STUDENT PERCEPTIONS OF THE FLIPPED CLASSROOM

by

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Abstract

The Flipped Classroom is an instructional strategy that can provide educators with a way of minimizing the amount of direct-instruction in their teaching practice while maximizing one-to-one interaction. This strategy leverages technology providing additional supporting instructional material for students that can be accessed online. This frees up classroom time that had previously been used for lecturing.

Students in three high school math classrooms where instruction was “flipped” were surveyed to examine their perceptions of the Flipped Classroom and to assess the role social media, educational technology, mastery learning, and self-pacing played in Flipped Classroom environments. The survey also addressed how the Flipped Classroom could support student learning and what could be done to improve Flipped Classroom implementations. The survey utilized both qualitative and quantitative research measures which provided a broader understanding of how students responded as a group and as individuals. The results revealed three major findings: students are doing less homework in a Flipped Classroom than in a traditional lecture-based classroom, students enjoyed learning in a Flipped Classroom environment, and students benefited from watching their lectures in condensed lesson videos.

This research has implications for instructional delivery in 21st century classrooms. The findings of this study illustrate that technology can provide a self-paced instructional setting that can effectively support mastery learning for students. Additionally, educators who use the Flipped Classroom can add additional supporting elements like assessment for learning, problem-based inquiry, strategies for differentiation, and can

create, overall, an environment for instruction that is more flexible than traditional classroom settings. Recommendations that emerged from the findings for improving Flipped Classroom implementation included: interactive instructional videos, increased in-class learning activities, and alterations to assessment.

Preface

The research in this thesis required ethics approval through the UBC Behaviour Research Ethics Board Okanagan. A Certificate of Approval with minimal risk was issued with UBC BREB Number: H11-03156.

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Acknowledgements

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Last, but surely not least, I want to acknowledge the undivided support of my wife Sarah. I am so glad that we decided to complete our Master's Degrees together and continue to grow as teachers and learners. While I may have not been able to achieve the same success as you in our classes it was a lot of fun trying! I have so much respect for the teacher you have become. Your students are lucky to have someone who is as knowledgeable, thoughtful and compassionate as you are. As we enter the next stage in our lives together I am excited to see you foster the same love of learning with our own children as you do with your students. I love you.

Dedicated to my beautiful wife Sarah and 'Baby J'

1 Chapter: Introduction

1.1 Context

I have been a math teacher for the last six years. It is an experience I have enjoyed immensely and one in which I take much pride. My students were doing well on their provincial math exams, parents were happy with the work I was doing with their children, and the school administration was giving me positive feedback. My teaching life was pretty good. I did notice however that many of the problems I had in my first year of teaching still remained. Many of my students seemed disengaged, some appeared to sleep through class, others texted under their desks, and a few were not even bothering to come in the first place. It also seemed I was the one doing all the talking. I was the one doing all the work, and for the most part, I was the only one doing the math in the math classroom. I spent the majority of my time lecturing my students, like many high school academic teachers do. The lecture format, after all, was the way I was taught when I was a student and it really was the only way I knew how to teach. Lecturing allowed me to cover a large curriculum and it seemed like the only way to get through the content. The lecture format seemed to be working for me; so much so that my students told me that they enjoyed my classes and found my lectures extremely beneficial. Yet those same students who found my lectures "crystal clear" were going home and struggling with assignments. The amount of knowledge that they had acquired during my hour lecture was minimal at best, and what was remembered was even less. Something was wrong.

As the years went by I became the department head of math at my school and in that capacity I heard from other colleagues that they were having many of the same problems I was having. My colleagues expressed concerns about attendance, punctuality, engagement, and students' desire to be successful. Teachers voiced their concerns to administration that they needed to do a better job enforcing attendance and stressed to their students that they needed to put in more effort and care into their studies. Despite these recommendations very little changed. The problems remained and teachers' concerns and stress continued to build. Rather than continuing to place the blame on others I started looking for my own solutions to these problems. I began by examining what I was doing to meet the needs of the 21st century learner which, in my own estimation, was very little.

It has been noticeable over the last several years that the way students interact with technology, the way students interact with each other, and the way students interact with their teachers is changing. It seems that in many ways the education system is not keeping pace with these changes. Many students today bring cell phones to the classroom. The capabilities of cell phones today exceed what a microcomputer could do only five to ten years ago. Students are engaging in different forms of communication through social media sites like Twitter and Facebook. Student skills in working with technology are evolving rapidly, yet most of the activities in classrooms have not changed for decades. Simply having technology in schools does not necessarily mean that learning is more effective. My classroom is full of the latest educational technologies. I have a SmartBoard, a convertible tablet PC, and an iPad but until recently I was still the one standing at the front of the classroom lecturing for the

majority of the time to students who were passively sitting in rows. Perhaps the chalkboards have evolved into more aesthetically pleasing SmartBoards and Tablets, but it has been clear my teaching had not changed.

In the spring of 2011, a colleague and I discovered the work of Jonathan Bergmann and Aaron Sams, two teachers from Woodland Park, Colorado. We watched a video about their award-winning teaching on an internet site (Bergmann & Sams, 2010). Bergmann and Sams are high school science teachers who also had students missing a significant amount of classes. Their high school was situated in a remote area that required students to be bussed long distances for school sporting events and other activities. Frustrated by the amount of time students were missing from class, Bergmann and Sams decided to record their lessons on video so that students could view their lectures outside of class. The response they had from students was extremely positive, so they continued recording more video lessons. Bergmann and Sams noticed an improvement in their teaching effectiveness and the engagement of their students. They noted that this was not due to their video lecture, but due to increased face-to-face time they had with their students because they were not spending time lecturing. By replacing the traditional in-class lecture with lesson videos Bergmann and Sams could use their limited classroom time to work with students one-on-one, conduct more labs, and answer more questions. The original idea was to assist those who were absent from class, but they soon realized this model was beneficial for all students (Bergmann & Sams, 2012). They described their new learning model as the *Flipped Classroom*, a learning experience where the lecture is recorded on video for asynchronous viewing

allowing students to spend valuable classroom time interacting with each other and their teacher.

After researching more about the Flipped Classroom, attending Bergmann and Sams' Flipped Classroom Conference in June of 2011 in Woodland Park, Colorado, and reading about its growing use in North America and internationally, I began preparing to *flip* my classes for the upcoming school year. My plan was to flip my *Pre-Calculus 11* and *Foundations & Pre-Calculus 10* classes. To give myself a head start, over the summer, I produced approximately 15 video lessons, accompanying student resource packages, tests and quizzes, as well as plans for classroom activities. The video lessons were similar to my traditional lectures but were condensed to 10-20 minutes in length. In the video lessons I provided the mathematical theory for the lesson and demonstrated a number of examples. The videos were made using a convertible tablet PC that enabled me to physically write on the screen. I also wore a microphone headset to record my voice. TechSmith's Camtasia software was used to record the screen and synchronize it with the audio to create a screencast. Once the screencast was recorded, it was edited to include additional graphics, callouts, and embedded video and then finally uploaded to YouTube. The student resource packages that I created included fill-in-the-blank notes that matched the lesson videos. This allowed students to follow along as they viewed the lectures and increased the interaction between student and video. Figure 1.1 below shows a screenshot of a *Pre-Calculus 11* lesson video on "Graphing Linear Inequalities in Two Variables."

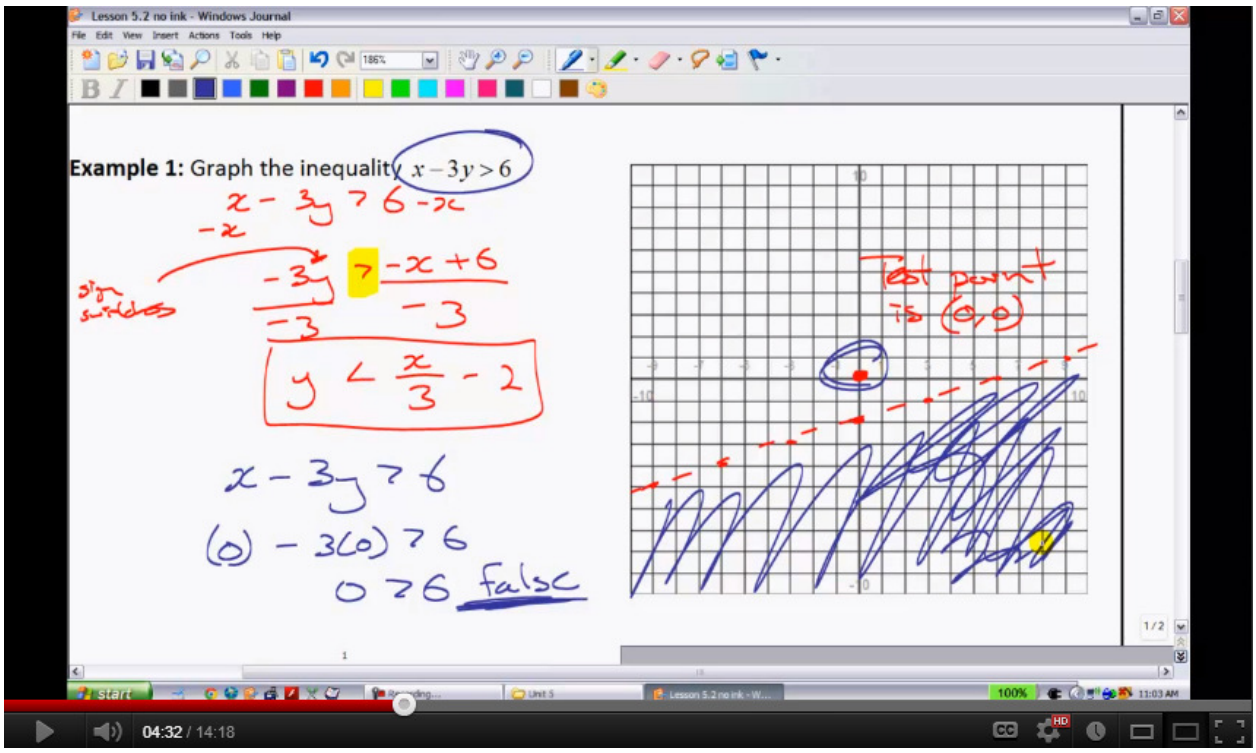

Figure 1.1 - Pre-Calculus 11 lesson video screenshot

I decided that my main focus of the Flipped Classroom was to create an environment that involved mastery learning in a self-paced environment. As a traditional classroom teacher, the idea of differentiating instruction to a class of 30 students seemed daunting, if not impossible. However, using the Flipped Classroom, I now had an opportunity to provide my students with a rich learning environment in a way I could not do before. I could now spend 10-15 minutes working with one student who was struggling on a concept or I could challenge one of my stronger learners in a way to extend their thinking; these were things that just never could have happened in my classroom prior to flipping.

To incorporate self-pacing I gave students the learning resource package at the beginning of each unit. This package explained the various tasks students needed to

complete before they could write their unit test. The package included instructions on where to access and which video lessons to watch, text assignments, math labs, journal entries, how long the unit would take, and test deadlines (see Appendix A for an example of a unit package). Students were free to move at a pace that suited their needs as long as they met the test deadlines. This provided students the flexibility to plan ahead and to take responsibility for their own learning.

In addition to self-pacing, mastery learning was incorporated into my practice. Math is a subject where the learning is scaffolded, and it was crucial that my students had a strong knowledge base before they moved ahead in the course. For example, it was necessary that students had a solid understanding of multiplication and division before they could graph a linear inequality like in Figure 1.1. Too often I had seen students with minimal grades passed onto the next math course only to have their struggles magnified as the content became more challenging. In order to implement mastery learning I used Moodle, a learning management system supported by my school district, to create a database of questions used for my tests and quizzes. I compiled roughly 1600 multiple-choice and numeric response questions per course that were sorted by learning outcome and difficulty level. Figure 1.2 below shows a screenshot of the Moodle database created for the *Pre-Calculus 11* course which was used to generate unique quizzes for each student.

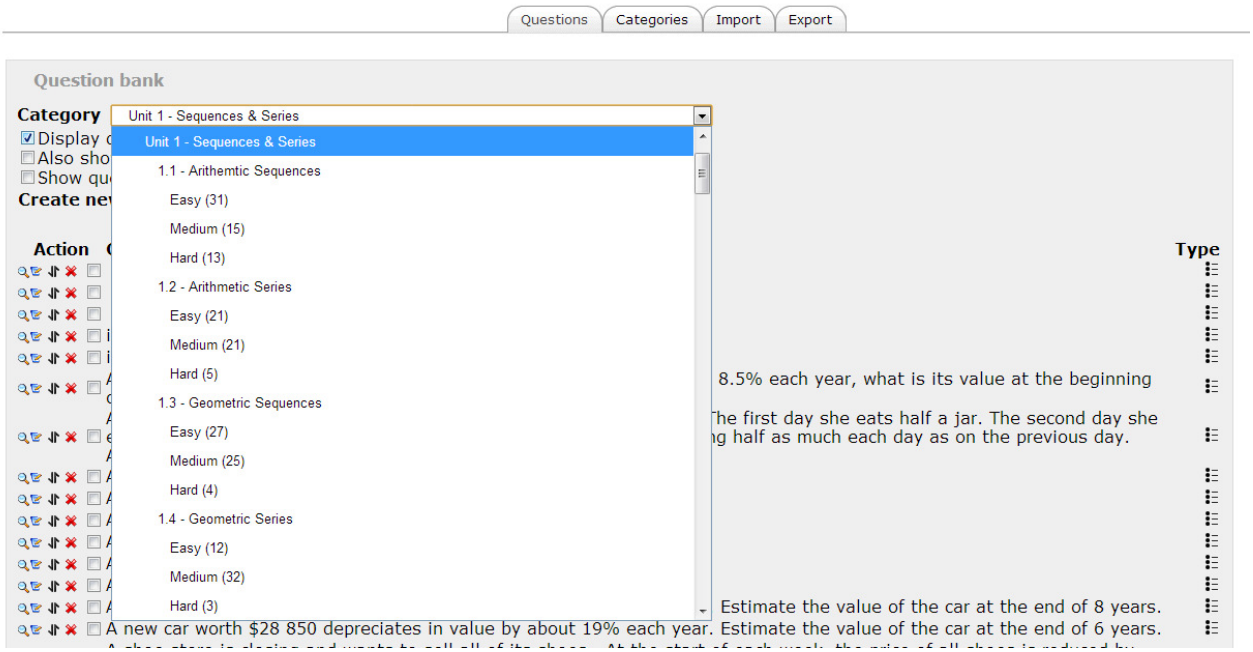

Figure 1.2 - Screenshot of Moodle database

Each unit required students to write three quizzes where they needed to demonstrate mastery. Mastery was set at 70%. This was a level I thought all students could achieve and it was substantially higher than the provincial pass level of 50%. Those students who achieved 70% or higher on their first quiz attempt could move forward in the course. Those students who struggled on their initial attempt would meet with me to discuss their results and they could do quiz corrections in their journal. Once they had completed this remediation they were allowed to reattempt the quiz. Figure 1.3 below is a screenshot of part of a quiz that was generated and marked using the Moodle database.

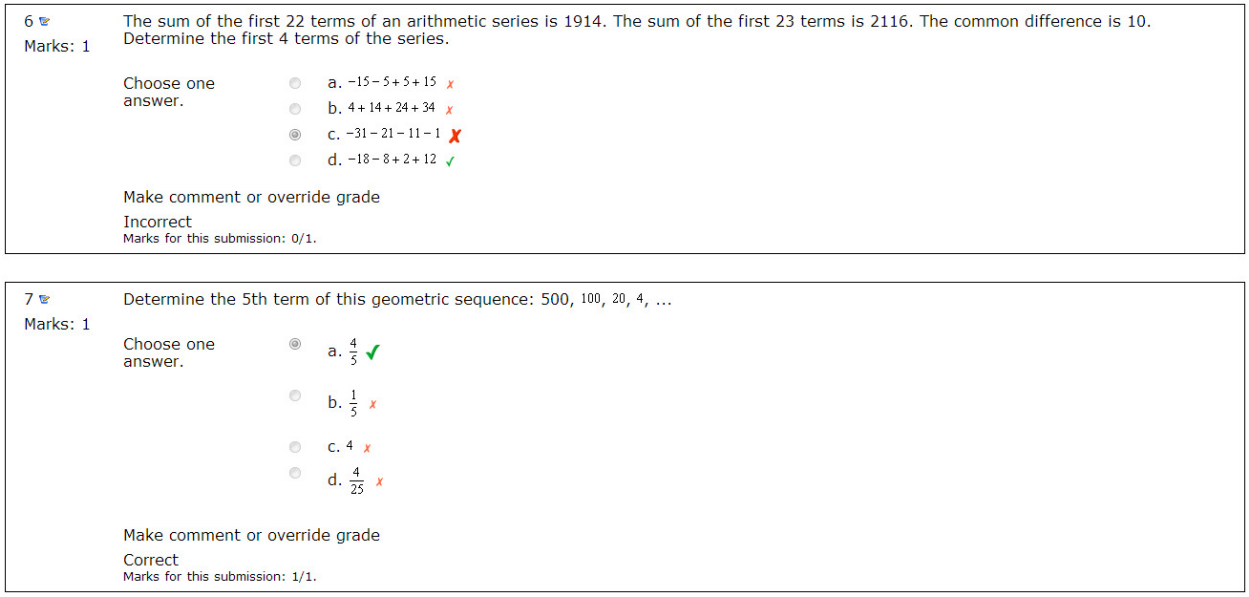

Figure 1.3 - Screenshot of a marked Moodle quiz

Moodle brought many benefits to my Flipped Classroom. The assessments I created tested the same learning outcomes but contained different questions for each student. I could also generate "reattempts" at the click of mouse. In addition, Moodle allowed students to receive immediate feedback from their quizzes so they could assess their results instantly as demonstrated in Figure 1.3. Each of the unit quizzes was used only as formative assessment and was not used for grade calculation. As a result, students began to view the quizzes as a supportive learning tool rather than a summative assessment or evaluative instrument.

The anecdotal feedback I received from students and parents after the first semester of the 2011/2012 school year where I implemented the Flipped Classroom was supportive (Baluja, 2012; Pearson, 2012; Steffenhagen, 2012). I was also satisfied with student achievement, experiencing a significant increase in my student's provincial exam scores compared to previous semester when I did not flip my classes, so I

decided I would continue with the Flipped Classroom. As my experience with the Flipped Classroom continued, I became interested in analyzing what students thought about their experience and how it affected their learning in a Flipped Classroom environment. This became the focus of this inquiry. It is presented here as a thesis that explores student perceptions of a Flipped Classroom.

