THE IMPACT OF FLIPPING A MIDDLE SCHOOL CLASSROOM ON STUDENT ACHIEVEMENT

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CERTIFICATION OF APPROVAL

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Dr. Dawn Poole Professor of Educational Technology	Date
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DEDICATION

This thesis is dedicated to the memory of my mother, Gloria. She taught me to have passion for what you choose to do with your life, to always be able to take care of yourself, and that there is always something to be learned. I only hope that I have inspired my own daughter, Annie Donalyn, to remain engaged and curious about the world around her and to remain a lifelong learner. Finally to my partner and best friend, Neil, without your constant encouragement, support and love this journey would not have become a reality. Thank you all!

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ABSTRACT

The purpose of this study was to determine the impact the flipped teaching model had on student achievement at the middle school level as well as examine student perception of the learning experience. Eighty-five students, 4 classes, were taught the same math material with two groups receiving instruction using the flipped model and two groups receiving instruction using the traditional classroom model. Pre- and post-assessment data were collected from each group to measure student achievement. Each class also had data collected from exit slips as well as homework scores. A survey was also administered to the flipped classes to measure students' attitudes toward and perceptions of the learning experience. The results demonstrated that the treatment group had statistically significant higher levels of achievement on exit slip scores, homework scores and the change from the pre- to post-test scores. However when controlling for existing differences between groups, no significant differences were found. The results also demonstrate that there was no interaction between treatment and English Learner (EL) status on post-test scores, exit slip scores and homework scores, but that ELs performed at lower levels than non-ELs on the post-test and homework. Results on the student survey indicated the flipped model of instruction had an overall favorable impact on student perception during the flipped classroom learning experience.

CHAPTER I

INTRODUCTION

Recent technology advancements have allowed teachers to utilize laptops, tablets, and smart phones that already appear to be in the hands of today's students, blending the interactive technologies with classroom instruction. The flipped classroom attempts to take the traditional model of the teacher being the sage on the stage–telling the student what to learn, how to learn, and what assignments to complete in order to show mastery–and "inverting" or "flipping" the instruction. The model seeks to accomplish these goals by "flipping" what traditionally has been done inside and outside the classroom by delivering rote lecture content online for students to study outside of class and use the time opened up in the classroom for learning-based activities. Students receive direct instruction at home through video lecture, podcast, or websites, swapping class time for a deeper understanding of the concept, engagement in cooperative activities and time for students to receive support as needed.

The idea of the flipped classroom has been around for over a decade. One could say the flipped classroom has been around for quite some time as English teachers have long required students to read novels before attending class, and class time is left for engaging conversation surrounding the novel. However the flipped classroom model has recently become popular as improvements in technology have allowed for the cost of technology to go down. Personal computers and related

technologies such as the tablet and mobile devices allow students access to information instantly. Students are highly deviced, networked, interactive, and social (McGlasson & Tenneson, 2006). The flipped classroom takes advantage of this availability to introduce course content outside of the classroom, with the "regular and systematic use of interactive technologies in the learning process" (Strayer, 2012, p.172).

J. Wesley Baker around 1982 envisioned the use of electronics to deliver rote material to students outside of the classroom, and began presenting his idea at conferences in the mid 90s in which he titled the method "The Classroom Flip" (as cited in Johnson & Renner, 2012). Around that same time, Lage, Platt and Treglia (2000) envisioned a similar procedure, "The Inverted Classroom", in which students would view lectures outside of class, then spend class time in small groups working on the same concepts referred to in the lecture.

In 2004 Jonathan Bergmann and Aaron Sams started working together at Woodland Park High School in Woodland Park, CO. The school where they worked was in a rural area and many student absences were seen due to athletics, illness, or students having to work while trying to attend school. Together they decided to start recording their daily Power Point lessons and posting their lessons online for students to watch. From there, Jonathan Bergmann and Aaron Sams (2009) began the flipped classroom: students watched recorded lectures for homework and completed their assignments, labs, and tests in class with their teacher available.

The flipped classroom is not just about the videos. The teacher is not replaced by videos and students are not left to work without guidance or structure. The student is not left in isolation, and the videos do not make the teacher's job obsolete. During class teachers have dialogue with students, helping students construct their own knowledge. The teacher's role becomes more of an interactive one. It is this interaction between the teacher and the student in class, along with meaningful well thought out learning activities, that occur during the face-to-face time that is most important. In 2007, Ginns and Ellis (as cited in Strayer, 2012), found when the work assigned online and the actual class time are not carefully aligned, the technology can actually become a barrier for students as they choose how fully they will invest in the learning goals of the classroom. Other research has shown that successful blended learning (i.e. flipped or inverted learning) occurs when teachers go beyond just replacing the lecture with an online event (Strayer, 2012).

Statement of the Problem

During a traditional classroom lecture many students seem to do just fine. Often times there are some students who understand quickly and are ready to move on so they may get bored and tune out, while there are other students who learn at a slower pace and could benefit from more time in class to process what was just taught. Once the lecture is complete students bring home traditional homework which they may or may not be able to complete. There may be families that are not able to help their students with the assigned homework; therefore, teachers are sending students home to an environment that does not support their learning. Students are left

to either not do the homework or simply copy from someone else. Either way the homework does not make a difference, and therefore becomes a waste of time.

Teachers try to differentiate instruction while teaching the content students need to learn. However differentiating instruction takes class time as teachers modify the content, the process or the product. At that same time the teacher needs to try to motivate all types of students to learn the material, provide feedback to the students regarding whether they have learned the material, and try to reduce the amount of time the teacher is lecturing by increasing the time students are engaged. At home students of all levels can easily move at their own pace in viewing lectures, and videos while being able to control their personal reading speed, by using the fast forward and rewind features as much as desired (Layman, 2013). Classroom time can be used more effectively and creatively. With flipped teaching, students become more actively involved in their own learning while working through higher level problems in which they can implement advanced concepts. Students become involved in collaborative learning while the teachers now have time to work individually with students.

Released in 2010, the Common Core State Standards (CCSS) are an important turning point in 21st century learning skills (California Department of Education, 2013). CCSS still include the traditional teaching of the 3 Rs – reading, writing and arithmetic; however, in order to be capable of participating in today's global community students must also master the 4 Cs – creativity, critical thinking, communication, and collaboration. "A 21st century classroom must engage and

energize both digital natives and non-digital natives, preparing all students to be active participants in our exciting global community" (Kulk, 2011, p.1). Crook (2012) reported that young people can be said to engage with the four themes of communicative practices, specifically through the use of Web 2.0 services. These themes are *collaborating*, exploring new *literacies*, pursuing *inquiry*, and they are *creating* by publishing to audiences. Learning in the 21st century is essentially learner-driven. Teachers do not need to add to the current curriculum with all of the information that can easily be found online, instructors no longer need to have students think of things, but think about them. Flipping the classroom easily allows for this switch in thinking and in teaching methods, but will it have a positive impact on student achievement?

