaching, I now observed the majority of my class volunteering their answers and sharing their thoughts among their peers.

In addition, students were becoming more interactive with the material by talking out ideas with their peers and not being afraid of being incorrect.

In conclusion, my action research study demonstrated the benefits of the flipped classroom model had with two high school Algebra 2 classes and the

benefits it had on engagement in the math classroom which sometimes is the most difficult part for any classroom teacher as many of my coworkers, myself, and other classroom teachers would agree.

In the future, I plan to continue utilizing the flipped classroom model with my students but to also mix it with some other methods of teaching. As stated by students, having just the flipped classroom became too repetitive and boring for them such that they started not liking the videos. I would like to do a mixture of teaching where, for a couple of days, I would utilize the flipped classroom and then change it to a more traditional approach or just have more activities intertwined within the various lessons. I would also like to redo the study with an Algebra class again. I would want to see if I would get similar results as I did for the current research or would the results depend on the types of students that I have for the class. In addition, I would also like to try the flipped classroom with an honors level class because from my observations as a teacher, this approach to teaching would seem to work for these types of students because they would be responsible for their own learning and would have more opportunity to explore and to challenge themselves on the various math topics.

I plan on sharing my findings with my math department and my school in hopes that the flipped classroom can be something that a teacher can use in their classroom. With the nature of our school and students missing classes for

performances, the flipped classroom can be used as something where the student can always look online to see what was missed and to not feel as if he or she is behind in the class. In addition, especially with math, the flipped classroom can be utilized as a tool for both teachers and students. Students can always go back to a lesson that they were or were not there for at any time of the day. Teachers can send students links to videos that will help them with the material.

Lastly, since our school's five year plan is to move to a one-to-one program, hopefully this research can be used as an incentive for the school and, therefore the teachers, to continue pushing into this direction and to give ideas to other teachers on how the flipped classroom can be utilized in their own classrooms.

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Appendices

Appendix A - Principal Consent Form

Academics

Principal Consent Form

April 3, 2018

Dear [REDACTED]

As discussed with our Technology Committee, we would like our school to become one-to-one. With this in mind, I will be conducting an action research project of a flipped classroom in mathematics for Moravian College coursework and the publication of me implementing the project into our core math curriculum. I am writing to obtain permission to conduct this research in my classroom from the month of September to the month of December.

I have decided to log data in and out of the classroom by looking at how engaged students are when working with math. I will do this by having students fill out three surveys, in the beginning of the year, during the middle of the research, and at the end of the research. Key themes will be analyzed to see if students progress with motivation in and out of the classroom. In addition, students will be first given a unit through a traditional approach and assessed through various formative and summative assessments. The students will then complete another unit through the flipped classroom approach and assessed through the same types of formative and summative assessments. This quantitative data will then be analyzed and compared. Along the way, a select group of students will be interviewed to check on their progress with each approach.

All data collected will be on a voluntary basis. I will be sending out parental consent before any interviews or surveys are given to the students. All data will be kept secure and will be shared anonymously. Student participation will be strictly voluntarily and will have no positive or negative impacts on their grades. Regardless of participation, students will receive the same instruction in and out of the classroom and will still be a part of all class activities. At any time, student participants may withdraw having their data used without any consequences.

As stated before, the research will be conducted from the month of September and will conclude no later than the beginning of the winter break. If you have any questions, please contact me or my faculty advisor, [REDACTED]. Thank you for your time and consideration.

Sincerely,

Chris Kieszek



Mission Statement

The [REDACTED] provides a unique environment that fosters a creative, rigorous academic approach to learning and a development of talents in the arts. Built on passion, discipline and a commitment to excellence, this integrative educational experience inspires all students to believe in who they are and in what they can accomplish.

[Redacted]

Academics

[Redacted]

I attest that I am the principal of the teacher who is conducting this action research study. I have read and understand the research study. By signing this consent form, I am giving permission for Chris Kieszek to conduct this action research study in his math classroom at [Redacted]

[Redacted]

[Redacted]

Signature of Principal [Redacted]

4.9.18

Date

Mission Statement

The [Redacted] provides a unique environment that fosters a creative, rigorous academic approach to learning and a development of talents in the arts. Built on passion, discipline and a commitment to excellence, this integrative educational experience inspires all students to believe in who they are and in what they can accomplish.

Appendix B - Parent Consent/Student Assent Form

Academics

Dear Parent and/or Guardian,

My name is Christopher Kieszek, and I am a Math Teacher at [REDACTED]. I am conducting an action research project in my classroom implementing a flipped classroom approach with various units. Our school is gearing towards 1 to 1 in the future which means all students will have access to their technology device. A flipped classroom approach to teaching would benefit our utilization of 1 to 1 with our students. A flipped classroom approach to teaching means instead of having the teacher lecture during the class and the students having little time to practice, the students will be taking notes at home, and the next day, there will be a lot more time for students to practice and discuss. In theory, students will be retaining more from the material and will understand it better.