1.2 Purpose

The purpose of this study was to provide insight about the Flipped Classroom with an emphasis on student perceptions. In my experience for educational initiatives to be successful it is helpful if students perceive it as a positive experience in addition to receiving accompanying educational benefits. Determining if students liked or disliked learning in a Flipped Classroom was at the heart of the study since this would determine if the teacher/researcher continued with its application. In addition, it was also important to describe an example of an implementation of a Flipped Classroom that focused on aspects that required more than students watching videos and completing worksheets. In this study additional aspects like mastery learning and self-pacing were examined in a Flipped Classroom context. This study provides educators who are considering implementing a Flipped Classroom in their own practice with information on its effectiveness and clear examples of how it can and cannot be executed.

To focus the study the following research questions were formulated:

1. What are students' perceptions of the Flipped Classroom?
2. Do students perceive that the Flipped Classroom supports their learning?

3. How could the Flipped Classroom be improved?

The first question assessed what students thought about their Flipped Classroom experience, and whether the Flipped Classroom should be continued as a method of instruction. The second question investigated how students perceive the Flipped Classroom to support their learning. Do self-pacing, mastery learning, and differentiation make for a better learning environment? The third question was posed to support those who are considering flipping their own classrooms.

1.3 Limitations

Although every precaution was taken to carefully prepare and conduct the research, there were some limitations. First, the number of participants in the study was small. There were 63 participants who came from the teacher/researcher's three upper-level flipped math classrooms. Therefore, to generalize the results for larger populations the study should have involved a larger sample size of math students taking a variety of different leveled courses from different teachers. However, as a pilot study with a small sample size this inquiry can still provide some indications of student perceptions of working in a Flipped Classroom and may also establish some foundations upon which further research may be undertaken. Second, the school where the study took place, which was the only school in the district implementing a Flipped Classroom, was located in a middle-to-upper class neighborhood; consequently, this social-cultural homogeneity may limit the transfer of any findings to a larger heterogeneous population. Third, since the classroom teacher was also the researcher, students may have wanted to satisfy their teacher by providing positive responses. Moreover, although steps were taken to

ensure that the teacher/researcher would not have access to the survey results until final report cards were sent home and students were aware of this, they may have felt that there could be repercussions for negative responses. Despite these limitations it must be strongly emphasized that all efforts were made to ensure student anonymity and privacy were protected. The findings, as they stand, may bring forward additional insights regarding Flipped Classroom implementations that may be typical of students in various settings and situations.

1.4 Personal Background

I began this research in the second semester of the 2011-2012 school year after using the Flipped Classroom as my method of instruction in the previous semester. During my initial attempt at implementing a Flipped Classroom I learned a lot about who I was as a teacher and what I wanted my students to gain from my classes. I was surprised to find that aspects of my teaching practice including content delivery, student activities, assessment, and marking could be improved and made more efficient in a Flipped Classroom. After having some initial success with the Flipped Classroom I wanted to explore its usage further and learn about how its implementation could be improved.

As with any research, subjectivity is inevitable. I acknowledge that I am a strong believer of the Flipped Classroom and that I wanted the results of this study to be positive and demonstrate the Flipped Classroom as a viable educational alternative. As any teacher would do, I worked extremely hard to create a classroom environment that students benefitted from and enjoyed. At all points throughout this study I was aware of

my personal biases and the study was structured in a way so that these biases had as minimal an effect as possible on the outcome of the study.

1.5 Organization of Thesis

This thesis is comprised of five chapters. This first chapter introduces the context and overview of the study. The second chapter provides a review of the relevant literature exploring five themes related to the Flipped Classroom: Lecturing, Repurposing the Lecture, Social Media and Technology, Mastery Learning, and Flipped Classroom Critiques. The third chapter details the research methodology used in this study, as well as the setting and demographics of the participants. Data collection and analysis is also discussed. The results of the study are presented in the fourth chapter. Qualitative and quantitative data are organised around five themes presented in the study survey: Time, Pacing, Mastery, Videos and Media, and Flipped Classroom. Chapter 5, the final chapter, presents the conclusions and implications of the study and also provides areas recommended for future research.

2 Chapter: Review of the Literature

2.1 Introduction

The purpose of this study was to examine students' perceptions of the Flipped Classroom in a high school mathematics setting. Five sections are presented in this literature review. First is a discussion of the effectiveness of traditional lectures, as well as some emerging critiques of the lecture as an instructional strategy. The second section focuses on the Flipped Classroom as a way of repurposing the lecture and making it more effective using today's technology. The third section examines the role technology and social media play in the Flipped Classroom environment. An analysis of how mastery learning is supported in the Flipped Classroom environment is presented in the fourth section. The fifth and final section presents common critiques of the Flipped Classroom and also reveals several gaps in the literature.

2.2 Lecturing

Since the late 1980s there has been significant debate between the traditionalists and progressivists as how to best teach children math. The National Council of Teachers of Mathematics (NCTM) and the National Research Council (NRC), two large American think tanks, have identified aspects of math classroom instruction that must be changed to improve math education and increase student achievement. The aspects include making stronger connections between mathematics and student lives and a shift away from traditional lecturing to where students are more actively engaged in creating their own meaning. Both of these councils advocate a shift toward progressive math

education where children think more critically (NCTM, 1989, 1991, 2000; NRC, 1989, as cited in Alsup & Sprigler, 2003). The Flipped Classroom may be one possible solution to address these councils' recommendations. It may allow children to learn math and other subjects in a progressive environment where thinking critically can be supported using 21st century tools. In a Flipped Classroom environment, content is delivered by lectures using screen capture software to record educator's lessons into videos that can be uploaded online. These lectures are significantly shorter than traditional lectures, and because they are viewed outside of class, time is repurposed so students can engage more fully in activities with their teacher in regular class time. Thus, the lecture is removed from regular class instruction.

Harvard Professor, Eric Mazur (2012) sees problems in the way educators present materials. "Frequently, [lectures] comes straight out of textbooks and/or lecture notes, giving students little incentive to attend class" (para. 1). Mazur believes that traditional lecture presentations are almost always delivered as a monologue to a passive disengaged audience. "Lectures simply reinforce students' feelings that the most important step in mastering the material is memorizing a zoo of apparently unrelated examples" (para. 1). Mazur's take on lecturing, while perhaps harsh, illustrates accurately how lectures are sometimes delivered and how students perceive them.

Educational blogger Donald Clark's (2007) writing exposes the lecture addiction. He believes that people enjoy lectures because they are easy; "It's easy just to turn up and listen. It's a lazy format for lazy learners" (para. 1). Clark created a list of negative features of lectures that include:

1. Babylonian hour: we only have hours because of the Babylonian base-60 number system. It has nothing to do with the psychology of learning.

2. Passive observers: lectures turn students into passive observers. Research shows that participation increases learning, yet few lecturers do this (Brophy & Good, 1986; Fisher & Berliner, 1985; Greenwood, Delquadri, & Hall, 1984).

3. Attention fall-off: our ability to retain information falls off badly after 10-20 minutes. The simple insertion of three ‘two-minute pauses’ led to a difference of two letter grades in a short and long-term recall test (1987, Winter).

4. Note-taking: lectures rely on note taking, yet note-taking is seldom taught, massively reducing their effectiveness (Saski, Swicegood, & Carter, 1983).

5. Disabilities: even slight disabilities in listening, language or motor skills make lectures ineffective, as it is difficult to focus, discriminate and note-take quickly enough in a lecture (Hughes & Suritsky, 1994).

6. One bite at cherry: if something is not understood on first exposure there’s no opportunity to pause, reflect or get clarification. This ‘one bite of the cherry’ approach to learning is against all that we know in the psychology of learning.

7. Cognitive overload: lecturers load up talks with too much detail leading to cognitive overload. In addition they often go ‘off on one’, with tangential material.

8. Tyranny of location: you have to go to a specific place to hear a lecture. This wastes huge amounts of time.

9. Tyranny of time: you have to turn up at a specific time to hear a lecture.

10. Poor presentation: many lecturers have neither the personality nor skills to hold the audience's attention.

Clark’s list addresses many of the problems with lecture-based classrooms that the Flipped Classroom aims to solve. The Flipped Classroom has 10-20 minute shortened lectures, it makes class time more active by including increased learning activities instead of traditional lecture, students are able to pause, rewind, and replay their lessons, lecture-videos can be planned and edited to maintain direction of content, and lastly, video-lectures can be viewed any place at any time. Clark believes that lectures have merit, although he says that the way most lectures are delivered today is ineffective. A shorter, more interactive lecture would help to solve this.

McFeeley and Milner (2009) studied the use of Kernal lectures in public high schools. Kernal lectures are defined as lectures that last no more than five minutes and are designed to provide background information on the topic, clear up questions from students that come up during class, and generate student discussion. Most of the Kernal lectures that McFeeley and Milner observed in their study gave classroom teachers enough time to demonstrate content while also making sure students were

engaged. Kernal lectures were also found to be effective for generating discussion. McFeeley and Milner concluded that the use of Kernel lectures have a positive effect on student engagement as they attempt “to incorporate lecture's best elements without compromising their student-centered philosophy" (p. 84). The research presented in this paper supports the use of shortened lectures in the Flipped Classroom as a way of creating more time for student-centered activities.

Knight and Wood (2005) carried out a study where they examined the work of the National Research Council (1999). The NRC found that student understanding of concepts was more effective when students were actively engaged in learning rather than in passive lecture based environments. Knight and Wood conducted an experiment in an upper-division Biology course to determine if learning gains could be made by changing the class to a more interactive format. The results of the study paralleled other studies (Šlekienė & Ragulienė, 2010, Revere & Koach, 2011, Sternberger, 2012) that found higher learning gains and greater conceptual understanding in interactive courses. Knight and Wood pointed out that any move to make a classroom environment more interactive and collaborative will lead to learning gains. This presents a case that educators who are currently using traditional lecture would not need to completely transform their classes to see increased results; rather they could make smaller and more manageable changes. The study also found that problem solving skills of those students in the interactive class improved significantly when compared to those students in a lecture-based class. Additionally, Knight and Wood addressed how students perceive a non-lecture environment. Students who were in their junior and senior years had developed study skills which they thought were effective for lecture-

based classes. At that point, in their university education, they resisted the interactive environment which took them out of their 'comfort zone.' Overall Knight and Wood found that, while results for student learning were positive, both students and teachers found that there was some initial discomfort adjusting to the decreased lectures which meant less transmission of information from instructor to student. This is a valuable lesson for Flipped Classroom adopters to understand. A transition to a new instructional model, regardless of success, may involve uneasiness among the participants.

2.3 The Flipped Classroom

The Flipped Classroom is a teaching method that has garnered a lot of media attention over the last year. USA Today (Toppo, 2011), The Globe and Mail (Hammer & Baluja, 2011), Washington Post (Strauss, 2012) and CNN (Green, 2012) are all media outlets which have recently reported on this new teaching model. While the Flipped Classroom is currently being presented as a new teaching innovation, it has been in use for well over a decade. There have been educators as far back as the late 1990s who have flipped their classes (Baker, 2000). However, the amount of literature and studies that pertain to the Flipped Classroom is limited. Educators have not had access to the technology that is needed to create video content until the last five years, which may explain the lack of information available. There is some anecdotal data and research that has been completed by principals and teachers over the last few years. Greg Green, Principal of Clintondale High School outside of Detroit Michigan, decided to flip the instruction of his entire high school. Green's school is located in a low socio-economic area that was experiencing an alarming amount of course failures. Before moving to the Flipped Classroom over 50% of Clintondale's students were failing English, 44% failed

Math, and there was a total of 736 discipline cases in a single year. (Green, 2011) After flipping his high school Green saw a dramatic improvement, 19% of students failed English, 13% failed Math, and discipline cases were reduced to 249. Crystal Kirch, a teacher also from a low socio-economic area in Lake Forest California, reported dramatic increases in student performance because of the Flipped Classroom (Kirch, 2012). Kirch noted increases in the number of students getting A's and B's, overall class averages, and fewer course failures in each of her three math courses.

Musallam (2010) examined the use of screencasts, a video recording of a computer screen with or without narration, as a pre-training technique for teaching advanced high school chemistry students. The focus of the study was to determine the effects screencasting had in managing intrinsic cognitive load, the natural complexity that a specific knowledge domain offers, and student performance. Upon looking at pre- and post-test results, Musallam concluded that screencasting significantly decreased the intrinsic load and increased performance on assessments.

Strayer (2007) surveyed university students on learning environment and learning activity. The study included a class that received traditional instruction and a class that was given flipped instruction. The results of the study showed that students in the Flipped Classroom "preferred and experienced a higher level of innovation and cooperation in their classroom" (p. 106). Strayer noted that, although students enjoyed the innovation and cooperation aspects the Flipped Classroom offered, they were less satisfied with the structure of the class. "The analysis showed that the variety of learning activities in the Flipped Classroom contributed to an unsettledness among students (a feeling of being "lost") that students in the traditional classroom did not experience" (p.

180). Strayer concluded by offering a number of suggestions to educators who consider the Flipped Classroom. He believes that students should have choice as to how they interact with the course content, the activities in class should be less open-ended and more step-by-step, and lastly, that students be given significant opportunity to reflect on their own learning.

Day and Foley (2006) conducted a study similar to Strayer (2009). Two introductory human-computer interaction upper-level undergraduate classes were studied. One received traditional in-class lecture, and the other class received web-based out of class lecture. Day and Foley sought to determine what effect the Flipped Classroom had on student achievement and student enjoyment. There results confirmed their hypothesis that the Flipped Classroom increased student achievement. Those students in the experimental Flipped Classroom scored higher grades on every assignment and every exam and, as a result, scored higher in the course. In addition, students reported that they learned more in this format than with the traditional lecture format. Students also indicated that they had positive attitudes towards the use of web-based lectures and the new format that they experienced. The authors briefly noted that the implementation of the web-based lecture was easy and inexpensive. The authors concluded by stating that they see no reason why the results in their study would not be similar to those in contexts other than upper-level undergraduate courses.

In 2008, Marc Franciszkowicz of the United States Military Academy at West Point used screen capture software to create "Video-based Additional Instruction" (VAI). The goal of the VAI was to “foster problem solving skills and conceptual understanding of the course material” (p. 5). The VAI was used differently than in some Flipped

Classrooms in that it was supplemental. This gave students the option to use VAI to get extra help and information when needed. Franciszkowicz found that VAI supported metacognition development because it was optional and the students were encouraged to seek it out on their own as needed. Students reported that they used VAI as a study tool and to prepare for class. Results of the study showed that, “students consistently agreed that VAI contributed to their learning and 82% stated that VAI was at least somewhat useful" (p. 12). Franciszkowicz also compared year end course surveys over 5 years and saw an increase in self-reported student motivation, students taking responsibility for learning, problem solving, and study skills. Franciszkowicz concluded that the potential benefits of VAI were significant and that there was no appreciable negative impact on students.

Toto and Nguyen (2009) examined results and feedback of the Flipped Classroom in an industrial engineering course. The purpose of the study was to investigate student perceptions of the Flipped Classroom. The researcher wanted to know if students found that flipped instructional supported their understanding of the course content and if it should be continued. Surveys revealed a number of interesting results. Students felt that 30 minute videos were the optimal amount of time for a video lecture. Students also noted that they felt that it was easy to be distracted while watching the video lecture. Overall, results of the study indicated that students value traditional face-to-face lectures but they like the benefits the Flipped Classroom offers by having additional classroom time for problem solving and hands-on activities. A suggestion made by the students was that the video lectures “be used to deliver theory-based course material, examples problem solutions, and supplemental course material,

such as content from guest speakers" (p. 4). In conclusion, Toto and Nguyen found that students thought the Flipped Classroom was an effective teaching strategy that could be effectively implemented at least 25% of the time.

2.4 Technology and Social Media

> The rapid rise of online learning and related technologies presents a tremendous opportunity for educators to design courses that engage students through the use of technology. When used appropriately, technology can foster student engagement in the learning process, which many students find beneficial and research has shown to decrease attrition, enhance learning outcomes, and improve student satisfaction. (Revere & Koach, 2011, p. 123)

Technology and social media work in hand-in-hand in the Flipped Classroom. To create learning materials teachers create video using various technologies that is then uploaded to social media sites like YouTube. The use of video to deliver content has become increasingly attractive for educators in math, science, and engineering courses. Franciszkowics (2008) argues that visual media is critical in courses where there are multiple steps that go into problem solving. Videos can be used to provide scaffolding for students through problems by modeling expert problem-solving strategies (Franciszkowics, 2008). In addition to the videos, technology and social media have given teachers greater opportunities to meet the needs of their learners.

2.4.1 Personalization

In the Flipped Classroom students have increased flexibility to pace the sequencing and delivery of their lessons. Students can pause, rewind, replay, and even

fast forward their video lessons provided in the course. Copley (2007) found that undergraduate and Master level students often listened to podcasts of lectures they had already attended. In Copley's study, students believed it was an effective method to review their notes and prepare for assessments, gave them flexibility to take notes at their own pace, catch up on missed lectures, and have a complete record available for reference. Franciszkowicz (2008) created Video-based Additional Instruction (VAI) as a supplemental resource for student use. Students in this study found the VAI useful not just for exam preparations but also for preparing for a regular class. Most students agreed that VAI was contributing to their learning success and 82% stated it was at least somewhat useful.

Technology also gives students flexibility in the way they access their learning. Students can view screencasts across virtually any personal electronic device in an asynchronous environment (Yee and Hargis, 2009). Roach (2006, as cited in Yee and Hargis, 2009) found that students prefer to access learning material asynchronously because they can choose to do so when it fits their schedules and lifestyle. The Flipped Classroom has emerged as a way to meet students on their own technological level (Franciszkowics, 2008). Franciszkowics also noted that, by having the information available online, students must become self-learners and seek access to information on their own. Moreover, further opportunities to access learning outside of the classroom are provided by the use of course management systems such as Blackboard, WebCT, and Moodle. These platforms give teachers and students opportunities to interact synchronously and asynchronously through discussion board and chat rooms (Revere & Kovach, 2011). Collins and Halverson (2010) see one of the great advantages of

information technology is the customization to the user. Computers can be used to respond to the particular interests and difficulties that learners have and provide content on any topic of interest to personalize the learning. Khan Academy (Khan Academy, 2012), as an example, has created a practice database of questions that respond to how well and how quickly a student answers. If a student responds to the first couple of questions quickly and accurately they may be prompted to move on to the next learning module, whereas a struggling student will receive feedback and be held back to receive remediation. As a result of these applications, non-linear learning pathways are provided that meet students' knowledge needs.