Should teachers require students to be plugged in more than they already are? This constant and immediate access to media has students rushing to leave school where they are "un-plugged" and return home to "plug-in". Shroff and Vogel (as cited in Johnson & Renner, 2009, p.2) claimed, "it is important to look for clues as to how e-learning technologies can become powerful catalysts for change as well as tools for redesigning our learning and instructional systems." The flipped model takes advantage of this constant plug-in at home, and delivers the classroom lecture on-line. The model allows for students to communicate and collaborate on-line and then again in person as the classroom has now been cleared for critical thinking and inquiry project-based lessons in which students can work together to produce evidence of their learning incorporating the 4Cs of the 21st century learner.

The purpose of this study was to determine the impact the flipped teaching model has on student achievement and student engagement. The study also examined the perception students have of the flipped teaching model.

Significance of the Study

While the inverted classroom or flipped teaching model is a fast growing trend in education, currently there is a lack of research on the flipped classroom method both in terms of effectiveness and student achievement at the middle school level. In a recent study by Clark (2015), it was noted that research on the flipped model of instruction is still at the early stages especially at a secondary math level. Many of the studies have been single-group study designs, and explore student perception and not whether there is any academic benefit to flipping the classroom.

The easy access to technology, benefits of more class time, and popularity of smart phones, tablets, computers, iTunes and YouTube, all blended together seem to generate an environment where the flipped classroom concept may benefit student achievement. Hopefully the study will uncover some useful teaching practices for educators surrounding the flipped classroom model along with how these teaching practices relate to student achievement. In addition the research may give some insight into the perceptions of the students and discover what implications these observations may have on the classroom environment and future student motivation. As stated earlier, the flipped classroom can only begin to work when teachers go beyond just replacing the lecture with an online event (Strayer, 2012). How to

implement this change and what that means for the classroom face-to-face time is important to study if teachers begin to put into practice this inverted model.

A potential problem that may arise during the research is the fact that not all students have Internet access at home, and the flipped classroom, so dependent on technology—could end up leaving some students behind and widening the achievement gap. Understanding how this potential problem can be addressed with teachers and students is something that may be revealed through the study.

Research Questions

What effect does the flipped teaching model have on student achievement at the middle school level? How does the flipped model of instruction impact student perception of the learning experience?

Hypotheses

H_1: There is a statistically significant difference on scores from a post test at the middle school level when instruction is administered using the flipped teaching model compared to students taught in the traditional classroom.

H_2: There is a statistically significant difference on scores from exit slips administered at the middle school level when instruction is administered using the flipped teaching model compared to students taught in the traditional classroom.

H_3: There is a statistically significant difference on scores from homework at the middle school level when instruction is administered using the flipped teaching model compared to students taught in the traditional classroom.

H_4: There is a statistically significant different change in pre-test scores compared to scores from a post test when administered at the middle school level when instruction is administered using the flipped teaching model compared to students taught in the traditional classroom.

H_5: After controlling for existing differences using the pre-test scores there is a statistically significant difference on homework scores the middle school level when instruction is administered using the flipped teaching model compared to students taught in the traditional classroom.

H_6: After controlling for existing differences using the pre-test scores there is a statistically significant difference on exit slip scores at the middle school level when instruction is administered using the flipped teaching model compared to students taught in the traditional classroom.

H_7: After controlling for existing differences using the pre-test scores there is a statistically significant difference on the post test scores at the middle school level when instruction is administered using the flipped teaching model compared to students taught in the traditional classroom.

H_8: There is an interaction between treatment and EL status on post-test scores.

H_9: There is an interaction between treatment and EL status on exit slip scores.

H_{10}: There is an interaction between treatment and EL status on homework scores.

Theory

The flipped classroom requires a seamless variety of experiences that happen both outside the classroom and within the classroom environment. At home students experience direct computer-based individual instruction and then bring that knowledge back into the classroom where engaging interactive student-centered group learning experiences occur. Kolb's Experiential Learning Theory (ELT) is based on a continuum of experiences and the reflection of these experiences.

Constructivism is the source of Kolb's theory, and is called "Experiential" to emphasize how important the experience of learning is as well as the reflection of those experiences. "The term "experiential" is used therefore to differentiate ELT both from cognitive learning theories, which tend to emphasize cognition over affect, and behavioral learning theories that deny any role for subjective experience in the learning process." (Kolb, Boyatzis, Mainemelis, 1999, p. 2).

Kolb's theory is based on two continuums that intersect and create a cyclical effect; Processing and Perception. Kolb described two ways of gaining this experience, and then two ways of transforming the experience. The processing continuum or "gaining the experience" includes the "Concrete Experience (CE) and Abstract Conceptualization (AC)". The perception continuum or "transforming experiences" are "Reflective Observation (RO) and Active Experimentation (AE)." (Kolb et al., 1999, p. 3).

Moving the lecture (having the experience) and the multiple choice questions incorporated into the video experience to check for understanding (learning from the

experience) into the home of students through personal computers and tablets allows teachers to free class time for the engaging higher-level activities (trying out what was learned from the experience) as well as allows for deep conversations (reflections on experiences). The effectiveness of learning relies on the ability to balance these two continuums. The Processing Continuum is how people approach a task and the Perception Continuum is how learners feel about it.

Movement between the four modes – CE, RO, AC, and AE – should occur and can be entered at any point. Kolb stated "The concept of learning style describes individual differences in learning based on the learner's preference for employing different phases of the learning cycle" (Kolb, 2008, p.9). There are four different learning styles depending on the different approaches to learning; Diverging, Assimilating, Converging, and Accommodating (Kolb, 2008, p.10).

Students enter Kolb's Learning Cycle at different points and need to be given various opportunities to build on their own learning and a stage to apply and show what they have learned and how that learning applies to real life situations. The flipped classroom "in-class" time must be filled with real-world experiences that promote group participation and include a safe learning environment. Students need time to reflect on their personal learning experience; this could be evident in a flipped classroom using blogs, comment feeds, or even personal learning logs allowing students the experience to self reflect and analyze their own learning. The flipped classroom is fluid enough for students to enter the learning cycle where they learn

best. This allows students to experience and learn the content at home so during class time students can try out what they learn and reflect on the experience.

Definitions

Differentiated Instruction. To differentiate instruction is to recognize students' varying background knowledge, readiness, language, preferences in learning and interests; and to react responsively. (Hall, et. al., 2014, p.2)

EngageNY. Common core math curricular modules. Module 1, Math 7, Topics A and B were used during the study. (EngageNY, 2015)

Exit Slips. Formative assessment strategy used to review content information, make decisions about what students understand and what students still need to be taught. Exit slips were used during the study and administered at the end of each of the ten EngageNY lessons in module 1. (EngageNY, 2015)

Flipped Classroom. An educational technique that consists of two parts: interactive group learning activities inside the classroom, and the direct computer-based individual instruction outside the classroom. (Bishop & Verleger, 2013, p. 5)

Higher Level Problem. Higher order thinking occurs when a person takes new information and information stored in memory and interrelates and/or rearranges and extends this information to achieve a purpose or find possible answers in perplexing situations. (Lewis & Smith, 1993)

Inverted Classroom. See Flipped classroom definition.

Podcast. A program, music or talk, made available in digital format for automatic download over the Internet.

Sophia. The online learning environment used to flip the classroom in this study.