I am asking for your permission to conduct surveys, interviews, and analyze quantitative data with your child. The surveys, interviews, and analyzing formative and summative assessments are strictly on a voluntary basis. No one is required to participate. Participation in the collection of the various data will be kept anonymous. The data will be used for publication at Moravian College and to benefit teaching at [REDACTED]. No identifying information will be given out about your child. There is no positive or negative effect on your child's grades from participating in the action research project. The student may withdraw from the research study at any time without penalty. In order to withdraw, the student needs to submit a signed note indicating that the student wants to withdraw from the study.

I have included the permission slip to allow your child to participate in the study. Again, all information will be kept anonymous, and all information will be destroyed after the action research study is completed.

Thank you so much for your time and assistance in helping me with this valuable research study. If you have any questions, please do not hesitate to email me or our principal [REDACTED]. We would be happy to discuss with you about the research including all the data that will be collected. My email is [REDACTED] and our principal's email is [REDACTED]. Again, thank you so much for your assistance and time.

Sincerely,

Christopher Kieszek






Academics

Student Permission Slip

I, _____ give permission for my child _____ to have data collected in school about their views on mathematics and to have data collected on different formative and summative assessments. Data collection will begin September 2018 and will end prior to the beginning of winter break. All data will be kept confidential. I understand that my child will not be identified in any way, either by name, gender, race, or any other identifying characteristics. Should you wish to withdraw your child from participating in this study, you may do so without any penalties. Your child will receive the same instruction in the classroom as all the other students. This study will not impact your child's grades in any way.

If you have any questions, please email me at 

Child's Name: _____

Child's Signature: _____

Parent's Name: _____

Parent's Signature: _____

Date: _____

Appendix C - Pre Traditional/Flipped Classroom Student Survey

Pre Traditional/Flipped Classroom Student Survey Questionnaire

1. Describe your view of math. Explain how it makes you feel.

2. Describe the experiences you have had with teachers in math classrooms. Explain how the classes operated from when you walked into the classroom to when you did your math homework at night.

3. Imagine that you were a math teacher with your own classroom. Describe how you would run a classroom so that students enjoy math.

For questions 4 and 5, please circle the number that describes what you think.

4. When I am in a math classroom, I feel motivated and excited to learn.

1	2	3	4	5
NOT AT ALL TRUE	SOMEWHAT TRUE		VERY TRUE	

5. When I am at home, I feel confident in what I am doing with the homework.

1	2	3	4	5
NOT AT ALL TRUE	SOMEWHAT TRUE		VERY TRUE	

Appendix D - Post Traditional Classroom Student Survey

Post Traditional Classroom Student Survey Questionnaire

1. Describe your experience with the traditional classroom approach. Please include positives and negatives that you may have experienced.

2. Describe the similarities and differences you have experienced with this approach compared to what you have experienced in previous math classes.

3. Put yourself as the teacher of a classroom. Is this an approach that you would want to use for your students? What areas do you feel work? What areas do you feel need to be improved?

For questions 4 and 5, please circle the number that describes what you think after experiencing the traditional classroom approach.

4. When I was in the math classroom, I felt motivated and excited to learn.
- | | | | | |
|-----------------|---------------|----------|----------|-----------|
| 1 | 2 | 3 | 4 | 5 |
| NOT AT ALL TRUE | SOMEWHAT TRUE | | | VERY TRUE |

5. When I was at home, I felt confident in what I was doing with the homework.
- | | | | | |
|-----------------|---------------|----------|----------|-----------|
| 1 | 2 | 3 | 4 | 5 |
| NOT AT ALL TRUE | SOMEWHAT TRUE | | | VERY TRUE |

Appendix E - Post Flipped Classroom Student Survey

Post Flipped Classroom Student Survey Questionnaire

1. Describe your experience with the flipped classroom approach. Please include positives and negatives that you may have experienced.

2. Describe the experiences you have had with the traditional classroom approach (Unit 2) with the experiences that you have had with the flipped classroom approach (Unit 3).

3. Imagine that you were a math teacher with your own classroom. Describe how you would run a classroom so that students enjoy math. Would your approach be more like the traditional or flipped classroom or both?

For questions 4 and 5, please circle the number that describes what you think as of now after experiencing the flipped classroom approach.

4. When I was in the math classroom, I felt motivated and excited to learn.

1	2	3	4	5
NOT AT ALL TRUE	SOMEWHAT TRUE			VERY TRUE

5. When I was at home, I felt confident in what I was doing with the homework.

1	2	3	4	5
NOT AT ALL TRUE	SOMEWHAT TRUE			VERY TRUE

Appendix F - Interview Question for Students for Traditional

Interview Question for Students for Traditional Approach

1. How do you feel things are going with the way the class is running? What positives and negatives have you experienced?

2. Please solve this problem: $3(x+5) - 7 = 80$

Appendix G - Interview Question for Students for Flipped Classroom