2.4.2 Communication

In 2000, the NCTM came out with a list of ten standards recommended for math teachers. One standard focused on communication. This standard states that

> Instructional programs should enable student to organize and consolidate their mathematical thinking through communication; communicate their mathematical thinking coherently and clearly to peers, teachers, and others; analyze and evaluate the mathematical thinking and strategies of others; use the language of mathematics to express mathematical ideas precisely. (NCTM, 2000)

This standard supports the Flipped Classroom where technology is leveraged to increase the amount of time to do meaningful classroom activities and allow for a greater focus on communication. Additionally, the Flipped Classroom can provide increased opportunities for interactive discussions and activities between students and student and teacher. These enhanced opportunities for communication are important in

instruction as evidenced in the research of Yee and Hargis (2009) and Dunlap and Lowenthal (2009) who consider communication between students and faculty in and out of the classroom to be critical to ensure strong student motivation and involvement. Social Media tools like YouTube, where many Flipped Classroom teachers upload their screencasts, provide great opportunities for communication. Students are able to post comments on a video for their classmates and teachers to read (Asselin & Moayeri, 2011). While Asselin and Moayeri see benefits in this communication they also note that some educators believe social networking and communication should not be included in the educational spectrum. The authors state:

> Will the fun of social networking be lost if it is incorporated into classrooms for different purposes than what students normally use it or will this mode engage students further in the learning process? Also, controversy has arisen over privacy issues and the ethics of making our students' lives publicly available over the internet. (p. 5)

Another concern with the increased communication in and out of the classroom is that educators are facing significant pressure to be available to their students at all times. This intensification of teaching may become more problematic as teachers increasingly spend more personal time checking emails and message boards in order to meet the needs of their students (Keeton & Scholar, 2004).

Another very common way to enhance communication in math is the use of journaling. Journaling was a learning activity incorporated into the Flipped Classroom in this study as a result of the elimination of traditional lecture-based instruction. Since the

beginning of formal math education, students have often been given step-by-step procedures to solve problems but may not have provided with the skills to analyze a problem conceptually. A lack of understanding of math concepts has led to short-term learning (Jingzi & Normandia, 2009). Journaling can help students acquire a conceptual understanding of math. As Hampton and Morrow (2003) found in their case study on an introductory course entitled General Psychology for Leaders at West Point, journaling helped students build their comprehension of abstract concepts and also enhanced self-awareness, student interest, and learning. Verlaan (2009) noted that math proofs are similar to math journaling; students initially find them difficult but "gain precision and clarity in their thinking about a concept, and through the act of constructing the proof, they develop a sense for logical sequence of steps necessary to solve problems involving the concept" (p. 187). Furthermore, an interesting study completed by Jurdak and Abu Zein (1998) found that journal writing produced additional benefits in math achievement particularly in conceptual understanding, procedural knowledge, and communication. An unexpected finding in their study was that journaling did not provide marked improvement in mathematical achievement directly as a result of journaling. Jurdak and Abu Zein suggested this result may have occurred because "school tests normally measures instruction-specific achievement of mathematical content rather than general abilities such as procedural knowledge and conceptual understanding" (p. 418). One final study worth mentioning was conducted by Baxter, Woodland, and Olson (2005). They found that journaling increased student's mathematical proficiency. Students who rarely contributed to classroom discussion wrote journals that surprised the teacher because of the amount of detail and conceptual understanding they

included in their writing. The significant benefit of journaling is that it can engage students actively as they structure meaning in math. In addition, journaling allows learners to learn at their own pace and provides opportunities for students to read the product of their thinking on paper (Jurdak and Abu Zein, 1998). The Flipped Classroom gives educators further opportunities to expand their practice to improve the personalization and communication of the learning.

2.5 Mastery Learning

> Perhaps the worst artifact of this system is that most students end up mastering nothing. What is the 5 percent that even the A student, with a 95 percent, doesn't know? The question becomes scarier when considering the B or C student. How can they even hope to understand 100 percent of a more advanced class? Is there any point in studying differential equations if you don't have an intuitive understanding of basic calculus? Is there any point to taking biochemistry when you have less than perfect understanding of first-year biology and chemistry? (Khan, 2010, p. 1)

Mastery Learning is an educational approach to learning that focuses on ensuring a level of mastery on a set of learning outcomes (Collins & Halverson, 2009). It requires that each student achieve the pre-established level of mastery before they move on to the next learning outcome (Lalley & Gentile, 2009). Lalley and Gentile state that a minimum passing score of 75% or 80% be used to ensure that a high rate of initial competence has been achieved. If a student fails to achieve mastery on their initial attempt, “corrective instruction may take the form of tutoring by the teacher,

teacher aides, student tutors or by students who did achieve at the criterion level" (Overmyer, 2010, p. 4). In subjects like math, where content is organized in a hierarchy, it is necessary that students have a strong grasp on the pre-requisite skills (Overmyer, 2010). One of Mastery Learning's greatest weaknesses is that it takes significant classroom time to implement (Guskey, 2007). Teachers have traditionally valued the principals of Mastery Learning since its inception in the last 1960's by Benjamin Bloom, but have not had time to practice it effectively. The Flipped Classroom provides teachers that time.

Guskey's (2007) article "*Closing Achievement Gaps: Revisiting Benjamin S. Bloom's Learning for Mastery,"* begins by noting some of Bloom's major contributions. Bloom observed that, although teachers taught in very different ways, there was little variation in student learning. In order to meet individual learning needs, Bloom suggested that educators, at all levels, must differentiate assessment. Bloom felt that most classroom assessment "did little more than verify for whom their initial instruction was and was not appropriate" (p. 11). Bloom suggested a better approach: teachers use classroom assessments not only for evaluation, but also as learning tools to provide students with feedback on their progress. It was obvious to Bloom that since no individual method of instruction worked for all students, Mastery Learning could provide opportunities for educators to spend time with their students working through corrective activities when students did not understand the initial instruction. Guskey addressed a common criticism of Mastery Learning that there isn't enough classroom time for effective implementation. He suggested that correcting basic skills at the beginning of the instruction would have long term benefits for further learning. As an example,

teachers no longer need to spend time reviewing material prior to assessing since students will have a stronger understanding of basic skills during the unit of study.

Wambugu and Johnson (2007) conducted a study that examined the effects of Mastery Learning on student achievement in Physics. In this study, students focused on mastering the content while teachers provided corrective feedback and remediation. The researchers found that those students who were taught through mastery learning achieved significantly higher scores compared to those not using mastery learning. Wambugu and Johnson also noted that mastery learning can easily and effectively be implemented in a high school setting.

Abakpa and Iji (2011) studied the effects of mastery learning on senior secondary achievement in geometry. They found similar results to Wambugu and Johnson (2007); student achievement scores in the mastery learning group were higher than those who did not use mastery learning. Additionally, Abakpa and Iji found that the use of mastery learning showed a positive influence on students with both high and low abilities.

Lalley and Gentile (2009) noted that when schools attempt to implement mastery learning one or more of the following four errors usually occur:

- Demonstrating mastery is conceptualized as the endpoint rather than the initial phase of the learning / memory / applications process;
- Mastery tests and activities are limited to knowledge / comprehension end of the thinking continuum;
- There is no requirement or grading incentive for going beyond initial mastery; and

- Assessment of student achievement remains embedded in a competitive or norm-referenced grading system. (p. 31)

Aforementioned implementation errors can be avoided by defining what good mastery learning should be. The following list establishes an acceptable model for mastery learning:

- Clearly stated and published objectives, sequenced to facilitate transfer of prior leaning to current and future competencies;
- A standard for passing master tests sufficiently high to assure that initial learning, once forgotten can be relearned quickly;
- Multiple and parallel forms of criterion-referenced tests, with corrective exercises and retesting as needed it demonstrate initial mastery; and
- Grading incentives to encourage students to reach beyond initial mastery and strive for fluency in the material, to better organize, and apply, and even teach others. (Block, Efthium, & Burns, 1989; Gentile & Lalley, 2003 as cited in Lalley & Gentile, 2009, p. 31)

Lalley and Gentile established a standard which educators can implement to ensure effective mastery learning is put into practice. The increased classroom time afforded by the Flipped Classroom provides opportunities for each of these four suggested goals to be met. The literature supports Mastery Learning as a worthwhile initiative to be implemented into any classroom, flipped or not flipped.

2.6 Flipped Classroom Critiques

The Flipped Classroom, as with any new education idea, has its critics. Since the Flipped Classroom concept is still in its infancy, there is not an abundance of published researched articles reporting on its instructional effectiveness. However, there are numerous online blogs and non-refereed reports that critique many aspects of its instructional use.

Wheeler (2012) has taken issue with the Flipped Classroom in his education blog. Wheeler begins by saying that “what 'flipping the classroom' boils down to it seems, is the creation of online content including videos that offsets the need for students to physically attend class" (para. 2). Wheeler’s second concern with the Flipped Classroom is the digital divide between those who can and cannot afford the necessary technology. The basic definition of the Flipped Classroom assumes that students will watch a lesson video outside of school which means they need technology to view the video and an internet connection. Wheeler goes on to point out that he feels that instead of replacing lectures with videos, time should be spent to improve lecturing. Wheeler believes that by removing traditional lectures, we are not providing students with a quality education and students will demand better quality for their tuition dollars. Lastly, Wheeler says “asking them [students] to stay at home, watch a video and then do an assignment based on their own independent study isn’t going to cut it" (para. 4).

Pettigrew (2012) refers to the Flipped Classroom as an education fad. "Flipped learning has just enough sense in it to make it appealing and to give its advocates a sense of superiority that sometimes convinces people they must be right. But like most

fads, it ignores a lot of the reality" (para. 4). Pettigrew believes it is possible to have innovation in education but most of the time people are already doing it or there are reasons why they are not. Pettigrew also notes that humanities professors have been flipping their classroom for years; students are assigned reading and the following class that reading is discussed in detail. Pettigrew agrees with the notion that bad lectures and lecturers need to be replaced, although he feels there are many professors whose lectures can be engaging and do more than just transfer information. "Good lecturing provides information but also context and perspective. Good lecturing allows for asking questions and considering answers—things that are best done live and in person — and the very things that flipped learning advocates are looking for" (para.7).

November and Mull (2012) combed Twitter looking for negative comments about Flipped Classrooms. Here are some common critiques they found:

- Implementing the Flipped learning method makes me, as the teacher, much less important.
- Kids do not want to sit at home watching boring video lectures on the web. At least in the classroom, they get some kind of interaction with me and with their peers. This is just a lot of excitement over bad pedagogy.
- Most of my kids do not even have internet access at home. There's no way they can watch all the videos.
- Where is the accountability? How do I even know if kids are watching the videos?
- As a teacher, I don't have the time or the expertise to produce all of the videos required to teach like this.

2.7 Conclusion

The review of the literature focused on five themes concerning the Flipped Classroom. Each of these themes provides insight into how the Flipped Classroom has evolved into an educational model. The majority of the literature surveyed investigates how the Flipped Classroom affects student academic achievement. My research focused on student perceptions of the Flipped Classroom as it is an area in the literature with significant gaps. I was interested in determining what students like and dislike about the Flipped Classroom as it was implemented in this study in order to help other educators inform their decisions regarding their Flipped Classroom practice.

3 Chapter: Research Methods

3.1 Setting

The research took place at a High School located in the interior of British Columbia, Canada. The high school is a public school located in a middle-to-upper class neighborhood. The school serves students in grades eight through twelve and has a population of approximately 1100. The majority of these students live in the school's catchment zone, although there are some students who live outside it because of the school's high academic reputation and/or its well-known Performing Arts department. The study took place near the end of second semester in the spring of the 2011/2012 school year.

The school is funded by the per pupil amount set by the British Columbia Ministry of Education. The physical building of the school is considered average compared to other school buildings in the district. Classes at the school are equipped with similar learning technologies that would be found in most British Columbian secondary classrooms. The classroom in this study has a LCD Projector, an Interactive Whiteboard, and ten laptop computers (provided by the School District for this pilot project). This amount of technology is above average compared to most classrooms at the school. In addition, the teacher has access to a Convertible Tablet PC computer to screencast and when in-class direct instruction is needed. An Apple iPad is also available in the classroom to demonstrate problems individually with students and discuss quiz results via the class's Learning Management System called Moodle. When additional computers are needed in the classroom students can gain access by signing them out

of the school's library or by accessing a laptop cart from a neighboring classroom. This ensures that every student has guaranteed continued access to a laptop when needed.

3.2 Participants

The participants in the research study came from three math courses: one section of *Foundations and Pre-Calculus 10* and two sections of *Pre-Calculus 11*. Grade 10 British Columbian students have options as to which math courses they wish to take. The *Foundations and Pre-Calculus 10* stream is designed for students that wish to pursue post-secondary education at university or college. The students in this *Foundations and Pre-Calculus 10* class are in an honours class. At this high school students can self-select if they want to take an honours course with approval from the Math Department. *Foundations and Pre-Calculus 10* concludes with a standardized province-wide exam, the only standardized provincial math exam students take in high school.

Pre-Calculus 11 is an important course for students in British Columbian high schools. It provides students with their grade 11 math graduation requirement, and also serves as a minimum requirement for students who wish to attend University. At the high school in this study, approximately 75% of the students take this stream to increase their post-secondary opportunities. This statistic is well above average compared to other district high schools and above those in the rest of the province. The students in the study were enrolled in these classes through regular timetable assignments. Students had no prior knowledge that the section they were enrolled in would be a flipped classroom as course selections were completed the previous spring.

The ages of the students in the three classes range between fourteen and eighteen. Some of the younger students may have taken honours classes or accelerated classes previously which is why they were ahead of their peers. The older students may be repeating the course to increase their standing or may have experienced difficulties in a previous math course and find themselves behind a year. The average class size of the three classes in the study was 24 students which is about 4 students less than the school class average. The classes were made up of roughly equal male and female students. There were two English-language learners between the classes. With the exception of six students, none of the students surveyed have been in a Flipped Classroom. Those six students either had the Flipped Classroom with a different teacher or the teacher in the study, in the first semester. As a result, this is the first time that a majority of the students have ever had an academic class that was taught using Flipped Classroom techniques.

Most of the students in the three classes, 63 out of 72, agreed to participate in the study. All students were required to complete an assent form. They also took home a consent from to be completed by their parents. Students and parents were notified that the survey involved with the study was a regular part of the teacher's evaluation as a method to support his professional development. The consent and assent forms were designed to give the researchers permission to include the data from the survey in this study and any additional publications. There was one student who opted out of the study and eight students who did not submit their parent consent form. As a result these surveys were not included in the study.

At the beginning of the study, the classroom teacher/researcher presented the students with a general overview of the study. Information was provided regarding the particulars of who was conducting the survey, why the survey was being completed, how the survey would be completed, what would be done with the data, any risks or benefits associated with the study, and who to contact for more information, comments, or concerns. Significant time was spent reminding students about various measures to maintain confidentiality. Students were explicitly told that they had the right to opt out of having their data used, at any point in the study, even though they all were required to complete the survey. After students were informed about the study, the teacher/researcher left the room and a school staff member distributed and later collected the consent and assent forms. A week later, with the teacher/researcher out of the room, the staff member distributed the surveys for each student to complete. The surveys of those students who had not submitted consent or assent forms or had opted out of the study were removed from the final collection of surveys. Their results were not included in this study. The staff member assisting in the study collected the surveys and locked them in a filing cabinet until the school year was complete and final grades were submitted. At the end of June, after report cards had been issued, the teacher/research accessed the anonymous results and began the data collection and analysis.

3.3 Data Collection

Data was collected in this study using both quantitative and qualitative methods. The research questions were designed so that a comprehensive understanding of student's perceptions could be attained. The following describes the methods used for collecting the data.

3.3.1 Quantitative Data

At the beginning of June, three weeks prior to the administration of their final exam, students were given the survey. Students had spent over four months with the Flipped Classroom and in this time had opportunities to develop their own likes, dislikes, and other perceptions about Flipped Classroom instruction. The survey focused on five major themes including mastery learning, pacing, time, social media and videos, and specific Flipped Classroom questions. The survey consisted of 17 five-level Likert Scale items which supplied the quantitative data for the study (See Appendix B).

3.3.2 Qualitative Data

In addition to quantitative data it was also important that the study include an understanding of the students' perceptions of the Flipped Classroom in their own words. The five open-ended written questions at the end of the survey provided students with the opportunity to describe their own experiences and offer feedback, something not possible with a Likert Scale questionnaire. One of the main purposes of the study was to provide educators who are flipping their classes, and educators who are considering flipping their classes, with feedback from a student’s perspective. The first four open-ended questions detailed specific Flipped Classroom applications. The last question was left for general comments (See Appendix B).

3.4 Data Analysis

This study implemented a mixed-methods approach for data analysis. For the purpose of this thesis, Creswell and Plano Clark's (2006) definition was used:

> Mixed methods research is a research design with philosophical assumptions as well as methods of inquiry. As a methodology, it involves philosophical assumptions that guide the direction of the collection and analysis of data and the mixture of qualitative and quantitative approaches in many phases in the research process. As a method, it focuses on collecting, analyzing, and mixing both quantitative and qualitative data in a single study or series of studies. Its central premise is that the use of quantitative and qualitative approaches in combination provides a better understanding of research problems than either approach alone. (p. 18)

This method allows for a broad analysis of the data while also ensuring that each participant was heard and understood in his or her own words.

3.4.1 Quantitative Analysis

There is significant controversy over whether Likert Scale data should be treated as ordinal or interval data.

> An underlying reason for analyzing ordinal data as interval data might be the contention that parametric statistical tests are more powerful that nonparametric alternatives. Also, conclusions and interpretations of parametric tests might be considered easier to interpret and provide more information than nonparametric alternatives (Allen & Seaman, 2007, para. 5).

The data in this study was treated as ordinal data because it was not possible for the participants to know the distance between two measures. As a result, mean and standard deviation were considered invalid parameters. Median and mode were the two

nonparametric procedures that were used to analyze the data. The data for each of the 17 questions will be presented in a bar graph and the percentage of students selecting each response will also be presented.