Student Engagement. The degree of attention, curiosity, interest, optimism, and passion that students show when they are learning or being taught, which extends to the level of motivation they have to learn and progress in their education.

Summary

The purpose of this study was to determine the impact the flipped teaching model had on student achievement as well as student perception of the learning experience. Chapter II contains a review of literature that examines both the learning environment of a flipped classroom environment and the instructional effectiveness of flipping the classroom on student achievement.

CHAPTER II

REVIEW OF LITERATURE

Two sections will be presented in this review of literature. The first section will look at the learning environment of a flipped classroom. The next section will focus on instructional effectiveness of flipping the classroom on student achievement.

Learning Environment

Strayer (2012) suggests in a flipped classroom the work assigned online and the actual class time must blend together seamlessly or the inverted teaching method can actually become a barrier for students as they choose how fully they will invest in the learning goals of the classroom. Strayer's research was a mixed methods comparative study of two college-level classrooms that compared a more traditional lecture-homework classroom (n=27) to a flipped classroom (n=23) that meet in a computer lab and used ALEKS (Assessment and Learning in Knowledge Spaces) to introduce content outside the classroom. Quantitatively the study gathered survey data that measured perceptions of learning environments using seven scales: personalization, innovation, student cohesion, task orientation, cooperation, individualization and equity. The survey also provided data in regard to two areas (1) students' perceptions of their learning environment and (2) students' opinions of what their ideal learning environment is. Qualitatively the study gathered data using a 4-member research team that kept field notes of student behavior in class, sound

recordings that were transcribed and analyzed, as well as conducted one-on-one and focus group interviews.

Students as a whole felt that their preferred learning environments and their actual learning environments were not measuring up. Every mean for the actual learning environment was statistically lower than the preferred learning environment within the seven scales. The study found that "students in the inverted classroom were less satisfied with how the classroom structure oriented them to the learning tasks in the course, but they became more open to cooperative learning and innovative teaching methods" (Strayer, 2012, p.5). The inverted class appreciated the in-class activities that allowed them to use the math in a real-life problem solving method. However, the students did state that it was difficult to tie together the use of the online intelligent tutoring system to the in-class activities and at times felt that the classroom environment was unpredictable and fragmented while the students in the traditional environment liked the settled nature of the class and were able to see the inter-connectedness between the concepts in the class.

Johnson (2013) focused on three high school math classes in British Columbia, Canada in a middle-to-upper class neighborhood. The study focused on what the students' (N = 63) perceptions were of the flipped classroom and whether the model supported and improved their learning. After spending four months in the flipped classroom environment a 17 five-level Likert Scale survey was administered to the students that focused on five major themes including mastery learning, pacing, time, social media and videos, and specific flipped classroom questions. In addition

there were five open-ended free response questions which provided students the opportunity to give their own feedback on the experience. The median and mode were reported and used to analyze the Likert Scale data while the five open-ended questions were coded and themes were drawn from significant similar multiple responses. The results were overwhelmingly positive in regard to the flipped classroom experience. It was found that only 7% of the students would not recommend the flipped classroom to a friend and 84% felt the flipped classroom was more engaging than a traditionally instructed classroom. Students (97%) believed their motivation had increased and 94% of the students felt like their learning of math had improved because of the flipped classroom. When students were asked how to improve the flipped classroom experience, they suggested more in-class activities and saw the value in this collaborative group work.

Devilin, Feldhaus and Bentrem (2013) suggested schools are making a shift to using technology to engage students; however there is fear that the students cannot concentrate, focus, and multi-task effectively with this constant attachment to a device. Their research employed a mixed methods approach of action research. The problem identified for the action research was based on a problem the research saw regarding middle school students in a STEM-course and how the students lacked focus and could not follow instructions at the beginning of the class. The sample included 87 students in 6 classes. Three of the classes (n=37) were given in-person instructions for a hands-on, problem-solving STEM activity, and three classes (n=50) were delivered instructions through a video. The data were collected by an

observation checklist during the activity and then after the activity each student was given a two-question survey and finally a focus group was asked seven interview questions.

The students' responses to the survey suggest there was no perceived difference in understanding the directions; however the data gathered from the observation checklist suggests otherwise. Students who received instruction via video appeared to be more on-task, more excited about the activity and did not ask as many questions as the students who received in-person instruction. The video groups completed the STEM-activity in the allotted amount of time and to the correct specifications, while the in-person instruction groups were less-likely to complete the activity.

Classroom strategies and pedagogy are constantly evolving; Vaughan (2014) wanted to highlight some of the innovations in teaching strategies guiding pre-service teachers through an introductory education course at Florida Atlantic University. During this study the researcher took second-year college students in the course An Introduction to the Teaching Profession and flipped the entire semester. Construction, engagement and implementation of the flipped classroom were all tied into three focus questions. Videos were created, 20-30 minutes in length, for each content section of the semester long course. A discussion question was embedded into each of the videos and students were required to write the questions down and respond to them on a discussion board. During class time the pre-service teachers were "given a realistic view of the teaching profession" (Vaughan, 2014, p.30) by being able to

practice, during class time, a greater number of the instructional strategies learned during the videos. Weekly journals, classroom observations and discussion board posts were reviewed and coded.

As stated earlier in Strayers (2012) research students noted themes of confusion during the flipped classroom experience. To avoid this confusion and successfully implement the flipped classroom model, Vaughan (2014) made sure to "create a clear set of instructions that were consistent throughout the semester" (pg.34), using The Learning Management System (LMS), Blackboard. The results showed many students watched videos multiple times and presented a "high-level of reflection and making connections" when posting to the discussion board (Vaughan, 2014, p.35). Students appreciated the freed class time to practice the instructional strategies (i.e. class debates, scenarios based on role playing, and small group discussions based on videos) they may use in their future classrooms and began to take ownership of their own learning and rose to the challenge of a flipped classroom.

Learning Performance

Marlowe (2012) investigated the effects of the flipped classroom on student achievement as well as on student stress levels. The study was comprised of high academic achievers (N = 19) in Year 2 of the International Baccalaureate (IB) Environmental Systems Societies (ESS) course at Dubai American Academy. The purpose of the study evolved from these students complaining about the level of homework given and the fact that there is no one to help with the homework other than their peers because in many cases the content level exceeds that of their parents.

The participants in the study either had a strong science background or a strong social science background which presented additional challenges. The researcher looked at how to differentiate the instruction by allowing for students to watch video lectures for homework and complete traditional homework in class with teacher assistance thereby reducing stress in the IB classroom.

Prior to the treatment students completed a Student Self-Reported Stress, Effort and Completion Levels Survey as well as a Term Terminate pre-assessment. During Topic 4: Conservation and Biodiversity, students watched video lectures, submitted questions regarding content from the videos and took formative quizzes after each video. The same Term Terminate was given as a post-assessment and finally students were asked to complete the survey again. Statistical methods were used to compare grades from different semesters.

Students showed an average percent change of 58% in content vocabulary. The difference in semester grades was statistically significant (N=19, p=0.02); the average increase was three points in semester grades; however when comparing science grades over the students' high school career there was no change in grades. Low performing students showed the greatest gains in grades. Results from the pre- and post-survey indicated that stress levels were less in the flipped environment versus other courses. No student stated his or her stress level higher than four, on a scale of 1-5, while other courses were ranked at a five.

The purpose of another study was to evaluate student attitudes and learning performance regarding the use of video podcasts that include worked examples of

math problems at a middle school level (Edwards & Kay, 2012). The researchers were also interested in whether there were individual differences in student attitudes and learning performance with respect to gender and grade when worked example video podcasts were used. There were three video podcasts created for this study that included six key features that the study claimed are well-researched design principles; each problem was segmented into clear steps, key elements were written down, clear visuals were used, important elements were highlighted, an engaging voice was used, and the length of the videos were kept to a minimum. A pre- and post-test was given to the middle school students (n=136) who also completed an attitude survey that included a 17 item, 5-point Likert scale, as well as one open-ended question about whether they thought they could learn using video podcasts.

In regard to student attitudes toward video podcasts, the research found that the students in this study had positive attitudes toward the worked example video podcasts and thought the pacing was appropriate. In regard to learning performance, an independent samples t-test was run and revealed that scores increased significantly for grade six ($t(29)=10.9$, $p<.001$), seven ($t(47)=15.9$, $p<.001$) and eight ($t(60)= 17.9$, $p<.001$). Finally the study showed that the podcasts were gender neutral.

Wells, Barry and Spence (2012) looked at the use of screen capture technology to deliver learning resources to their first-year engineering students within computer programming classes. Deakin University, where the research was conducted, was experiencing high failure rates (30%-38%) of these students in a required computer programming class and needed a new researched based approach

to engage students in their learning. The sample was three years worth of first-year engineering students in the required computer programming class. The class was 12 weeks (3 hours of lecture, 3 hours of practical class weekly) of lectures, plus one week of revisions and a two-week exam period. Of the students in the classes, 80% attended class on campus while the other 20% attended online only. Each student was given a voluntary SETU (Student Evaluation of Teaching) survey to be completed at the end of the course in which six statements are made and students provided a score from 0 to 5.

The first year of the study the 12 videos were created focusing on the content for that week. Each video was approximately 10-15 minutes in length, and broken into content specific components. During the first year student results on the SETU improved in the overall perception of the class, teaching approach and service being provided. However the failure rate was unchanged. For the second year adjustments were made to the videos to include more powerful video capture software, content formats and topic-development techniques were redesigned, production values were upgraded, and music and graphics during transitions were added. The results were excellent in both the second and third year of the study. The failure rate decreased by 17% for on-campus students and for online students a decrease of 32%. An unexpected result from the study was the decrease in attendance of in-class lectures from the on-campus students. These students felt that the in-class lectures provided no immediate information needed to complete tasks over what the videos tutorials did; in addition they could watch the videos 24 hours a day from anywhere.

Moravec, Williams, Aguilar-Roca, and O'Dowd, 2010 posed the question, "Will students learn material as effectively if the first exposure is moved out of the classroom and time in lecture is devoted to teaching higher-order thinking?" Participants (N = 771) were enrolled in a 10-week introductory biology class taught at the University of California, Irvine. During the study researchers replaced a small amount of material from the prior year's lectures and revamped it into two different formats. The first format was a worksheet that directed students to read a PDF document online and included questions to be answered. The second format was a narrated PowerPoint video containing knowledge level material and also required a worksheet to be complete as students were watching the video. Each lesson was called an LBL (Learn before Lecture). In both cases students were asked to scan an image or take a photo of the completed worksheet and upload the image to the professor before class.

The results of the study suggest 90% of the students uploaded the LBL assignment prior to class for the three different lectures that were flipped into Learn before Lecture activities. The final exam for the class included six questions related to the content found in the LBLs. The percentage of students who answered the six questions correctly was significantly higher (Fisher's exact test, p<.001) than the prior year (no LBLs). In addition to learning performance the study also examined learning environments. Students were asked to respond to a survey related to their experience with the Learn before Lecture Activities. Of the participants, 80% indicated that the LBLs were helpful and 73% said they watched the videos more than

one time. There was no difference in the format of LBL the students preferred; 50% indicated the worksheets were more effective and 50% said the narrated PowerPoint format was more effective.

In a more recent study, Clark (2015) looked at the effects of the flipped classroom model at the secondary math level. The researcher was concerned with the mediocre math achievement throughout the classes at the rural high school and sought to bring improvements in student engagement and performance through research. This mixed methods study included two Algebra 1 classes (N = 42) in a rural high school. The voluntary participants, 18 boys and 24 girls, were all enrolled in ninth grade regular education Algebra 1 courses and participated in the data collection process. During the seven weeks of instruction on solving and graphing systems of equations and systems of inequalities, all student participants prepared for class by "watching videos, listening to podcasts, reading articles, viewing presentations, and contemplating questions on the required topic of study" (Clarke, 2015, p. 98). The study made a point to state that alternative media (i.e. flash drives and DVDs) were made available for students without access to internet. During the flipped model implementation stage, the researcher filled class time with engaging hands-on activities, real-world applications, and independent practice. Pre- and Post- survey data were collected as well as unit-test scores and were analyzed quantitatively. The qualitative data included student interviews (N = 12) and focus groups (N = 10). The researcher kept a journal as well throughout the seven week period and included

observations, experiences, thoughts, and insights. A thematic analysis of the qualitative data was completed.

The quantitative results showed that there was not a statistical difference in performance between students taught using the flipped model compared to students in a traditional classroom. The unit test results showed similar abilities when comparing the flipped group, $M = 80.38$, $SD = 11.02$, to the traditional classroom, $M = 80$, $SD = 11.56$; $t\ (80) = 0.15$, $p = 0.44$. The Likert scale pre- and post-survey suggests overall satisfactory student perception with both the traditional and flipped classrooms, thus revealing minimal variations between the two delivery approaches. The survey did suggest students were more engaged and more involved in the flipped model of instruction, 80%, when compared to the traditional delivery approach, 76%. The qualitative data showed the flipped model of instruction improved the quality of instruction according to several themes that were revealed through analyses: active engagement and learning, class time and structure, quality of instruction, collaboration, and communication.

Summary

The review of literature presented in this section examined the learning environment of a flipped classroom as well as the instructional effectiveness of flipping the classroom on student achievement. The review included research from four college classes, 3 high school classes and 2 middle school classes. This current research studied the impact the flipped teaching model had on student achievement as well as student perception of the learning experience at the middle school level.

CHAPTER III

METHODS

The purpose of this study was to determine the impact the flipped teaching model had on student achievement as well as student perception of the learning experience. Four groups of students were taught the same material with two groups receiving instruction using the flipped model and two groups receiving instruction using the traditional model. The results of pre-test scores, post-test scores, exit-slip scores and homework scores were used as a comparison between the treatment groups and the control groups.

Sample

For this study the sample population consisted of 85 students all enrolled in a 7^{th} grade mathematics course. The students were from a school district located in California's Central Valley. The district is located in a Census Designated Place (CDP), with a total population of 13,722 people in 2010 (City-Data, 2014). This CDP population in 2013 included an ethnic distribution of Hispanic (48%), White (43%), Asian (6%), African American (2%) and other (1%) (City-Data, 2014).