3.4.2 Qualitative Analysis

Each student response was coded into common themes that emerged through the five open-ended questions. Themes were drawn from significant similar multiple responses to an open-ended question, for example there were 29 of the 63 (46%) students surveyed who responded that self-pacing was an advantage of the Flipped Classroom. Responses that had more than one student answer in a similar way were also described as a percentage in terms of the number of students who answered in this way as displayed in the previous example. If a response was unique, it was coded as miscellaneous, and if relevant, included in the qualitative analysis. For each question the number of students who did not respond was also included as a percentage if applicable.

4 Chapter: Results

This study investigated student perceptions of the Flipped Classroom. Both quantitative and qualitative analyses were used in an attempt to provide a broad and balanced investigation into student perceptions of the Flipped Classroom. The quantitative data provided an overview of the general opinion of the students surveyed; the qualitative data helped give each student an opportunity to address in more detail some of the issues of the Flipped Classroom. The results in both the quantitative and qualitative inquiries are presented in this chapter under five themes including: Time, Pacing, Mastery, Videos and Media, and Flipped Classroom.

4.1 Quantitative Results

The five themes stated above were presented as a series of Likert Scale items. There were at least two items that addressed each theme. To improve reliability in the data, items were constructed such that some were phrased positively and others negatively. Also the thematic items were randomly distributed to ensure students did not simply select a single response to all the items without reading them.

4.1.1 Flipped Classroom

There were six items that assessed students' general perceptions of the Flipped Classroom. These items: 1, 2, 3, 8, 16, and 17 all addressed general Flipped Classroom applications. Item 1 stated: *The Flipped Classroom is more engaging than traditional classroom instruction.* The results from this item were overwhelmingly positive. Fifty-three of the sixty-three (84%) students surveyed either agreed or strongly agreed with

this statement (See Table 4.1). Only 5% responded that they disagreed. The median and mode[1] (33) scores support a strong agreement with the statement.

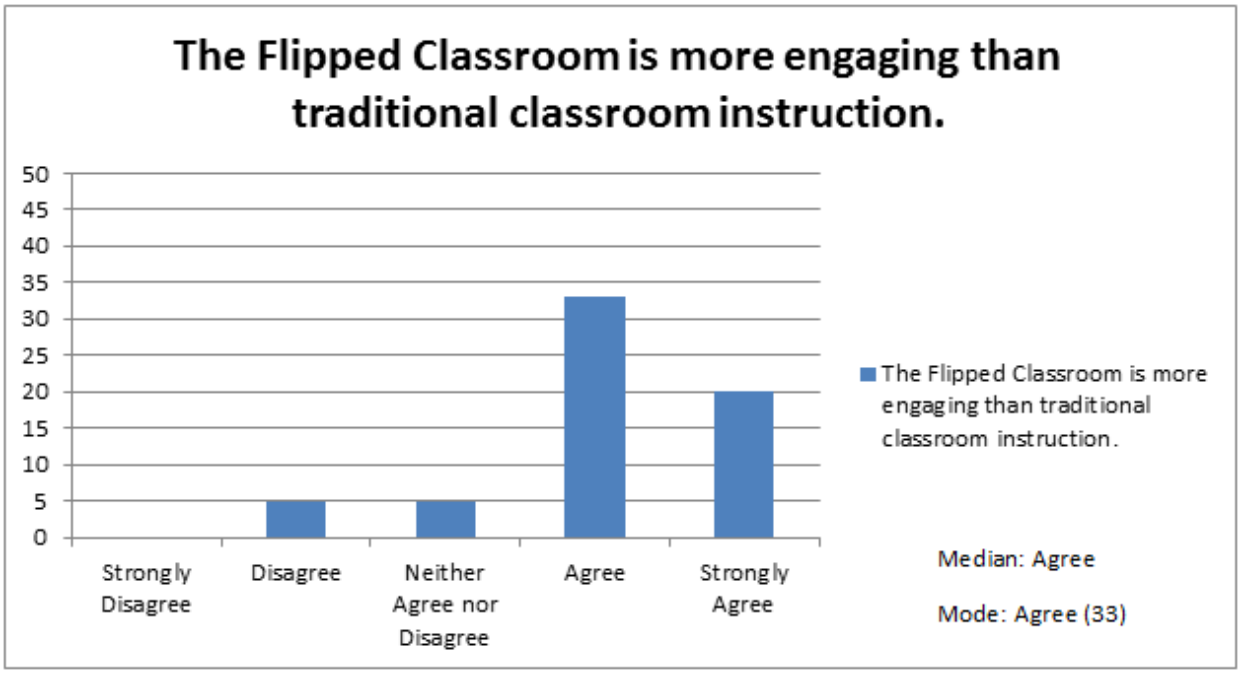

Figure 4.1 - Likert item 1

Item 2 elicited the strongest response from students for this theme. The item stated: *I would not recommend the Flipped Classroom to a friend.* Eighty-three percent either strongly disagreed or disagreed with this statement, whereas only 7% supported the statement (See Figure 4.2). The results showed students believed the Flipped Classroom was worth recommending to a friend. The median and mode score (29) for this statement demonstrated disagreement. It should be noted that there were only three students who agreed with this statement while one student strongly disagreed.

[1] A note about median and mode scores; Median scores are ordinal and cannot be expressed with a numerical value. However, mode scores are based on population response numbers and the numerical value represents the maximum amount of students that responded to a value.

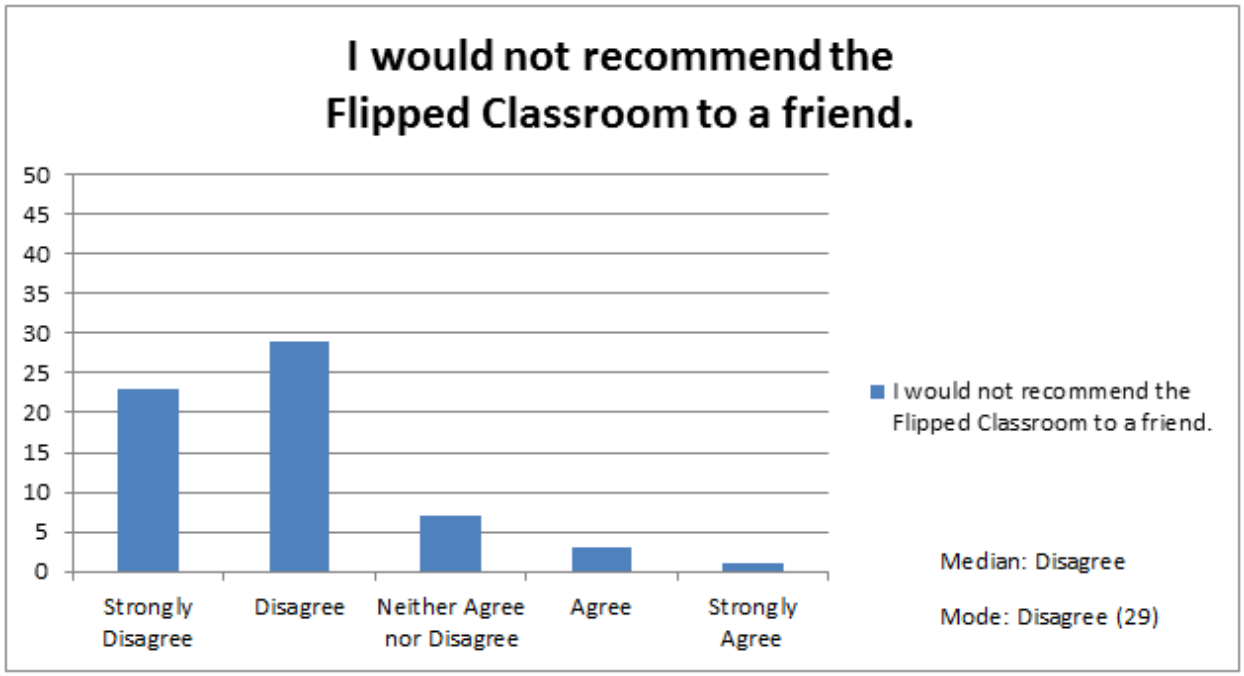

Figure 4.2 - Likert item 2

Item 3 stated: *The Flipped Classroom gives me greater opportunities to communicate with other students.* Again, the results were very one sided, with only one student disagreeing with this statement and no students strongly disagreeing with the statement. 85% of the students either agreed or strongly agreed with this statement (See Figure 4.3).

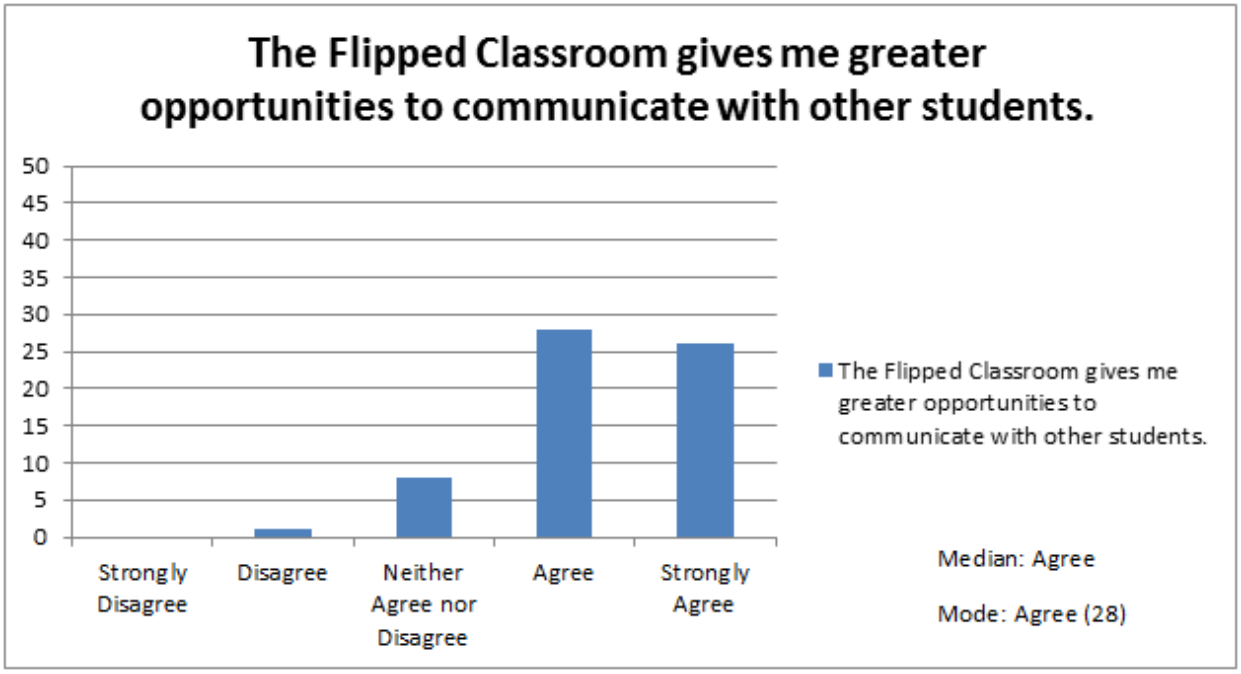

Figure 4.3 - Likert item 3

Item 8 stated: *I regularly watch the video assignment,* found that 84% either agreed or strongly agreed that they regularly watched the video assignment. This item had median and mode scores that showed strong agreement (See Figure 4.4).

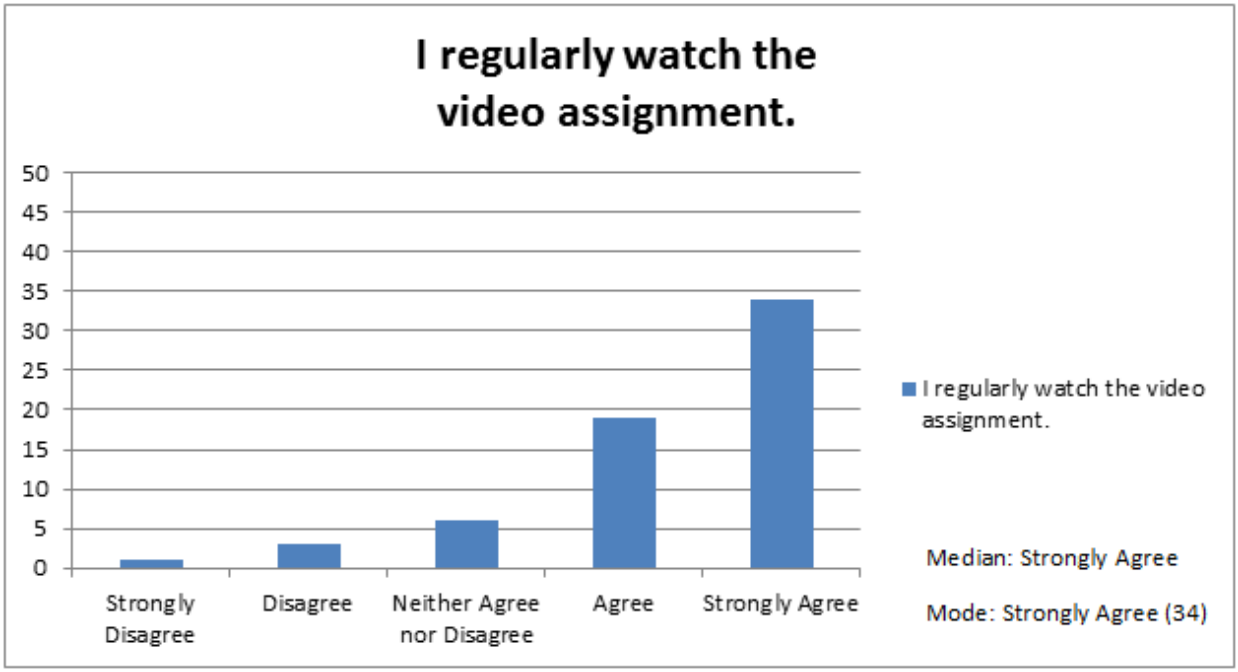

Figure 4.4 - Likert item 8

One item in this theme of general Flipped Classroom applications received mixed results from students. Item 16 stated: *I am more motivated to learn math in the Flipped Classroom.* While no one strongly disagreed, and only two disagreed, there were nineteen students (30%) who neither agreed nor disagreed (See Figure 4.5). The median and mode central tendencies confirmed that students agreed with this statement although there was a wider dispersal of responses.

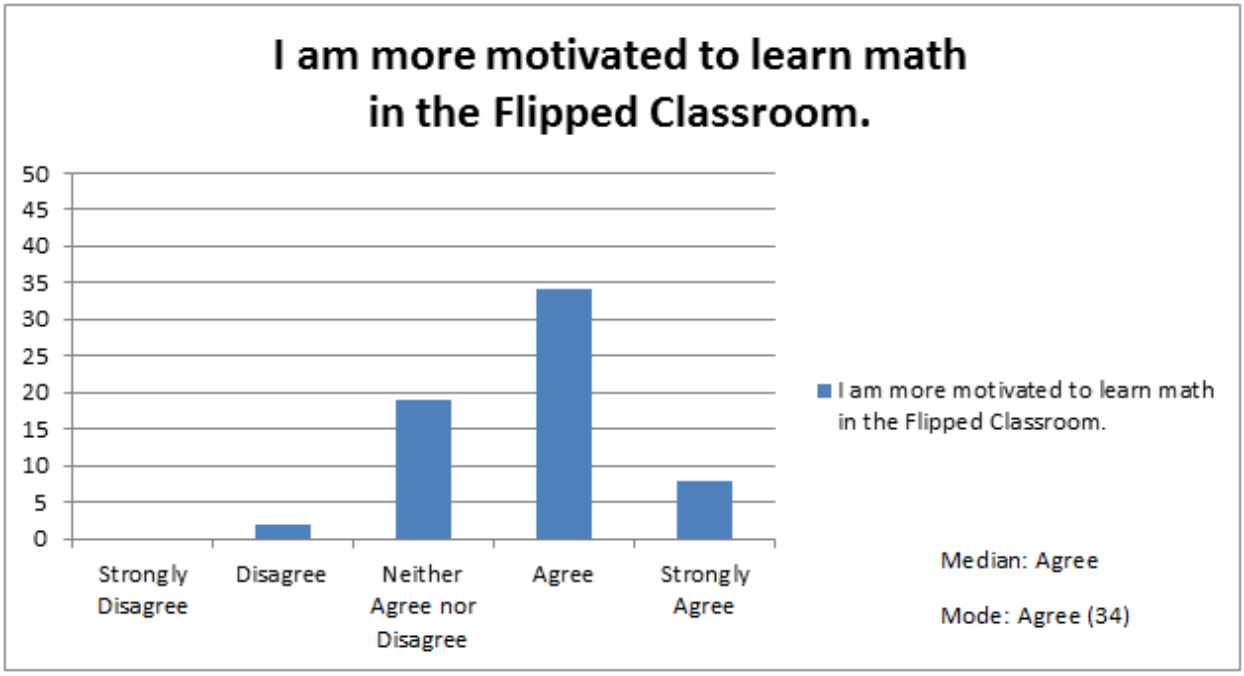

Figure 4.5 - Likert item 16

While students were somewhat ambivalent about the Flipped Classroom improving motivation their responses indicated that the Flipped Classroom helped improve their learning of math. Item 17 stated: *The Flipped Classroom has not improved my learning of mathematics*. The responses demonstrated that 79% of the students disagreed with this statement and only 6% of the students agreed (See Figure 4.6). This result supports the assumption that the Flipped Classroom has a positive impact on students' perceptions of learning math.

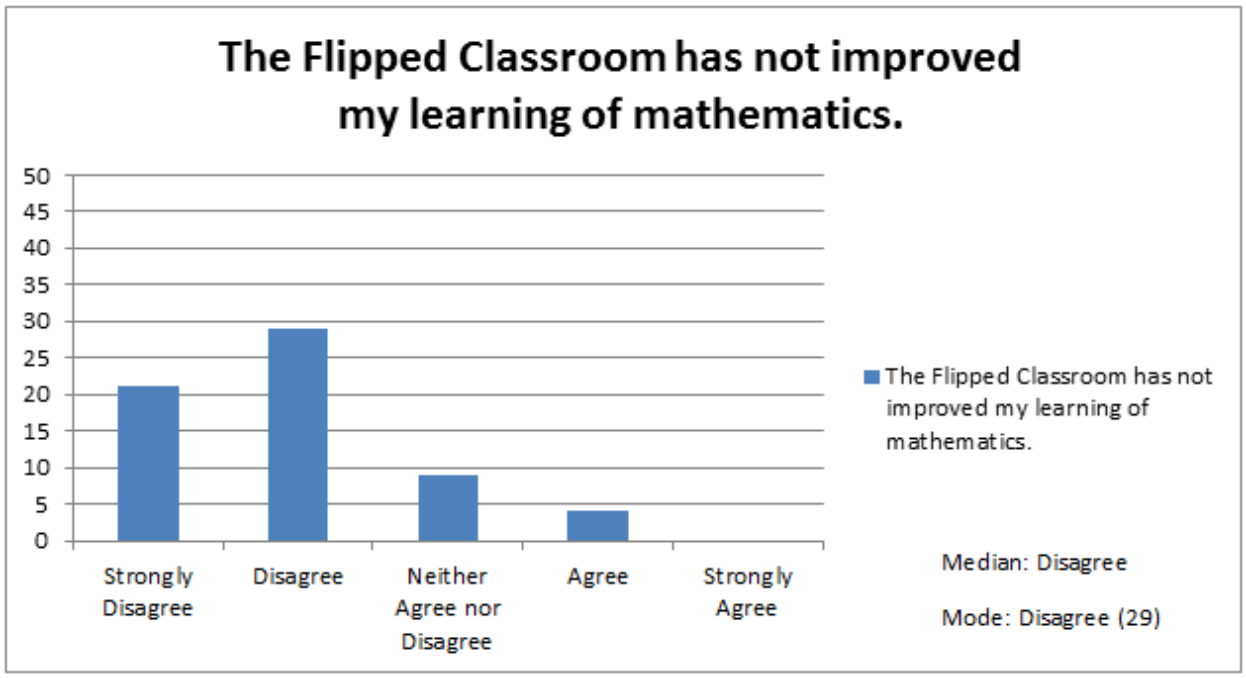

Figure 4.6 - Likert item 17

4.1.2 Videos and Social Media

Items 4, 7, and 11 examined the role that video and media play in the Flipped Classroom. The video lessons are the foundation of the Flipped Classroom, and it was important to inquire about students' perception of this media. Item 4 stated: *I like watching the lessons on video.* The results of this item were mixed. While only 15% either disagreed or strongly disagreed with the statement, 57% either agreed or strongly agreed with it. Twenty-nine percent, or 18 students, neither agreed nor disagreed with the statement (See Figure 4.7). The median and mode both support a positive response to this item. Students generally liked watching their lessons on video, although almost one third were neutral.

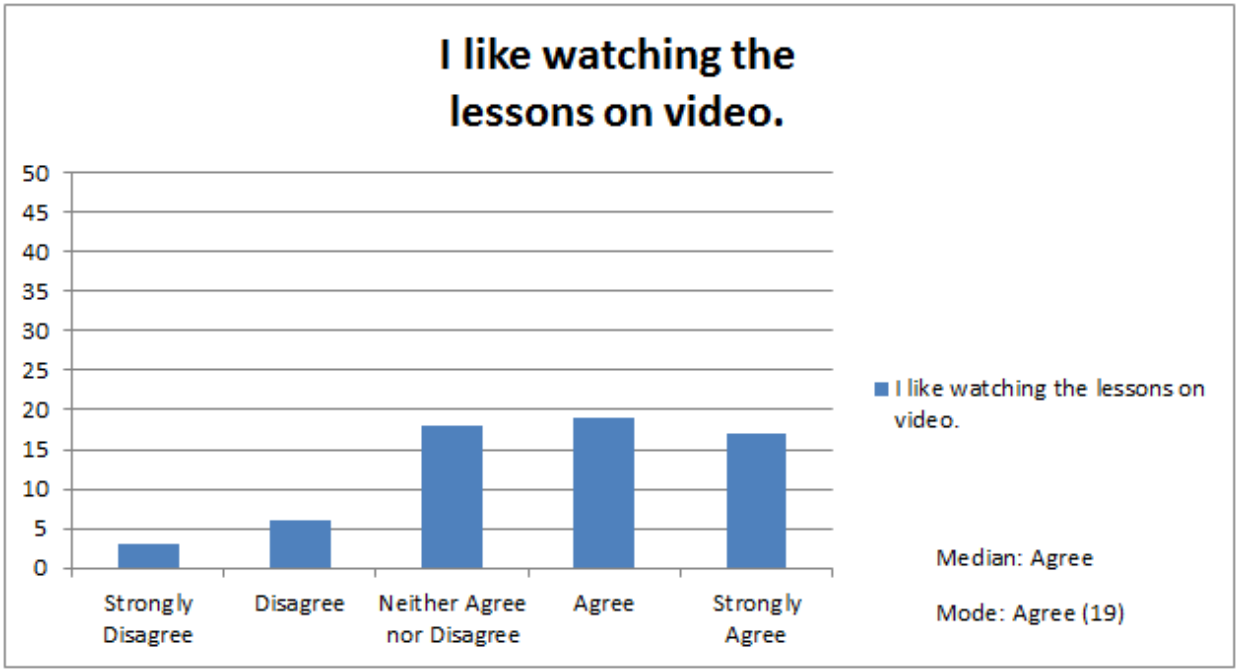

Figure 4.7 - Likert item 4

Item 7 asked a broad question concerning social media by asking: *Social Media (YouTube, Twitter, Facebook) are not an important part in my learning.* This item was the only item where the median and mode both showed a neutral response. The majority of the students neither agreed nor disagreed with the statement (See Figure 4.8).

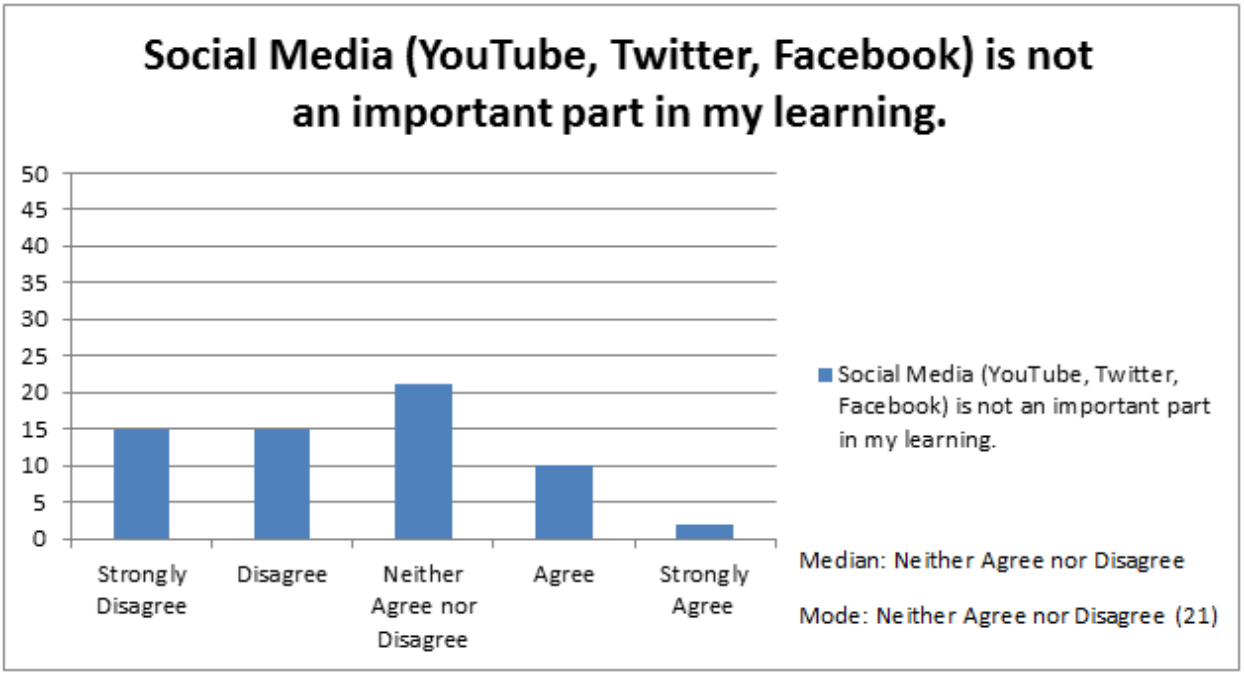

Figure 4.8 - Likert item 7

Item 11 was the last item of the theme addressing video and social media. It stated: *I would rather watch a traditional teacher-led lesson than a lesson video.* Seventy percent either disagreed or strongly disagreed with this statement, whereas only 13% either agreed or strongly agreed (See Figure 4.9). The median for this item hovered around disagreement and the mode showed disagreement with 24 students responding (38%).

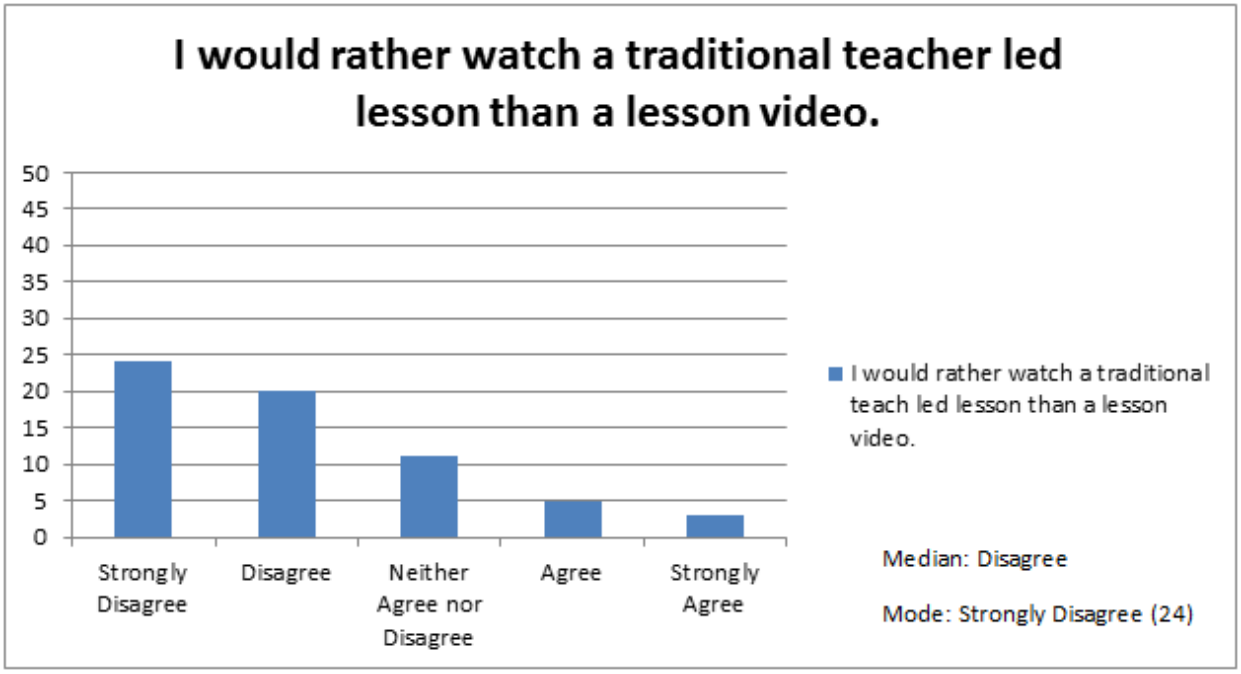

Figure 4.9 - Likert item 11

4.1.3 Time

The third theme, Time, was addressed in items 6 and 15. These items investigated how much time students were spending at home doing math-related work and how students were spending their additional classroom time. Item 6 stated: *I am spending less time working on traditional math homework.* Seventy-one percent of the students either agreed or strongly agreed to this statement (See Figure 4.10). The median and mode (26) also showed agreement with this statement. Eleven out of the 63 students either disagreed or strongly disagreed with this statement.

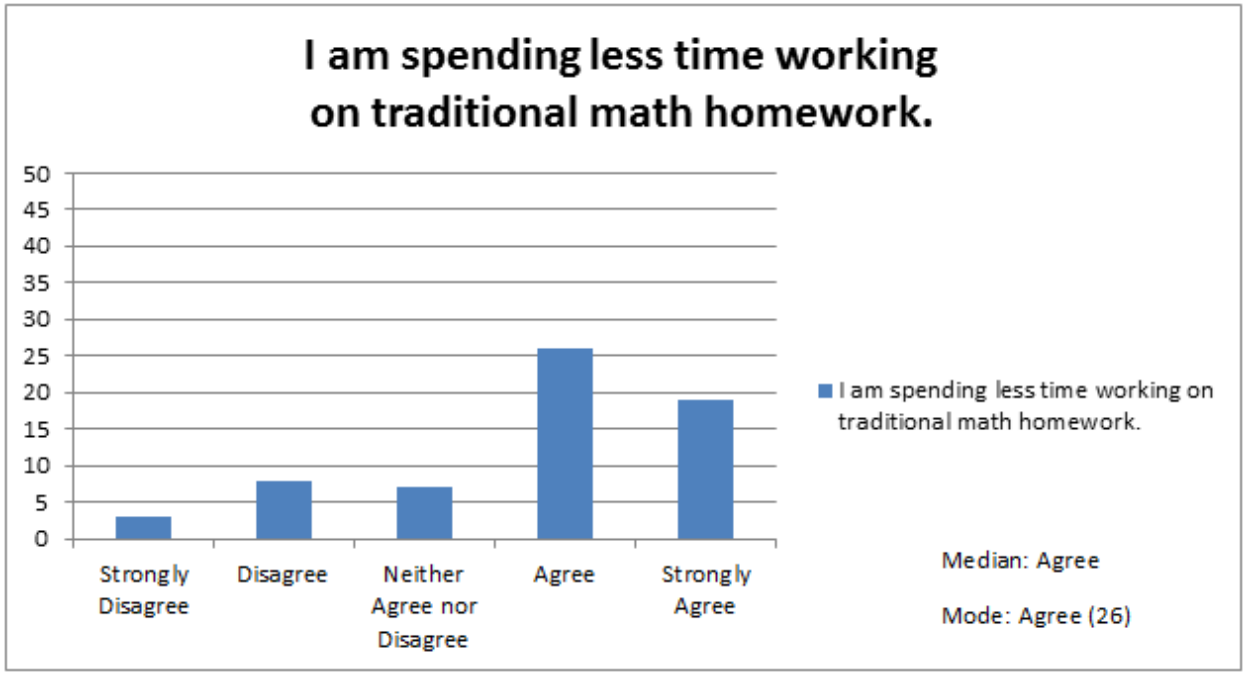

Figure 4.10 - Likert item 6

Item 15 stated: *The Flipped Classroom gives me less class time to practice math.* This item had very one-sided results with 91% choosing to disagree or strongly disagree. The median showed disagreement with the statement and the mode at 30 students showed strong disagreement with this statement. Only 2 out of 63 students agreed with this statement and no students responded that they strongly agreed (See Figure 4.11).

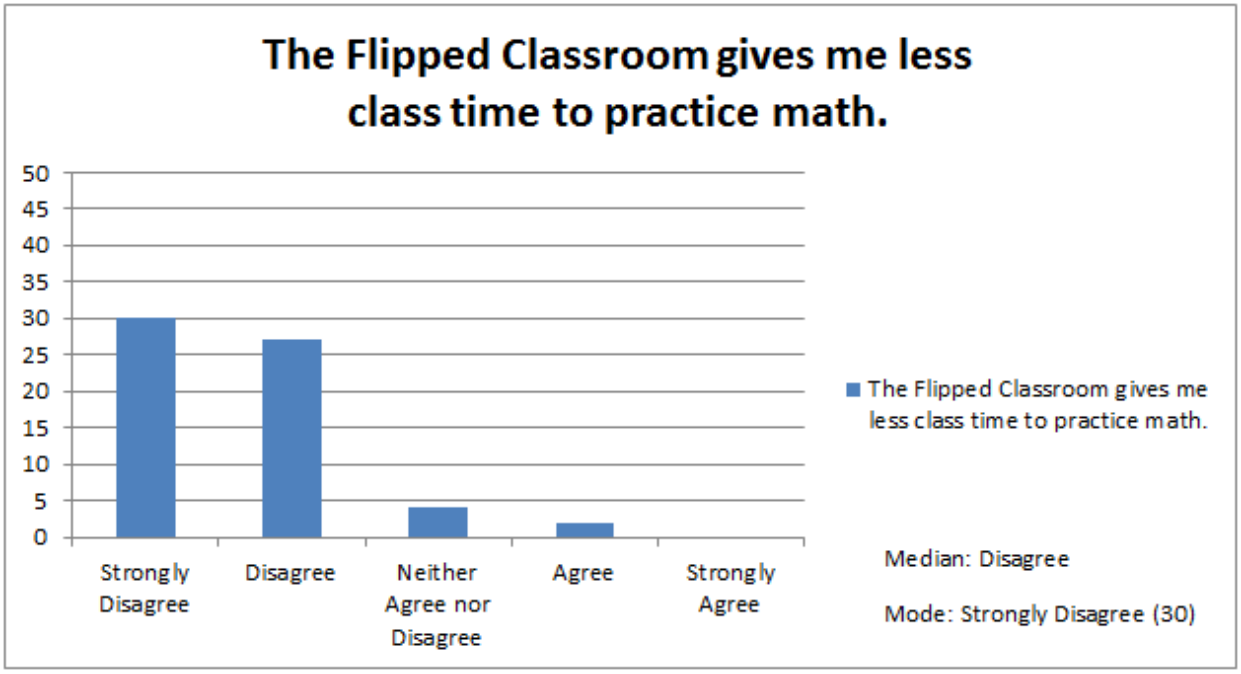

Figure 4.11 - Likert item 15

4.1.4 Pacing

The fourth theme, consisting of items 5, 9, 13 and 14, examined how students felt about being in a classroom that was self-paced. Specifically, if they liked self-pacing, if they found it easy to self-pace themselves, and how they felt about taking quizzes at their own pace. Items 5 and 13 were similar. Item 5 stated: *I would rather have the entire class moving at the same pace in the course*, and item 13 stated: *I dislike self-pacing myself through the course*. Sixty-nine percent either disagreed or strongly disagreed that they would rather have the entire class move at the same pace. Eleven percent agreed or strongly agreed with the statement. The results of item 13 were very similar. Eighty-five percent either disagreed or strongly disagreed that they dislike self-pacing in the course. Both the median and modes for these items also showed either disagreement or strong disagreement to the statements (See Figures 4.12 & 4.13).