The district's student population for the 2012-2013 school year was 2,602 (California Department of Education, 2014). The population included Hispanics (60%), White (26%), African American (3%), and Asian (3%). Other ethnic groups were at one percent or below. Approximately 57% of students were classified as socioeconomically disadvantaged. The district has three elementary schools, one

independent charter school, and one middle school (California Department of Education, 2014).

The sample population for this study included four math classes from the middle school. During the 2013-2014 school years the middle school had a total population of 919 students and included Hispanic (56%), White (28%), African-American (5%), Asian (3%), and Filipino (2%) students, with the other ethnic groups at one percent or below (California Department of Education, 2014). Students who had been classified as Limited English Proficient made up 14% of the population and the average math class size was 31 students (California Department of Education, 2014).

Four, 7th grade, math classes were chosen randomly by a roll of the dice to participate in the study. Two of the classes were the control group (n=40) and two of the classes were the treatment group (n=45). The control group included 18 EL students while the treatment group included 20 EL students.

Procedure

This quasi-experimental study examined the impact the flipped teaching model had on student achievement in a 7th grade middle school classroom, as well as explored the impact the flipped teaching model had on student engagement and perception of the classroom environment. Permission was obtained from the Institutional Review Board (IRB) as well as approval from the school district and the site administration.

The study was conducted during the first trimester of the 2014-2015 school year, for a total length of 16 weeks. Each class met four days weekly for 54 minutes and one day for 39 minutes (excluding any rallies or assemblies; however each class was affected the same way by exceptions). Pre- and Post-Assessment data were collected from each group to measure student achievement. Each class also had data collected from each lesson quiz as well as homework scores. All classes used the same material; Engage NY. A survey was also collected from each flipped class to measure students' attitudes and perception of the learning experience.

A pre-assessment from Engage NY- Module 1-Topic A, was administered to each group. The test was graded on a 4-point rubric for each question. The control group was taught in the traditional sense. The teacher lectured during class time, while students took notes. Traditional homework was assigned according to the Engage NY guidelines, and corrected the next day in class. Students in both groups were instructed how to complete the class notes prior to the first flipped lesson. The treatment group watched video lectures and answered practice problems at home using a home PC, tablet, or Smartphone while taking the same set of structured class-notes as the control group. After watching the video lecture students were then instructed to answer practice problems that gave immediate feedback whether the answer was correct; three items correct in a row suggested mastery. Then in class the treatment groups were involved in interactive group-based problem solving activities as well as completing the same homework as the control group, but within the classroom setting.

An example of an interactive group-based problem solving activity for the flipped group included being given a proportional relationship real-world problem to solve and as a group students created a Google Slide presentation that included four slides: the problem, a function table, a graph, and an explanation of the results. Each slide needed to include a graphic as well. During this activity students were able to apply the mathematical strategies learned during video lectures as well as use 21st Century skills to create a presentation that was then presented to their peers.

At the end of each lesson from Engage NY- Module 1, was a formative exit-slip that was administered and collected. A rubric was used to grade each quiz and data were collected on these scores for each class. At the end of the Engage NY- Module 1 – Topic A a post-assessment (the exact same as the pre-assessment), was then administered to each group. The test was graded on a 4-point rubric for each question and data were collected for each post test score. There was a total of three questions on the exam; however question–3 had five sub parts making the final test score of 28 possible points. Finally a survey was also administered to each group measuring how they perceived the class environment.

Instruments

To test the effect on student achievement when instruction is administered using the flipped teaching model a pre and post test were administered to participants. To calculate the instrument reliability over time student participants (n = 33) from the prior school year were administered the test, and then three weeks later the same participants (n = 33) were given the same test. The results were run through the

Statistical Program for the Social Sciences (SPSS) software. The test-retest correlation coefficient (r (31) = .82) for the exam suggests that participants generally responded in a similar fashion both times they took the test. In addition a group of five middle school math teachers were in consensus that the test was accurate and covered the Common Core Standards (California Department of Education, 2013); 7.RP.1, 7.RP.2, 7.RP.3, taught during the Engage NY- Module 1.

In addition to student achievement the study looked at student perceptions of the flipped classroom environment and how that instruction model impacted their learning experience. To gather additional data for the study a 15 item five-level Likert Scale survey focused on five major themes including video lectures (4 items), platform (sophia.org) (4 items), flipped classroom method (4 items), achievement (4 items), and classroom environment–flipped vs. traditional (4 items) as well as one open-ended response. After the overall five major themes were decided, four questions were written under each content area. Next a group of four teachers was gathered to help identify whether the content of the survey was valid. After several revisions were made the survey was validated by the panel of experts and later distributed to students using Qualtrics.

Data Analysis

The quantitative data gathered regarding student achievement and student perception of the flipped classroom were entered into the Statistics Package for the Social Sciences, v. 21.0. An alpha level of .05 was used for all analyses. Independent samples *t*-tests were run to show the effect instruction had on post test scores, exit slip

scores, homework scores, and the change from pre-test scores to post test scores when instruction was administered using the flipped teaching model compared to students taught in the traditional classroom. ANCOVAs were run to compare the post–test, exit slip scores, and homework scores between students in both groups; the pre-test scores were used as the covariate. The means and standard deviations were reported as were the *F* and *p* values. Two-way analyses of variance were run to show if there was an interaction between treatment and EL status on post-test, exit slip scores, and homework scores.

Finally data from the survey were collected and the means and standard deviations were reported for each item.

Summary

This chapter presented information about the sample, procedure, instruments, and data analyses used in this study. The results of student scores on the pre-test, post-test, exit slips, and homework were recorded for each group of students. All students were taught by the same material all students completed the same homework and took the same exit slips, and tests regardless of the group they were in. All data were entered into SPSS for analysis. Qualtrics was used to gather student survey data and a statistics report was run in SPSS. Chapter IV presents the results of the study.

CHAPTER IV

RESULTS

The purpose of this study was to determine the impact the flipped teaching model had on student achievement as well as student perception of the learning experience. Scores from a pre-test, a post-test, several exit-slips and homework were collected. After experiencing the flipped model of instruction the students also participated in a voluntary survey assessing the models impact on their learning experience. Results are reported in this chapter.

Findings

Research Question 1

What effect does the flipped teaching model have on student achievement at the middle school level?

H_1: There is a statistically significant difference on scores from a post test at the middle school level when instruction is administered using the flipped teaching model compared to students taught in the traditional classroom.

Table 1 shows the effect instruction had on post test scores, exit slip scores, homework scores, and the change from pre-test scores to post test scores when instruction was administered using the flipped teaching model compared to students taught in the traditional classroom.

An independent samples *t*-test was run using SPSS and revealed that post test scores (t (43) = -.49, p =.625) were not statistically significant. There was no

statistical difference in the mean scores from the control group (M = 20.73) and the treatment group (M = 21.37).

H_2: There is a statistically significant difference on scores from exit slips at the middle school level when instruction is administered using the flipped teaching model compared to students taught in the traditional classroom.

An independent samples *t*-test was run and revealed that when examining exit slip scores (t (38) = -2.12, p =.037) there is a statistically significant difference in the mean scores from the control group (M=48.45) and the treatment group (M = 53.37).