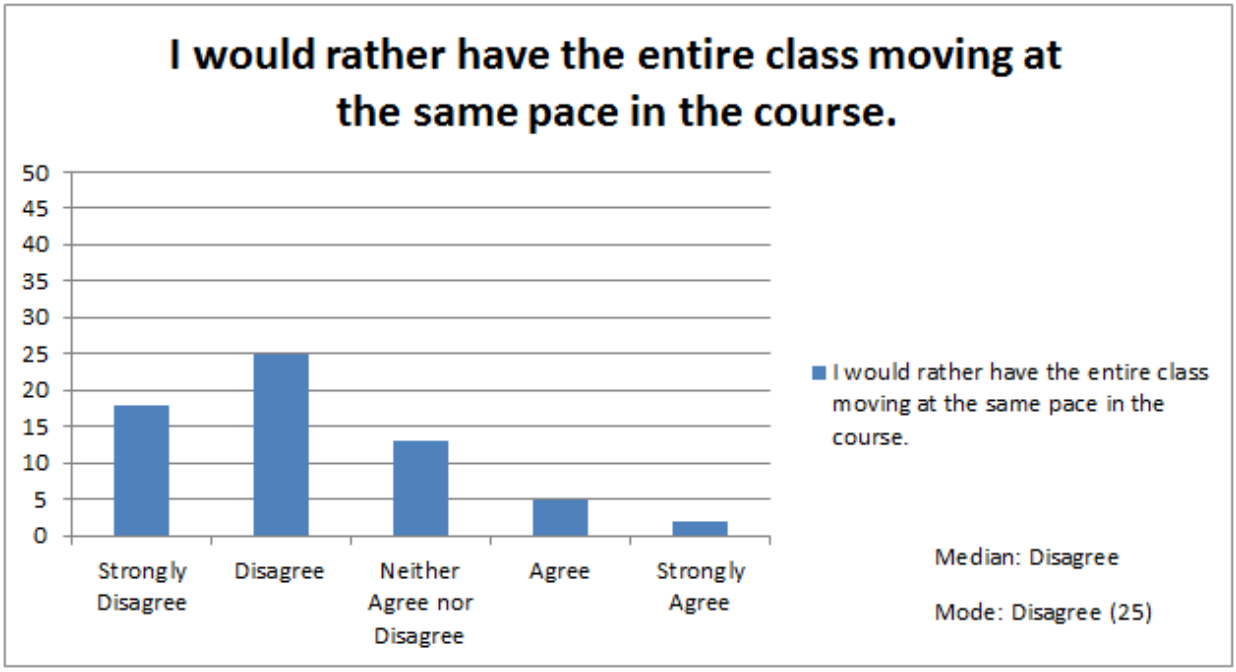

Figure 4.12 - Likert item 5

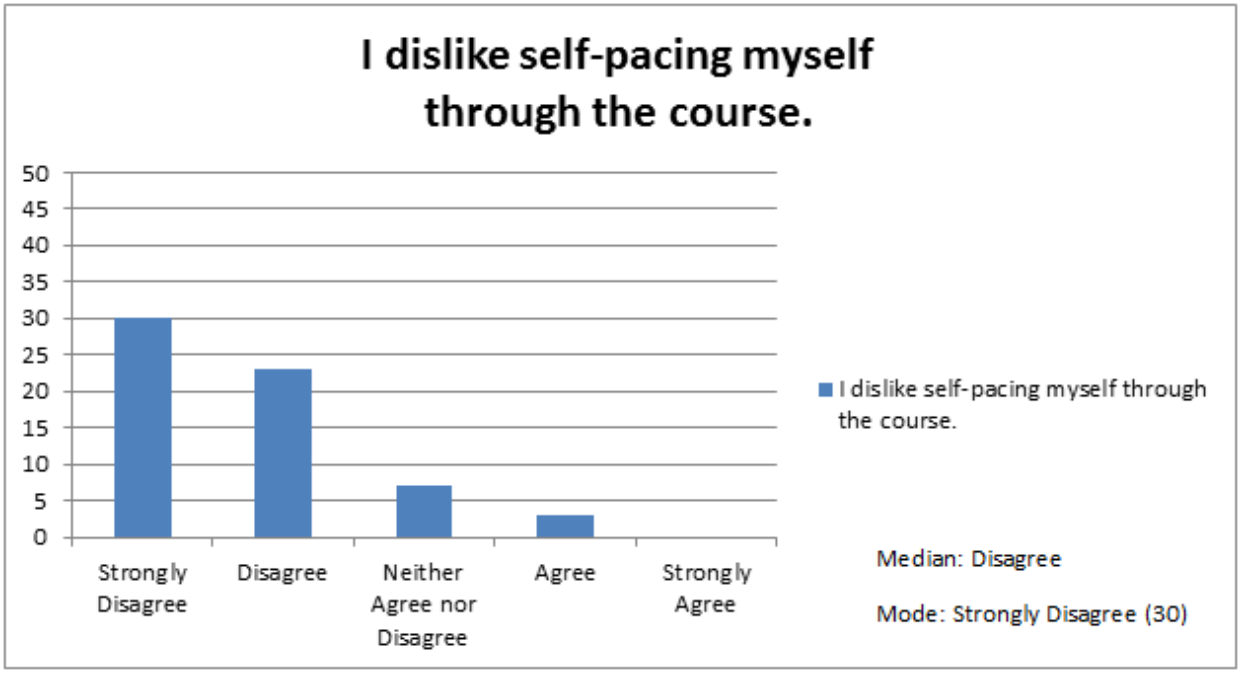

Figure 4.13 - Likert item 13

Item 9 stated*: I dislike that I can take my quizzes at my own pace.* Similar to most of the items in this theme, it was clear that students favoured self-pacing. Ninety-seven percent either disagreed or strongly disagreed with this statement. No student surveyed would rather have the class take quizzes together (See Figure 4.14). Both the median and the mode (48) strongly disagreed with the statement that they disliked taking quizzes at their own pace.

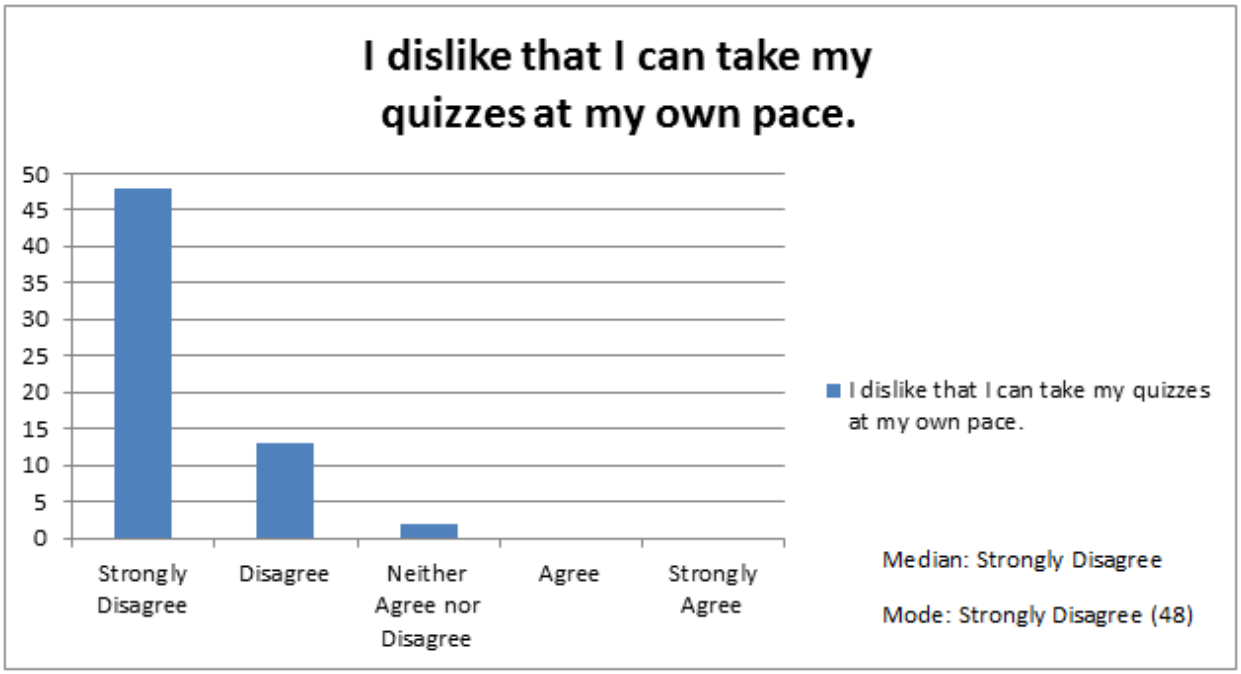

Figure 4.14 - Likert item 9

The last item in this theme, item 14, stated*: I find it easy to pace myself successfully through the course*. The median and mode (30) showed agreement with this statement. Seventy-two percent either agreed or strongly agreed and 18% either disagreed or strongly disagreed (See Figure 4.15).

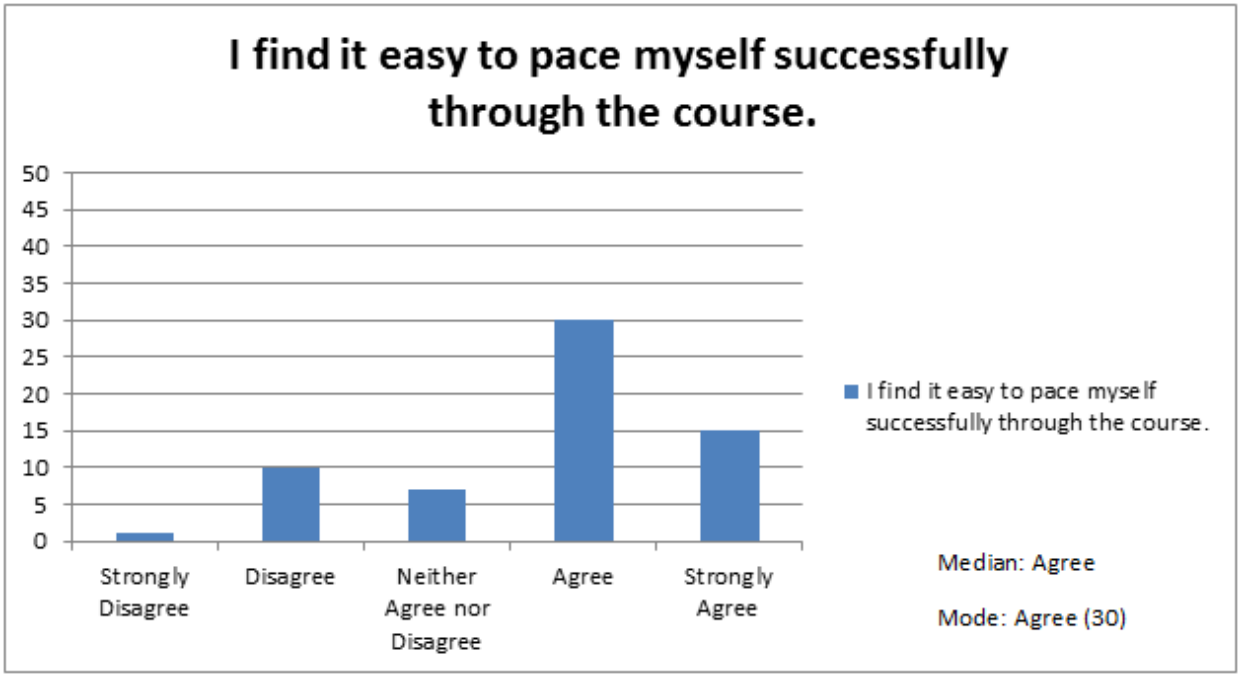

Figure 4.15- Likert item 14

4.1.5 Mastery

The last theme, items 10 and 12, sought to determine students' perceptions regarding mastery learning in the Flipped Classroom. Item 10 stated: *I like taking my tests and quizzes online using Moodle*. Moodle was the mechanism that was used to incorporate mastery learning into Flipped Classroom in this study which is why this item was included in this theme. Seventy-six percent either agreed or strongly disagreed with this statement. Eight percent neither agreed nor disagreed, 6% disagreed, and 10% strong disagreed (See Figure 4.16). The median showed an agreement and the mode, at 29 students, showed that they strongly agreed to the statement.

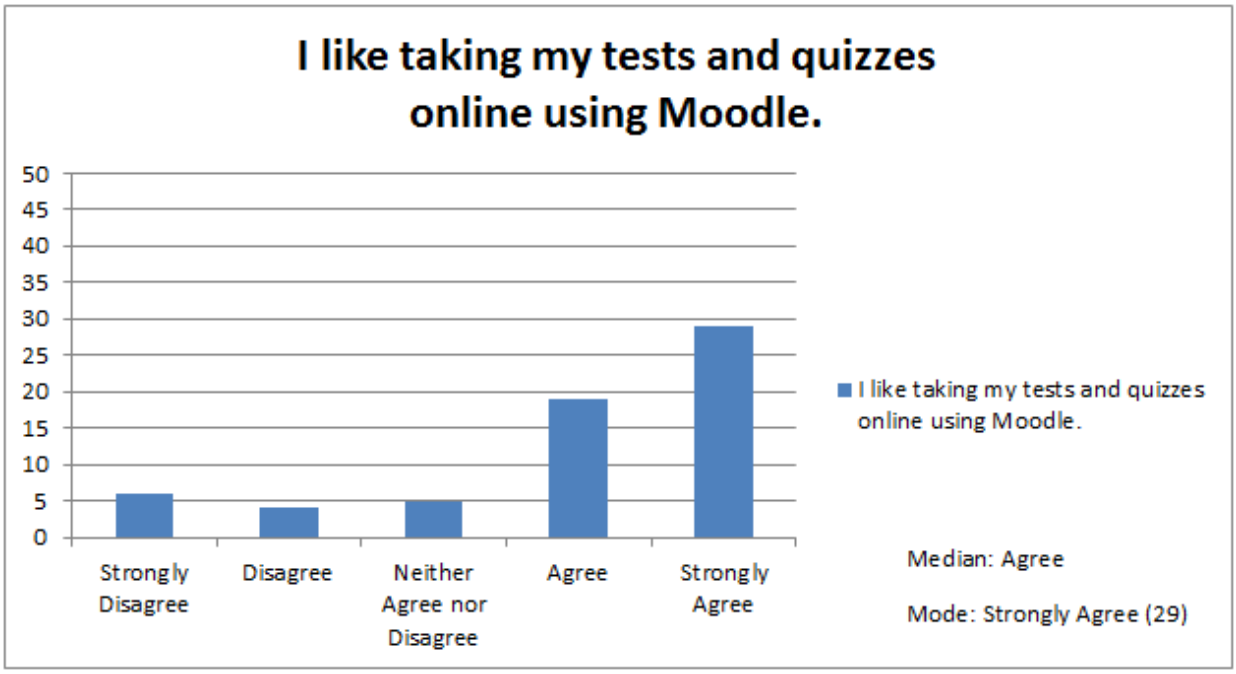

Figure 4.16 - Likert item 10

Item 12 stated: *I feel that mastery learning has improved my math understanding.* Only 4 students disagreed with this statement and no students strongly disagreed. The median and mode (30) both showed an agreement with this statement. Seventy-two percent either agreed or strongly agreed that mastery learning improved their math understanding (See Figure 4.17).

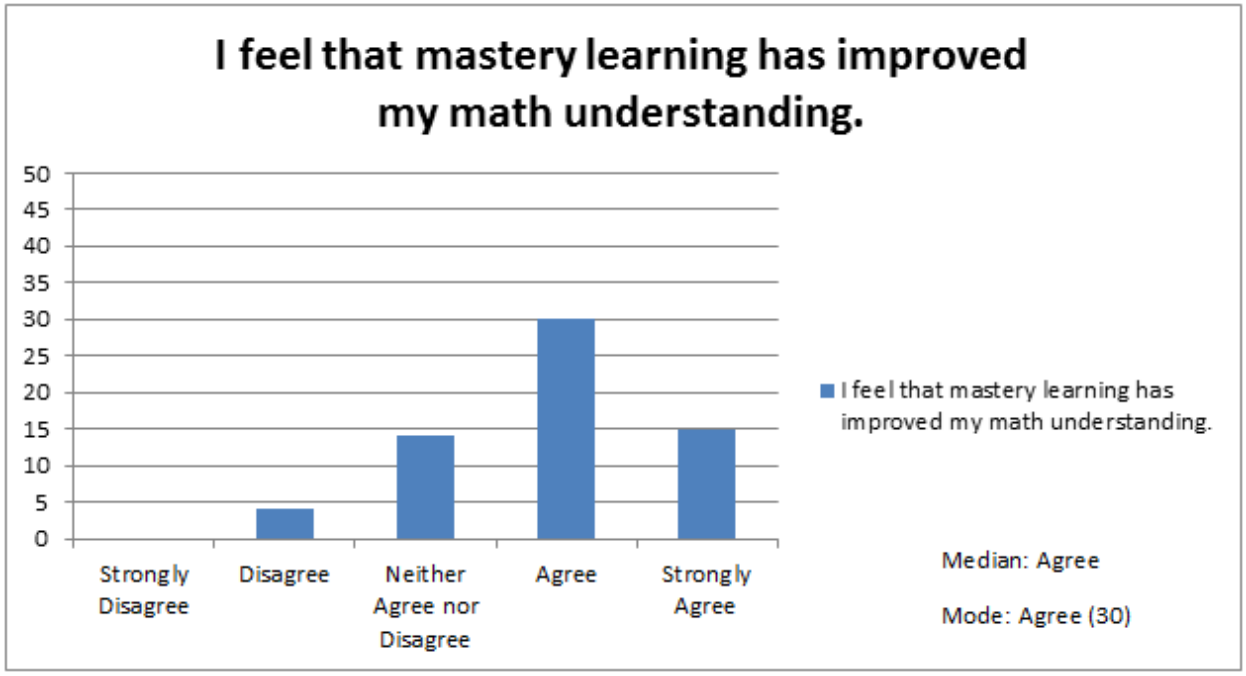

Figure 4.17- Likert item 12

4.2 Qualitative Results

There were five open-ended qualitative response questions at the end of the survey. The questions were as follows:

1. What are the advantages of the Flipped Classroom?
2. What are the disadvantages of the Flipped Classroom?
3. Would the Flipped Classroom be useful for other subjects? Why or why not?
4. What improvements would you recommend to improve learning in the Flipped Classroom?
5. Please state any other comment you wish to make about the Flipped Classroom.