H_3: There is a statistically significant difference on scores from homework at the middle school level when instruction is administered using the flipped teaching model compared to students taught in the traditional classroom.

An independent samples *t*-test was run and revealed that when examining homework scores (t (40) = -2.71, p =.008) there is a statistically significant difference in the mean scores from the control group (M = 283.89) and the treatment group (M = 335.75).

H_4: There is a statistically significant difference on scores from pre-test scores compared to scores from a post test when administered at the middle school level when instruction is administered using the flipped teaching model compared to students taught in the traditional classroom.

An independent samples *t*-test was run and revealed that the change in scores from a pre-test compared to scores from a post-test was not statistically significant (t (43) = 1.62, p =.110) based on treatment. There was no statistical difference in the

mean change from the control group (M = 14.57) and the treatment group (M = 12.33).

Table 1

Effects of Student Achievement Using the Flipped Teaching Model Compared to Students Taught in the Traditional Classroom

	N	*M*	*SD*	*t*	*p*
Post Test, Treatment	43	21.37	5.49	-.49	.625
Post Test, Control	37	20.71	6.22		
Exit Slips, Treatment	38	53.37	6.77	-.12	.037
Exit Slips, Control	33	48.45	12.25		
Homework, Treatment	40	335.75	76.27	-.71	.008
Homework, Control	36	283.89	90.75		
Change from Pre to Post; Treatment	43	12.33	5.74	1.62	.110
Change from Pre to Post, Control	37	14.57	6.67		

H_5: After controlling for existing differences using the pre-test scores there is a statistically significant difference on homework scores at the middle school level when instruction is administered using the flipped teaching model compared to students taught in the traditional classroom.

A one-way analysis of covariance (ANCOVA) was run. There was no statistical difference, $F(1, 77) = .156$, $p = .694$, on the adjusted mean scores from the post test when instruction was administered using the flipped teaching model

compared to students taught in the traditional classroom after controlling for existing differences using the pre-test scores. Table 2 shows the results.

H_6: After controlling for existing differences using the pre-test scores there is a statistically significant difference on exit slip scores at the middle school level when instruction is administered using the flipped teaching model compared to students taught in the traditional classroom.

An ANCOVA was run. Table 2 shows there was no statistical difference, $F(1, 68) = 1.30$, $p = .259$, on the adjusted mean scores from the exit slips when instruction was administered using the flipped teaching model compared to students taught in the traditional classroom after controlling for existing differences using the pre-test scores.

H_7: After controlling for existing differences using the pre-test scores there is a statistically significant difference on the post test scores at the middle school level when instruction is administered using the flipped teaching model compared to students taught in the traditional classroom.

A one-way analysis of covariance was run. Table 2 shows there was no statistical difference, $F(1, 73) = 2.60$, $p = .111$, on the adjusted mean scores from homework when instruction was administered using the flipped teaching model compared to students taught in the traditional classroom after controlling for existing differences using the pre-test scores.

Table 2

Effects of Student Achievement Using the Flipped Teaching Model Compared to Students Taught in the Traditional Classroom after Controlling for Existing Differences Using the Pre-test Scores

	n	M_{adj}	*SD*	*F*	*p*
Post Test, Treatment	43	21.37	5.49	0.16	.694
Post Test, Control	37	20.84	6.22		
Exit Slips, Treatment	38	52.32	6.77	1.30	.289
Exit Slips, Control	33	49.66	12.25		
Homework, Treatment	40	325.05	76.27	2.60	.111
Homework, Control	36	295.78	90.75		

H_8: There is an interaction between treatment and EL status on post-test scores.

A two-way analysis of variance was run. Table 3 shows there was no significant interaction, F (1, 76) = 1.28, p =.261, between treatment and EL status on post-test scores. However, there was a significant effect for EL status, F (1, 76) = 5.18, p = .026. There was a significant effect in the mean change when controlling for post-test scores between EL (M = 19.46) and Non-EL (M = 22.47).

H_9: There is an interaction between treatment and EL status on exit slip scores.

A two-way analysis of covariance was run. Table 3 shows there was no significant interaction, F (1, 67) = .002, p = .962, between treatment and EL status on exit slip scores.

H_{10}: There is an interaction between treatment and EL status on homework scores.

A two-way analysis of variance was run. Table 3 shows there was no significant interaction, F (1, 72) = .559, p = .457, between treatment and El status on exit slip scores. However there was a significant effect for EL status, F (1, 72) = 8.13, p = .006. There was a significant effect in the mean change when controlling for homework scores between EL (M = 284.73) and Non-EL (M = 336.28).

Table 3

Interaction between Treatment and EL Status on Post-Test Scores, Exit Slip Scores and Homework Scores

	n	*M*	*SD*	*F*	*p*
Post Test, EL	20	19.46	6.04	1.28	.261
Post Test, Non-EL	23	22.47	5.29		
Exit Slips, EL	16	48.70	10.52	.002	.962
Exit Slips, Non-EL	17	53.16	9.11		
Homework, EL	17	284.73	100.40	.559	.457
Homework, Non-EL	19	336.28	63.41		

Research Question 2

How does the flipped model of instruction impact student perception of the learning experience?

Table 4 shows the results from a 20 item five-level Likert Scale survey which focused on five major themes as well as one open-ended response. The table is organized from the highest mean down to the lowest mean. The results indicated that 19 of the 20 means ranged between 4.08 and 3.10, with higher values indicating more favorable responses. The highest mean, $M = 4.08$, $SD = 1.01$, was for the survey item: The teacher was clear and easy to follow in the videos. The lowest mean, $M = 1.97$, $SD = 1.13$, was for the survey item: Parents, guardians and siblings watched the video lectures as well. See *Appendix A* for the complete survey.

Table 4

How the Flipped Model Impacts Student Perception of the Learning Experience

Item	*M*	*SD*
The teacher was clear and easy to follow in the videos.	4.08	1.01
The flipped classroom is more engaging than the traditional class.	3.95	1.11
I liked watching the lecture videos.	3.93	1.03
I felt the multiple choice quizzes provided were helpful.	3.84	1.07
I felt the Google forms provided were helpful.	3.84	1.04
I felt the questions provided during the Sophia video lectures were helpful.	3.83	0.98
A flipped classroom is more interesting and likeable than a traditional classroom.	3.82	1.17

I work on math problems during class time with other students in my math class.	3.75	1.03
I would recommend the flipped classroom to a friend.	3.74	1.02
I am confident in my math abilities.	3.67	1.11
The flipped classroom gives me greater opportunities to communicate with other students compared to a traditional class.	3.66	1.16
I felt there were clear and well-defined instructions for the flipped activities.	3.66	1.09
I felt there was a clear connection between in class activities and online activities.	3.61	0.96
The flipped classroom has improved my learning and understanding of math.	3.51	1.12
I am more motivated to learn math in the flipped classroom than in a traditional classroom.	3.48	1.11
In a flipped classroom I am more willing to discuss math concepts with my peers than in a traditional classroom.	3.29	1.11
I feel the flipped classroom has improved my ability to work in groups and pairs.	3.27	1.13
I watched the video lectures more than one time.	3.25	1.28
I spent more time completing Sophia lessons than I did traditional homework.	3.10	1.30
Parents, guardians and siblings watched the video lectures as well.	1.97	1.10

Summary

Post test data, exit slip data, homework data, and the change from pre to post data were used to research the effect of the flipped teaching model on student achievement at the middle school level. The results of the statistical analyses

demonstrated that when examining exit slip scores, homework scores and the change from the pre to post test scores, there was a statistically significant difference in the mean scores between the control group and the treatment group, with the treatment group having higher levels of achievement. However when additional statistical analyses were run to control for existing differences using the pre-test scores no statistical differences were found. The results also demonstrate that there was no interaction between treatment and EL status on post-test scores, exit slip scores and homework scores, but that ELs performed at lower levels than non-ELs on the post-test and homework. Results for the voluntary student survey were also included and indicated the flipped model of instruction had an overall favorable impact on student perception of the learning experience. The Chapter V presents a discussion and recommendations for further research of this topic.