Each of these questions, in addition to the quantitative likert-scale questions, assessed student perceptions of the Flipped Classroom. Common themes in student responses were put into a spreadsheet then coded and identified.

4.2.1 Advantages of the Flipped Classroom

Twenty-nine of the 63 (46%) students surveyed responded that self-pacing was an advantage of the Flipped Classroom. Students mentioned that they liked how they were not rushed in class to move at the pace set by the teacher and that it was a more relaxed environment. In addition, a number of students enjoyed having the ability to move ahead in the course if they found the material easy or if they wanted to be challenged. As one student pointed out, "the self-pacing and online classes are great for people with really busy schedules, who have to miss class. It's great to be able to catch up and/or get ahead if you're going on vacation, or miss school due to extra-curricular activities." Other students appreciated being able to slow the pace of the course down to take additional time on concepts they struggled with. One advantage of the Flipped Classroom pointed out by a student was "being able to work at my own pace and be able to get ahead of the class if I choose to. It decreased the stress of needing to have certain things done by the next class." "No need to wait for others" was another comment from two students. Three students responded that, since the class was self-paced, it was easier to catch up when you were ill or had other commitments that forced you to miss class. One student responded that "I don't have to take the test on the final test day if I am not ready."

Twelve of the 63 (19%) students found that having more time in class to work on problems and activities was also an advantage of the Flipped Classroom. Students liked having the opportunity to do more of their homework in class. One student stated that "If you have questions from the homework you can ask the teacher during math class." Another student said, "I don't have to sit through long lessons, the teacher has more time for me as an individual student, creativity is more involved." Additionally, several students stated that they enjoyed working through problems with their classmates rather than being left to do their homework alone. Seven of the 63 (11%) students found that opportunities to do their homework in class and watch videos reduced the amount of time spent at home doing homework. One student responded that "before in math I barely ever did homework, now I haven't missed any."

Generally, students liked learning from video lessons. They benefitted from being able to pause, rewind, and replay lessons whenever they needed. Two students mentioned that they used the videos to review before upcoming tests, and the fact that they knew they could access the videos whenever they needed reduced their stress.

While there were some common themes to the student responses, there were also several outlier responses:

- I like how the teacher has time for every student.
- The whole system is way more organised!
- Instead of listening to a lecture, I can use class time to ask the teacher questions.

- It's a lot more relaxed in class; you aren't really pressured and put on the spot a lot. It makes math more relaxed so I can actually understand it.
- The stress free quizzes help you retain knowledge, videos and notes are helpful. Deeper class discussions are more often and engaging.
- It is easier to be social and have fun in the class while doing work, and the teacher is always free to help.
- Not boring.
- We learned more than we would have learned in a 'normal' class.

Of the 63 students surveyed it should be noted that each students listed at least one advantage of the Flipped Classroom. No students left this portion of the survey blank.

4.2.2 Disadvantages of the Flipped Classroom

Self-pacing was the part of the Flipped Classroom students enjoyed the most, yet 19 of the 63 students (30%) also had problems with it. While students knew they could take extra time in the course and fall behind, several responded they did not like to do so. One stated, "sometimes it is hard to pace yourself and you fall behind without motivation." Another responded that, "kids can become lazy and fall behind." A third student observed that, "giving students access to internet provides possibility for off-task behavior."

There were a number of students who expressed concern with taking responsibility for their learning in a self-paced environment. As one student remarked, "It's hard to stay on pace, hard to stay motivated to work every day. As an example, in a regular classroom if I don't feel like working I have to suck it up and do the lesson but in

flipped class I can just not do it." Another student commented that, "you can get behind if you procrastinate for too long." Three students responded that they felt that the pace of the class, even though it was self-paced, was too quick. They had a difficult time keeping up and said that they always felt rushed.

Seven of the 63 students (11%) were disappointed that they could not immediately ask a question when they were at home watching a lesson video. One observed that, "if the video doesn't explain a concept well enough, you will likely get frustrated and give up." Students did not like having to wait until the next day because they may forget or not be able to finish the work they were doing at home.

Four of the 63 students (6%) found the videos less stimulating than traditional lectures. One student said "I find the video very boring." Another replied that the videos were less engaging. One student, who also said the videos were boring, just tended to copy the lesson notes down without really engaging in the video, "I was copying without learning" the student stated.

The classroom assessments were completed using the Moodle Learning Management System. Students were concerned that the questions were timed and also that they could not receive partial credit since the assessments were multiple-choice. One student stated, "Moodle has a timer for tests which is rattling." Another student responded, "doing tests on the computer sucks." A third student replied, "disadvantages included having to do quizzes and tests online when either I accidentally select the wrong answer when I got the correct one and not being able to have my written work count for marks."

The following responses did not fit into a code related to a common theme:

- Sometimes, I couldn't read the words in the video really well, teacher couldn't see the actual commitment that the student might have in a 'normal' classroom.
- The disadvantages of the flipped classroom are that if you don't have internet at home its (sic) harder to do or if your internet is glitchy.
- If you are a shyer student I can see how it would be more difficult to get help from the teacher as many demand it.
- Freedom is good but given the chance to redo a test or take it a day later gave me the chance to do that and I took advantage.
- Class activities/quizzes/assignments hardly count for anything.
- If I am behind in the course I feel too scared to ask the teacher questions. I feel he might get mad at me for being behind.
- Some videos are confusing or have 'outbursts' like sneezes.

Six of the 63 students (10%) did not cite any disadvantages of the Flipped Classroom.

4.2.3 The Flipped Classroom in Other Subjects

Students were asked if the Flipped Classroom could be useful in subjects other than Math and to explain why or why not. The vast majority, 56 of the 63 (89%) students, reported that the Flipped Classroom could be used in other subjects. Students felt that Science lent itself well to the Flipped Classroom. One student said it would make sense in science because it is similar to math in that it has "problems." Another student thought that the self-pacing concept could and should be used in every subject. "In

Science, just like Math, if you were really good at one topic but not in another then you could go fast through one and get more time to finish the others."

Students had reservations about using the Flipped Classroom with Social Studies and English. One student expressed the belief that, "the Flipped Classroom is for learning concepts, not necessarily people and dates as in Socials Studies." Another student stated, "I think it works fantastically in math, but definitely not English. I would not be able to get through a course like English by watching it on video." A third student answered, "I feel like the flipped class would work for fact-driven classes like Science, but not for classes such as English because it's not all based on facts."

Those students who felt the Flipped Classroom could be applied in other courses had varying responses. One student said, "I would love for most of my classes to be flipped simply for the accessibility and ease." Whereas another student said, "I believe that it would help kids with busy lives pass the courses needed to get a University education." Four out of the 63 students (6%) felt that the Flipped Classroom gives teachers more opportunities to do hands-on activities in the classroom and that this could lend itself to any discipline. Students also recommended minimizing or even an all-out elimination of traditional lectures as another reason to consider the Flipped Classroom outside of the Math classroom. One student suggested the Flipped Classroom helps them understand difficult concepts stating that, "the flip class would benefit in every class I am in because say you don't understand a lecture…can you rewind real life? I don't think so!"

Some students were quite adamant about the flipped classroom only being used in math. One student said that, "other classes need to have a teacher there explaining, but in math it works." Another student explained, "I think other subjects need lectures, whereas math needs more one on one time with students." A third student responded, "I don't believe it could be used elsewhere, unless it was very unit based."

The following are other comments student made about using the Flipped Classroom in subjects other than math:

- Yes, I think it would be useful because some students might understand the subject matter better.
- It would be hard to teach entire lessons over video.
- You can't really write an essay on Moodle.
- Yes, I think so, because videos could be a more interesting instead of notes.
- Yes it would be because it allows you to pace yourself and you can spend more time on subjects that you are unsure about.

4.2.4 Flipped Classroom Improvements

The fourth open-ended response question asked students what improvements they would recommend for the Flipped Classroom. The majority of the responses concerned improvements to the amount of in-class activities, classroom assessment strategies, and to the quality of the lesson videos.

Increasing the amount of in-class activities was the most common suggestion for improvement in the Flipped Classroom. Nine of the 63 students (14%) felt that the group

activities like math labs, whiteboarding[2], and games benefit student learning. The most popular activity that students requested to do more often was whiteboarding. Students responded that they liked the collaborative environment that whiteboards fostered and that because it is so easy to erase a response, when compared with traditional paper-pencil assignment, they were more likely to take risks.

Students had a number of recommendations around assessment. One was to make the unit tests available online or in written format, so that students could demonstrate their understanding in the way that best fit their learning needs. Another recommendation was to remove the timer that was on the tests and quizzes. Students felt that the timer added a significant amount of stress. The last improvement around assessment was to go over the quizzes and tests with the entire class.

Students also recommended that improvements could be made to the videos. Four students mentioned that they would like to see the videos go slower. They felt they were rushing to keep up and had to continuously pause the video. One student mentioned the need for a better microphone. Another student remarked that the writing was difficult to understand. Students also recommended that the videos include more interactivity to make them more engaging. Two students suggested that unit review videos be created that provide a summary of the topics completed in a unit.

The following are additional recommendations that students made to improve the Flipped Classroom:

[2] Whiteboarding is locally developed in-class learning activity. Students work collaboratively in small groups and solve problems, ask questions, and play games using the classroom whiteboards.

- My only problem was that early in the year I was moving at a faster pace than Mr. Johnson had the units ready.
- I would just work on the entertainment of the videos and small classrooms, only one teacher to help ~30 kids.
- Compared to traditional classes in Germany it was the best math class I can imagine.
- Little bit more switching between Flipped Classroom and 'normal' classroom so that that the teacher can see how far every student actually is.
- Make the examples in the videos more difficult to match the ones in the workbook, more time at the end of the course for re-tests.
- More music.
- A computer in class for every student.
- I would keep everything the same except give all students a written test to avoid the chance of one student receiving a harder test than another.

Fifteen of the 63 students (24%) did not respond with any suggested improvement for the Flipped Classroom.

4.2.5 Other Comments

The last survey question, *Please state any other comments you wish to make about the Flipped Classroom*, was provided to give students the opportunity to provide additional feedback that was not related to the 17 Likert Scale questions and the 4 previous open-ended response questions. Thirty-seven of the 63 students (59%) used

this question to provide positive feedback about their experience in the Flipped Classroom. The comments included:

- I really enjoyed the opportunity to take part in this experience.
- I really loved it, never had this little trouble in math, very easy, best math ever.
- The flipped classroom worked very well for me. My grade improved a lot.
- It is probably the greatest way of learning, besides hands on training that I ever had.
- Flipped class is a lot more fun.
- I love the laid back atmosphere.
- It's great! I don't know how I'll ever go back…
- I have enjoyed being a part of it, it has helped me learn better and is easy to stay motivated.
- I feel well prepared for the provincial exam because of it.
- I personally enjoy math a lot more in the flipped classroom and think it's an effective way of learning.
- I really liked it, way less boring than in a normal class, you have to pay more attention and you have to work more for yourself.

Five of the 63 students (8%) surveyed responded that they were not in favour of the Flipped Classroom. One student stated that, "it is an interesting program with great ideas however I prefer the traditional way of learning." Another student commented that, "I prefer standard teaching style, I feel like my understanding of math has declined from

what I would predict it would be in a normal class." A third student responded that, "the Flipped Classroom is not my favourite way of learning, but it was a good experience." One student wrote simply, "it was a different year."

A number of the students endorsed the Flipped Classroom and their teacher. Their responses included:

- I think the teaching was fantastic and I love the flipped classroom. Honestly, my favorite class.
- The teacher is very experienced in running the flipped classroom. I find his methods very effective and efficient. Please continue this course, as it's very helpful and easy for students to learn in this matter.
- The teacher did a fabulous job teaching flipped classroom style and I've never been as successful as I've been this year in math if it wasn't for the teacher's helpfulness, patience, morning tutorials, 1-on-1 help etc. :) .
- I think it is a very innovative and successful program overall. Like anything that is still in its early stages, there is some work to be done, but I think the Flipped Classroom has the potential to change the way math is taught.

There were 18 students of the 63 surveyed (29%) who did not respond with any additional comments.

5 Chapter: Conclusion, Implications and Recommendations

In this chapter, a summary of the study and a discussion of the implications of the research findings are presented. In addition, opposing viewpoints of the Flipped Classroom are addressed and future research is recommended.

5.1 Summary

The purpose of this study was to investigate student perceptions of the Flipped Classroom. The Flipped Classroom is a significant shift in the way students traditionally function in a classroom. In a Flipped Classroom students receive their direct-instruction through video which can be watched in or out of class. No longer is the teacher using the majority of classroom time to lecture; instead students are engaging in various learning activities with increased face-to-face classroom time. The general focus of the Flipped Classroom in this study was to make the learning environment more student-centered by moving the learning from a passive format to an active one. The study investigated three central questions: What are student perceptions of the Flipped Classroom? How has the Flipped Classroom supported student learning? How can the Flipped Classroom be improved?

The study did not just examine if students did or did not like watching their lessons on video. This study focused on additional aspects of the Flipped Classroom, those that were not available in a traditional classroom setting. As a result of the increased classroom time afforded by pre-recorded lesson videos the teacher/researcher was able to run a self-paced mastery class. Students were allowed to move at their own pace throughout each individual unit as long as they met certain

deadlines throughout the course. In addition, students were required to attain certain benchmarks on unit quizzes, 70% or above in this case, before they were permitted to move forward in the course. Those students who struggled to meet the benchmarks went back into the learning cycle where they received remediation from the teacher until they were ready to retry the quiz. The Flipped Classroom also featured many learning activities that the teacher had never had classroom time for before: math labs, games, whiteboarding activities, journaling, and pre-test student-teacher interviews known as the "hot seat."

The study involved three Flipped Classrooms totalling 63 students. A survey was administered to each student who assented and had parent consent at the end of the semester as their Flipped Classroom experience came to an end. Students were asked a series of Likert Scale items and open-ended questions concerning different aspects of the Flipped Classroom. These included questions about mastery learning, time, self-pacing, social media and videos, and general Flipped Classroom questions.

So that there would be a broad understanding of student perceptions the study implemented a mixed approach of quantitative and qualitative methods. The quantitative data was examined using median and mode as the central tendency measures. In addition, each question was graphed based on the total number of students answering a question in each of the five Likert Scale responses. The qualitative data was sorted by common themes based on the five open-ended response questions. Responses were grouped by coherence to each particular theme. Those students whose comments did not match other student response data were also represented in the data. It was

important that each student's perception of the Flipped Classroom was included in the results.

5.2 Discussion of Research Questions

The first research question guiding this study pertained to students' perceptions of the Flipped Classroom. The results from the surveys supported the hypothesis that the majority of students enjoyed the Flipped Classroom experience. Each questionnaire item that examined student engagement and enjoyment showed positive responses concerning the Flipped Classroom. Only 7% would not recommend the Flipped Classroom to a friend. Only 8% felt the Flipped Classroom was less engaging than a more traditionally instructed classroom. Fifteen percent stated they did not like watching lesson videos. The majority of students also responded positively that they liked the self-paced nature of the course. The open-ended response questionnaire items corroborated the Likert Scale data as students listed many advantages of the Flipped Classroom.

The second question guiding this study concerned students' perception of their learning in the Flipped Classroom. Again, most students responded positively that the Flipped Classroom supported their learning. Students found that they had further opportunities to communicate with their classmates and teacher, finish their homework in class, and to engage in meaningful classroom activities. Only 3% of the students believed their motivation had decreased and only 6% felt like their learning of math had not improved because of the Flipped Classroom.

The third research question guiding this study examined how the Flipped Classroom could be improved. There were three questionnaire items that asked students about Flipped Classroom improvements. Students responded that they would like to have additional in-class learning activities. They saw value in the activities that were currently being done in the Flipped Classroom but felt that these activities should be more frequent. Additionally, there was a strong consensus that certain aspects of the assessment process could be changed. Students liked the self-pacing and mastery aspects that were ingrained in the assessment strategy, but felt that having more of the assessments as paper-and-pencil rather than computerized assessments would allow them to better show their work and receive partial credit. Students also found that the assessment timer that was built into Moodle was stressful and recommended removing it. Lastly, students found that the videos could be improved. Better sound quality, more examples, and slower paced instruction were some of the most common responses. A number of students also suggested that the videos be created so that they were more interactive. Students offered suggestions for the videos including having interactive buttons throughout, embedded quizzes, a table of contents, and a glossary to create a more engaging experience for the user.

5.3 Conclusions

There were three major findings in this study that contribute to the field of Flipped Classroom research. The first major finding from the study revealed that students in a Flipped Classroom were doing less homework than in a traditional classroom. This finding runs contrary to the belief that students in a Flipped Classroom do more work at home to free up time in the regular classroom. Additionally, students reported that time

was spent more efficiently in a Flipped Classroom. As a result, students had time to complete their daily assignments or activities and complete the next day's lesson video at the end of class. Students experienced less down time in the Flipped Classroom. As a result, they completed what they needed to in class minimizing, or for some students completely eliminating, the amount of time they needed to spend at home doing math.

The second major finding of this study was that students simply enjoyed learning in a Flipped Classroom. Both the qualitative and quantitative data and teachers observations supported this. Students reported that they enjoyed the flexibility of the Flipped Classroom. They were able to interact with the teacher more frequently; they enjoyed the increase in learning activities in class; and, they appreciated the reduced amount of homework. The data showed students' perceptions of their own engagement, communication, and understanding all increased as a result of the Flipped Classroom.

The third major finding was that students benefit from watching video recorded lessons. When developing this Flipped Classroom a concern that arose was that students would be less engaged and would request traditional lecture instruction. Students reported that they benefitted from being able to watch the video at a time that suited their schedule and their learning needs. They also appreciated that the videos could be paused, rewound, and even fast-forwarded when they understood a concept. This finding is important since it shows that instructional videos in education can be an effective alternative to traditional lecture.

5.4 Implications

The results of the research have significant implications for the delivery of education in the 21st century. No longer does a teacher need to provide a synchronous lesson to his or her students. Technology can liberate the teacher to move towards an asynchronous student-centered learning environment where each student receives a personalized education program.

The Flipped Classroom offers those educators looking to reinvent their practice a way to move from being the "sage on the stage" to the "guide on the side." A common problem in teacher professional development is a lack of time to learn how to alter or modify teaching practice. It takes significant time to incorporate educational strategies like assessment for learning, problem-based learning, differentiation, and other strategies into an environment where the majority of the time is spent lecturing. The Flipped Classroom can make educational improvement possible since it frees up teacher instructional time.

The Flipped Classroom implemented in this study is just one example of how a teacher can change their own practice. The teacher/researcher in this study chose to develop a Flipped Classroom that focused on self-paced instruction, mastery learning, and student-centered learning. Students were given a learning resource package at the beginning of a unit that listed the tasks they needed to complete. Students were free to move through the unit at their own pace as long as they met the test deadline at the end of the unit. Additional time was provided to students who needed it, providing the additional time was used to support their learning. One aspect of this classroom that

may differ from other Flipped Classrooms was that students were not required to watch the lesson videos at home. A common response heard from students was that they found their classroom time more efficient, and this efficiency gave them time to watch upcoming assigned videos in class. Informal anecdotal polling mid-way through the semester of the study revealed that more than half the students were watching the upcoming videos in class rather than at home; this was corroborated by the research data that confirmed that 71% of the students either agreed or strongly agreed they had less homework because of the Flipped Classroom.

Another aspect of the Flipped Classroom in this study that may differ from other Flipped Classroom applications was the use of mastery-learning. Students were required to achieve greater than 70% on their formative assessment quizzes before they were permitted to move forward in the course. Those students who did not achieve 70% or greater were required to meet with the teacher and receive remediation to better prepare them for their reassessment. The benefit of this, especially in a course like math where the learning is scaffolded, was that the teacher could ensure students had a stronger baseline understanding of the curriculum.

An additional implication of the Flipped Classroom in this study was the use of learning activities to support student learning. There was rarely time prior to flipping the classroom for students to engage in math further than doing traditional textbook questions. It was found that when non-traditional learning activities were used, they were ineffective, and students disliked them since they were not done frequently enough to become part of the classroom culture. The Flipped Classroom incorporated learning journals, math labs, whiteboarding activities, games, and interviews. These

activities proved to be more effective because they were ingrained in the classroom culture from day one and became something the teacher used frequently on a daily basis.

The Flipped Classroom presented in this study is just one example of how a Flipped Classroom can be implemented. The Flipped Classroom, generally, should be viewed as mindset rather than a pedagogy. The traditional Flipped Classroom definition requires students to watch their lessons at home and work on various activities in the classroom, but that doesn't mean every Flipped Classroom needs to operate in this fashion. Educators are continuing to experiment with Flipped Classroom strategies to meet their curricular needs.

Educators considering the Flipped Classroom should not be concerned with their content area or the age of their students, but instead should consider if their classes would benefit from being flipped. Do they find they do not have enough classroom time to do the things they want to in class? Are they spending a significant amount of time lecturing? Are they struggling to meet the diverse needs of theirs learners? If they answered yes to any of these questions, then the Flipped Classroom may be a viable alternative. It should be noted that it does not mean every lesson, or every unit of a course needs to be flipped. Any aspect of a teacher's lesson that could be presented in video could help free the teacher to do those things they always wished they had the time for.

5.5 Addressing the Concerns

There are concerns expressed in the literature about the Flipped Classroom. Generally three main concerns are expressed:

- Equal access to technology
- A continuation of lecturing
- An increase in homework

In this study equal access to technology did not prove to be a major issue. There were very few students that expressed that they either did not have access to internet or a computer at home. Those students who did not have internet access but had a computer at home were given a memory stick with the lessons on them which could be viewed without an internet connection. Those students who did not have a computer at home were invited to come to class early, watch the lesson at lunch hour on one of the computers in the library, or stay after to watch their lesson on one of the classroom computers. It should be noted that many students, regardless of what technology they had at home, chose to watch the videos inside of class and did not appear to need technology at home to be successful with the Flipped Classroom. Students often expressed that they liked watching the lesson videos in class with a classmate so they could discuss the video as it progressed and they could access the teacher when further clarification on a concept was required. As presented in the Literature Review, there are schools in low socio-economical areas that are thriving with a Flipped Classroom model of instruction. Even though technological inequities can be present,

these schools are finding that the "playing field can be leveled" by simply opening the doors before and after school so students can have access to the necessary technology.

The second concern is that the Flipped Classroom still relies on lectures; there is no arguing against this. However, the lectures that take place as videos in the Flipped Classroom are quite different than the lectures that are delivered in a traditional classroom. The first notable difference is that they are considerably shorter in length. The videos lessons in this study ranged from 10-20 minutes in length, whereas the traditional lectures used in my previous years classes ranged from 40-60 minutes. A useful recommendation heard from Flipped Classroom educators when trying to determine the length of their videos is to take the grade level of their students and multiply by one to two minutes. For example, a student in the tenth grade should be viewing a lesson video between 10 and 20 minutes. A second notable difference is the way lectures can be viewed. Students can watch their lesson videos at anytime and anyplace, alone, with a partner, or in a small group. Students can pause, rewind, fast-forward, and replay the videos. These are all features that traditional lecture based lesson cannot provide.

Currently there is a move away from traditional lecturing in education. The Flipped Classroom offers educators a way to move in that direction without completely eliminating lectures altogether. Some Flipped Classroom educators like Musallam (2012) are using Flipped Classroom videos in an inquiry-based classroom. Students first explore a concept, then they watch a flipped video lesson, then they apply the concept (See Appendix C for Musallam's *Explore-Flip-Apply: Theoretical Framework Cycle of Learning*). There are many ways that the Flipped Classroom can be used, yet

almost every Flipped Classroom teacher uses their lesson videos as a way to minimize lectures regardless of how they are delivered.

The third concern of those who question the Flipped Classroom pertains to a possible increase in homework. It is argued that students already are assigned significant amount of homework in traditional classroom settings. The Flipped Classroom in this study has shown that there can be a significant reduction in homework. Additionally, students are no longer going home to complete their assignments alone. A common complaint of math students in a traditional classroom is that they may appear to have understood the lesson in class but struggle when they try to apply this knowledge at home. In the Flipped Classroom model, students may still struggle after watching a lesson video, but now the struggle occurs in class where the teacher and the rest of the class are there to provide assistance.

5.6 Future Research

This study focused on student perceptions of the Flipped Classroom experience. The summary of the research concludes that the majority of students enjoyed the Flipped Classroom and believed it supported their learning. The study had a limited number of participants due to the fact that there were only a few classes that were participating in the Flipped Classroom at this school. A study which has a larger sample size across different grades would be beneficial in order to see if the results found in this study prove similar.

Research of how the Flipped Classroom in non-math and non-science courses would be beneficial. One of the open-ended response questions in this study asked

students if the Flipped Classroom would be effective in other educational domains. Student responses were mixed as they had only been exposed to the Flipped Classroom in Math. As the Flipped Classroom applications become more prevalent, there likely will be further opportunities to investigate the Flipped Classroom in non-traditional domains. There is a common viewpoint that the Flipped Classroom lends itself to STEM (Science, Technology, Engineering, and Mathematics) subjects but, perhaps, teachers in other areas could also find its implementation beneficial.

Students in this study suggested that the lesson videos could be more interactive. Products like TechSmith's Camtasia 8 (TechSmith, 2012) or YouTube (YouTube, 2012) allow educators to create videos that have interactive buttons and incorporate quizzes to make the viewing experience more active. As these products become more commonplace, educators may find that they greatly enhance student's Flipped Classroom experience. Further research could explore how these and other technological advances could make Flipped Classroom experiences more engaging. As a result of the student responses for an increase to interactivity I have experimented with interactive video production. Figure 5.1 below provides a screenshot of an interactive video for parents that describe different aspects of my Flipped Classroom. Parents could use the interactive buttons to access information that they were interested in rather than watching the entire length of a video.

Figure 5.1 - Flipped Classroom interactive parent information video screenshot

The Flipped Classroom can create more classroom time to provide rich, meaningful learning activities. No longer does a lesson need to be comprised of lectures and worksheets. It was found in this study that students appreciated the additional classroom time and liked the various activities that were incorporated into lessons. But what is the best use of this time to support student learning? This is a question that requires further research. Many teachers find that they have spent their entire career lecturing. Now they may have additional classroom time but are not sure what to do with it. Inquiry based labs? Communication based activities? Virtual learning communities? With the advent of new technologies and social media many options are now available for teachers to use. The best one to use, however, will likely be based on learner needs and teacher preferences.

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Appendices

Appendix A: Unit Outline

Unit 1: Sequences & Series Outline

Test Deadline: _____

1.1 – Arithmetic Sequences

- Watch Lesson Video & Complete Notes *(we'll watch in class together)* ☐
- Assignment: Pg. 7-13, #'s 1, 4, 5ac, 6, 8, 10, 13, 15, 16 ☐
- Journal prompt: What are your first impressions of the Flipped Classroom? What are the strengths and weaknesses? ☐

1.2 – Arithmetic Series

- Watch Lesson Video & Complete Notes ☐
- Assignment: Pg. 18-24 , #'s 1, 2, 5, 7ac, 9, 10, 12, 14, 18 ☐

1.3 – Geometric Sequences

- Watch Lesson Video & Complete Notes ☐
- Assignment: Pg. 35-42, #'s 3-9, 11, 15 ☐

1.4 – Geometric Series

- Quiz 1.1 / 1.2 / 1.3 *(make corrections in your journal)* ☐
- Watch Lesson Video & Complete Notes ☐
- Assignment: Pg. 48-53, #'s 1, 2, 4-7, 9, 10, 13, 16 ☐
- Journal prompt: Are you satisfied thus far with your work ethic? Why or why not? ☐

1.6 – Infinite Geometric Series

- Quiz 1.4 / 1.5 / 1.6 *(make correction in your journal)* ☐
- Watch Lesson Video & Complete Notes ☐
- Assignment: Pg. 67-73, #'s 1-5, 7, 8, 10, 13 ☐

Review

- Journal Prompt: Summarize all of the different things you have learned into a small study guide. *(This will be done at the end of each unit in your journal, ask me for help if you need)* ☐
- Review Assignment: Pg. 76-79 *(Practice Test is optional)* ☐
- Practice Test via Moodle *(make correction in your journal)* ☐
- 'Hot Seat' with Mr. Johnson
    - Once the above is completed you will schedule an in-class appointment to meet Mr. Johnson on the 'Hot Seat' to show your learning evidence and discuss your understanding of the learning outcomes from this unit. If Mr. Johnson believes you have done quality work and have a strong understanding of the learning outcomes you will then be able to write your Unit Test. If Mr. Johnson does not think your work is of high quality or you do not have a strong enough understanding you will be asked to complete some additional learning activities or improve on the work you have already completed. ☐

Write Unit Test on Moodle

- If you achieve greater than 70% on the unit test, Congratulations, you can proceed to Unit 2 -Trigonometry. If you got less than 70% on the unit test (don't worry – be happy, life will go on!) please see Mr. Johnson to discuss your results. ☐

Appendix B: Student Survey

Student Perceptions of the Flipped Classroom Survey

1. Rate each item on the scale provided to indicate your agreement.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
The Flipped Classroom is more engaging than traditional classroom instruction.	○	○	○	○	○
I would not recommend the Flipped Classroom to a friend.	○	○	○	○	○
The Flipped Classroom gives me greater opportunities to communicate with other students.	○	○	○	○	○
I like watching the lessons on video.	○	○	○	○	○
I would rather have the entire class moving at the same pace in the course.	○	○	○	○	○
I am spending less time working on traditional math homework.	○	○	○	○	○
Social Media (YouTube, Twitter, Facebook) is not an important part in my learning.	○	○	○	○	○
I regularly watch the video assignment.	○	○	○	○	○
I dislike that I can take my quizzes at my own pace.	○	○	○	○	○
I like taking my tests and quizzes online using Moodle.	○	○	○	○	○
I would rather watch a traditional teacher led lesson than a lesson video.	○	○	○	○	○
I feel that mastery learning has improved my math understanding.	○	○	○	○	○
I dislike self-pace myself through the course.	○	○	○	○	○
I find it easy to pace myself successfully through the course.	○	○	○	○	○
The Flipped Classroom gives me less class time to practice math.	○	○	○	○	○
I am more motivated to learn math in the Flipped Classroom.	○	○	○	○	○
The Flipped Classroom has not improved my learning of mathematics.	○	○	○	○	○

2. What are the advantages of the Flipped Classroom?

_____

_____

_____

_____

_____

3. What are the disadvantages of the Flipped Classroom?

_____

_____

_____

_____

_____

4. Would the Flipped Classroom be useful for other subjects? Why or why not?

_____

_____

_____

_____

_____

5. What improvements would you recommend to improve learning in the Flipped Classroom?

_____

_____

_____

_____

_____

6. Please state any other comments you wish to make about the Flipped Classroom.

_____

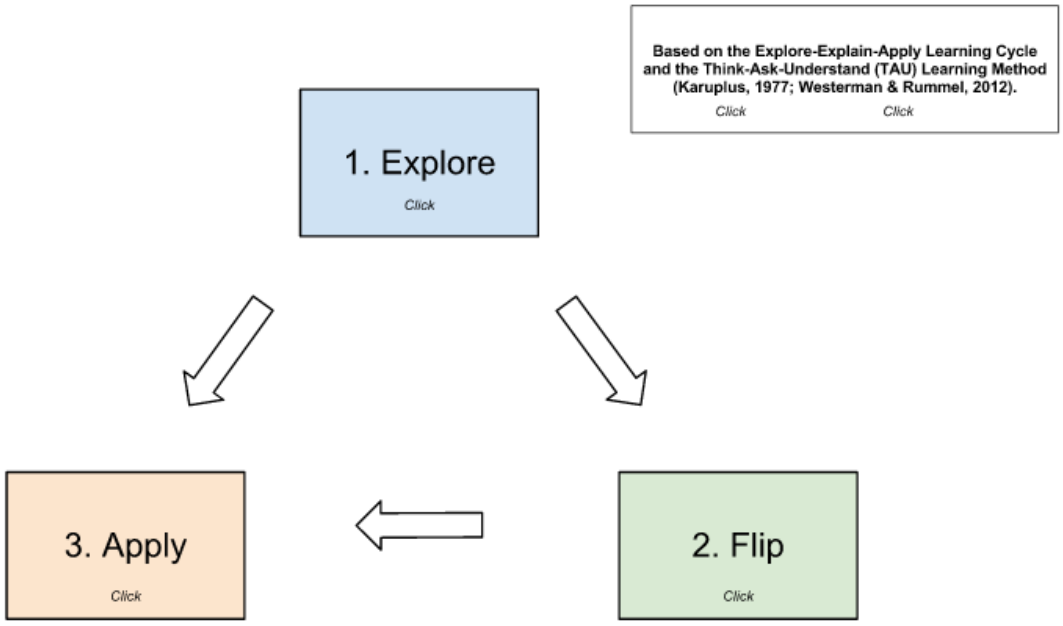
_____

_____

_____

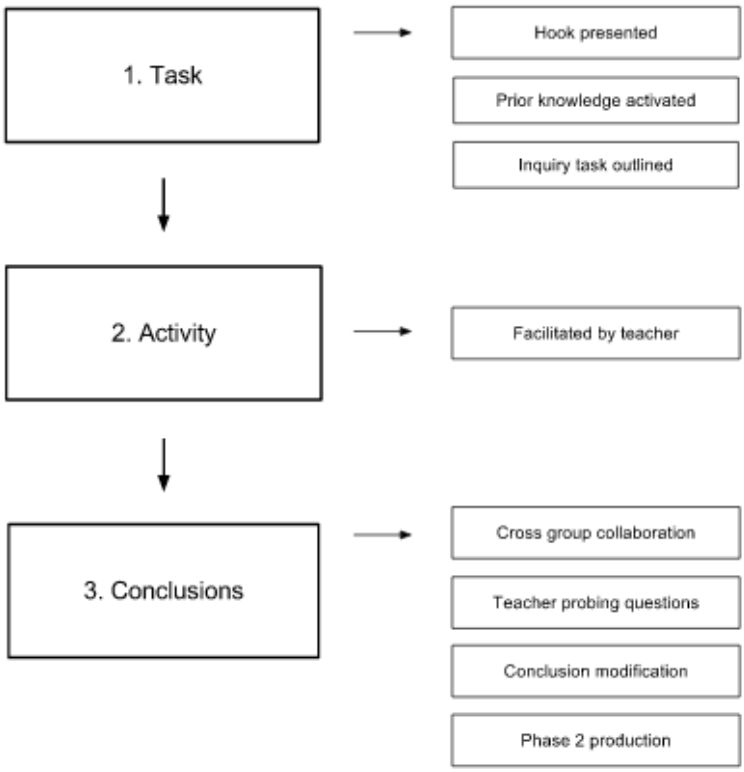
_____

Appendix C: Explore-Flip-Apply: Theoretical Framework Cycle of Learning (Musallam, 2012)



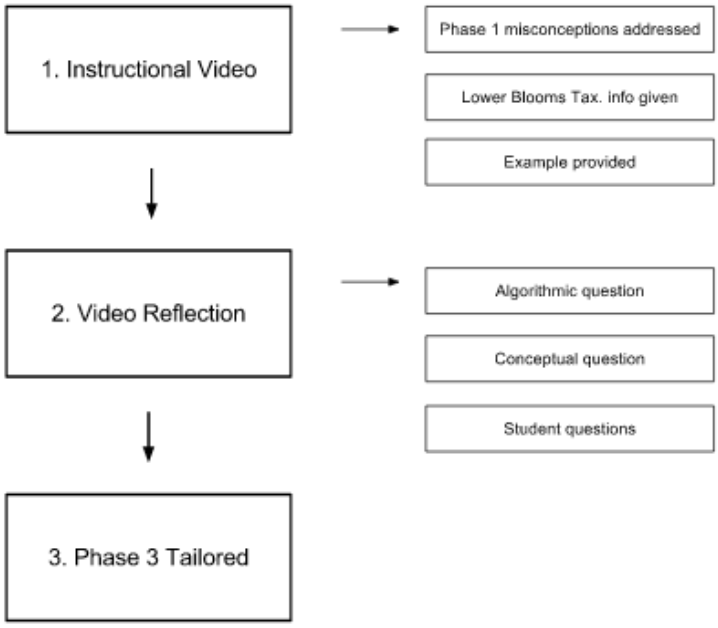
Phase 1: Guided Inquiry

Click



Phase 2: Just-In-Time Teaching (JiTT) Model Using Instructional Video (Mayer, 1997; Novak, et al., 1999)

Click *Click*



Phase 3: Peer Instruction (PI) & Application (Mazur, 1997).

Click