CHAPTER V

DISCUSSION AND RECOMMENDATIONS

The results of this study will help teachers understand the effect the flipped teaching model has at the middle school level in regard to both student achievement and student perception of the flipped learning experience. This study will help assist teachers in determining whether the flipped teaching model is a method worth implementing in their own classrooms.

Summary of Results

The student data analyzed in the previous chapter included post test scores, exit slip scores, homework scores, and the change from pre-test scores to post test scores. They were used to compare results when instruction was administered using the flipped teaching model versus when students were taught using traditional classroom methods. Results from these analyses were used to research the effect the flipped teaching model had on student achievement. Finally a 20 item five-level Likert Scale survey which focused on five major themes as well as one open-ended response was used to analyze how the flipped model of instruction impacted student perception of the learning experience.

Research hypotheses examining the mean scores on the post test and scores from pre-test scores compared to scores from a post test (H_1, H_4) were tested using an alpha level of .05. Independent *t*-tests were not significant, $t\ (43) = -.49$, $p = .625$ and $t\ (43) = 1.62$, $p = .110$ respectively.

Research hypotheses examining the mean scores on the exit slips and scores from homework ($H_{2,}$ H_3) were tested using an alpha level of .05. Independent *t*-tests were significant, t (38) = -2.12, p =.037 and t (40) = -2.71, p =.008 respectively, with students in the flipped classroom scoring higher than those in the traditional classrooms.

Research hypotheses examining the mean scores on the post test, homework, and exit slips, after controlling for existing differences using the pre-test scores (H_5, $H_{6,}$ $H_{7)}$, were tested using an alpha level of .05. A one-way analysis of covariance (ANCOVA) was run for each hypothesis. There was no statistical difference, F(1, 77) = .156, p =.694; F(1, 68) = 1.30, p =.259; and F(1, 73) = 2.60, p =.111 respectively on these scores at the middle school level when instruction was administered using the flipped teaching model compared to students taught in the traditional classroom.

Research hypotheses examining the interaction between treatment and EL status on post-test scores, exit slips scores and homework scores were tested using an alpha level of .05. A two-way analysis of variance was run for each hypothesis. There was no significant interaction between EL status and post-test scores, F (1, 76) = 1.28, p =.261, between EL status and exit slip scores, F (1, 67) = .002, p = .962, and between EL status and homework scores, F (1, 72) = .559, p = .457. However there was a significant effect for EL status on post-test scores, F (1, 76) = 5.18, p = .026 and homework scores, F (1, 72) = 8.13, p = .006, with ELs scoring lower than non-ELs

Finally student perceptions of the learning experience were examined using a 20 item five-level Likert Scale survey. The results indicated that 19 of the 20 means ranged between 4.08 and 3.10, with higher values indicating more favorable responses.

Discussion

The analysis of the data collected examining the effect instruction had on post test scores, exit slip scores, homework scores, and the change from pre-test scores to post test scores when instruction was administered using the flipped teaching model compared to students taught in the traditional classroom revealed that post test scores and change from pre-test scores to post test scores showed no statistical significance while exit slips scores and homework scores revealed an advantage for the flipped learning group. However after controlling for existing differences using the pre-test scores, results revealed there was no statistically significant difference in any of the categories when instruction was administered using the flipped teaching model compared to students taught in the traditional classroom. These results could have been caused by any number of reasons.

The flipped classroom is a new concept for many educators; the idea of putting the traditional lecture in digital form and having students access that from home is almost scary both for teachers and students. The traditional lecture given in a classroom is a concept teachers have depended on for years to disseminate information to students, yet has been shown repeatedly in educational literature to be ineffective.

During the research the treatment group watched video lectures and answered practice problems at home using a home PC, tablet, or Smartphone while taking the same set of structured class notes as the control group. After watching the video lecture students were then instructed to answer practice problems that gave immediate feedback whether the answer was correct; three items correct in a row suggested mastery.

This entire process has a learning curve for all involved. The researcher, who was also the classroom teacher, had to process not only how to make a video and get it online, but the video lecture itself had to be an effective lecture that covered the same material as the traditional class, while keeping the flipped students interested enough to stay focused in a home setting filled with possible distractions. The survey administered to the participants suggested that the videos were clear and easy to follow ($M = 4.08$) and that the students liked watching the videos ($M = 3.93$).

However a limitation to this study was that there was no accountability for students to actually view the video. It was initially thought this would be combated by requiring the same set of notes for the flipped learners that were required in the traditional class room; each time a video lecture for a lesson was assigned, notes were checked the next day. Also a Google form with fillable answers regarding the lecture needed to be complete before the next class, as well as a set of multiple choice questions within Sophia.org in which students needed to get three questions correct in a row to show mastery. Both sets of questions could be checked immediately and the researcher knew before students walked in the room whether these were complete.

Nevertheless, some of the middle school participants found a loop hole. It was that students were not actually watching all the videos and were simply copying the lecture notes from their peers. Marlowe (2012) found "several students would watch the videos but would not retain much information because they were not actively engaged in the viewing and learning process" (pg. 22). While the current research required questions to be answered to show content knowledge many students when answering the multiple choice questions just kept clicking the answer choices until they figured out the correct answers and could then "show mastery". These multiple attempts could be seen through the teacher side of Sophia.

A suggestion is to use a tool like EdPuzzle that now allows users to embed questions directly into a video requiring the viewer to answer the questions before watching the rest of the video. This concept would at least force the students to watch the video in its entirety. Even though the participants felt that the Google forms, and multiple choices questions were helpful (M = 3.84), embedding the actual questions into the video would hold more accountability and possibly require the students to have to rewind the videos and re-watch certain sections to find the correct response.

To hold middle school students responsible for their own learning, not just passively sitting in a classroom is tough in a traditional classroom; now try flipping that instruction. Not much research has been conducted at the middle school level in regard to the flipped classroom. Edwards and Kay (2012) looked at showing a 5-minute video podcast one time to middle school students and then examined learning performance. This current research was over a 16 week period and included 10

lessons. Holding students accountable to go back and check their work to see why they missed a problem is tough enough in a traditional setting, but requiring them to watch a video at home, try and understand the material, and be ready for discussion and application the next day is a huge undertaking at this age. The videos used in this research may have lacked the engagement needed to invoke the perseverance and retention that these middle school students lack. Even though the 5-scale Likert survey revealed the top mean ($M = 4.08$) was for the statement "The teacher was clear and easy to follow in the videos" and secondly "I liked watching the videos" ($M = 3.93$). This research also showed the videos–or learning–did not appear to be important or engaging enough to some students at this age as it was discovered the videos were not viewed by some students and that notes were merely copied from peers. This same behavior of just "copying" notes is seen in the traditional class as well as students are not really listening to the teacher but just copying the math steps.

The quality of note-taking was different between the two classes as well. The traditional classroom had the teacher walking around making suggestions and corrections to the students' math notes to help combat any mathematical misconceptions, along with neatness of math notes (i.e. how to show correct steps during a math problem; spacing). For the flipped classroom students' notes were already completed when they arrived to class ready for the planned activity. During the flipped class time activities the teacher would refer to the students' notes and many times the notes were illegible and students were not sure what the notes were referring to. This suggests they only "copied" the notes from the video without

actually trying to learn the material. In the traditional class the teacher could "pause" the lecture and ask leading questions, make suggestions or steer the lecture in a different direction if needed.

The results revealed that exit slips scores and homework scores showed an advantage for the flipped learning group. The homework scores in both classroom settings were given for completion, not correctness. The fact that the flipped classroom had higher homework scores shows that these students were more willing to complete homework by watching the video lectures and completing the online quizzes. Homework credit was given if notes and quizzes were completed before class, while the traditional class received credit for homework completion if they completed a set of traditional homework problems. While it was mentioned above that some of the students were found to be copying other students' notes and possibly not watching some of the videos, it is not know how many students actually did this. It is also important to remember both sets of classes took notes.

The possible explanation for the higher exit slip scores could be that the flipped classroom was exposed to more test-question type problems through the online quizzes and Google forms. The 5-scale Likert survey revealed a mean of 3.84 for both statements "I felt the multiple choice quizzes provided were helpful" and "I felt the Google forms provided were helpful". The traditional class never saw these types of questions. It may have been the question types or the process of watching the video, taking notes, and receiving immediate feedback regarding whether or not students understood the concept. This could be a possible further research question.

It is important to note that if students in the flipped classroom did not have access to computers or internet at home that they were able to access the videos through the school library or students could come into the classroom before school, after school or during their lunch hour. There was a Chromebook cart and a wireless network available in the classroom and library. The lack of computer and internet did not seem to present a problem to any of the participants except one student. It was found that this student was using the family's 4G limited data plan to watch the videos because wireless was not available in the home; the parents were concerned for the rising costs for going past the data plan's limits. Fortunately this was discovered early and the student came into the classroom from then on to use the wireless network. The traditional class students could come in during those hours as well for help on their homework problems.

There was a significant effect for EL status in the mean change from pre=test to post-test scores, (EL M = 19.46 and Non-EL M = 22.47) and homework scores (EL M = 284.73 and Non-EL M = 336.28). One of the potential strengths of flipping instruction is that while students watch the video at home the controls are at their fingertips. If students need to pause and rewind the lecture, that can be done as many times as necessary. Struggling students can watch the video numerous times and the higher level students can work at their own pace. This autonomous control could be a potential advantage for all students involved but especially the EL students even though results here did not provide this extra support for ELs.

By watching the videos before the classroom lesson ELs, as well as all students, have been exposed to new vocabulary and background information. Flipped instruction gives ELs time to watch the video at their own pace, process the new concept and vocabulary at their own pace, and then interact with their peers during class. In a traditional classroom the teacher controls the pace and this is troublesome for many different types of learners. The flipped model could help the ELs create a more interactive student centered environment within the flipped classroom. It was noted in the 5-scale Likert survey that "The flipped classroom gives me greater opportunities to communicate with other students compared to a traditional class (M = 3.66) and "I work on math problems during class time with other students in my math class" (M = 3.75). The flipped classroom appears to maximize the opportunities for ELs to speak English in class and for them to use academic vocabulary.

Recommendations

Further research might include a more blended environment, one in which the video, with embedded questions, is watched right in the classroom with the teacher. This way any immediate questions could be answered and students could work at their own pace. Then once the video was watched, questions answered, and notes were checked, students could move on to an engaging classroom activity in which the newly learned concept was applied to a real-world mathematical activity in which they have to apply the math.

Math is an extremely tough subject to teach, students are apprehensive about the subject to begin with, and then to hold them accountable to learn the material at

home on their own so they can apply it in the classroom to real-life situations is even tougher. Marlowe (2012) conducted research at the high school level by flipping her high school IB Environmental Systems and Societies course and questioned whether this model would work with less motivated and less mature students; "the flipped model with younger students would need more rules and accountability" (pg. 21).

Dan Meyer (TED Talk, 2010), a leader in mathematical education and an advocate for better math instruction has stated math students lack initiative, perseverance, retention, have an aversion to word problems and are eager for a formula. He has created a series of Three Act math problems that start in video form and pose a question in the first act (video), then the second act (video) provides more necessary information to complete the problem and finally the third act is the solution. Further research could be conducted on the types of videos students watch. For example if the videos that were watched at home were not "instructional" videos on specific concepts but rather more problem-based videos to spark that initiative students seem to lack, maybe they would be more willing to learn the concepts. After watching the first act of these three-act type videos students could return to class with ideas of how to approach the real-life problem from the video; what would be the information needed to move forward in the problem, what other problems could stem from that initial video. The videos used in this research may have lacked the engagement needed to invoke the perseverance and retention that these middle school students lack.

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APPENDIX

APPENDIX

THE FLIPPED CLASSROOM SURVEY

For each question below circle the response that best characterizes how you feel about the statement

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
The following questions are regarding the sophia.org lessons present to you during the flipped lessons.					
1. I felt the questions provided during the Sophia video lectures were helpful.	1	2	3	4	5
2. I felt the Google forms provided during the Sophia video lectures were helpful.	1	2	3	4	5
3. I felt the multiple choice questions provided during the Sophia video lectures were helpful.	1	2	3	4	5
4. I spent more time completing Sophia lessons than I did completing traditional homework.	1	2	3	4	5

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
The following questions are regarding the videos presented to you during the flipped lessons.					
5. I liked watching the lecture videos	1	2	3	4	5
6. Parents, guardians, or siblings watched the video	1	2	3	4	5

lectures as well.					
7. I watched the video lectures more than one time.	1	2	3	4	5
8. The teacher was clear and easy to follow in the video.	1	2	3	4	5

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
The following questions are regarding your involvement in the flipped classroom.					
9. The flipped classroom is more engaging than traditional classroom instruction.	1	2	3	4	5
10. I would recommend the flipped classroom to a friend	1	2	3	4	5
11. The flipped classroom gives me greater opportunities to communicate with other students compared to a traditional class	1	2	3	4	5
12. I felt there were clear and well-defined instructions for the flipped activities	1	2	3	4	5
	1	2	3	4	5

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
The following questions are regarding your performance in the flipped lessons.					
13. The flipped classroom has improved my learning and understanding of math	1	2	3	4	5
14. I am more motivated to learn math in the flipped classroom than in a traditional class	1	2	3	4	5

environment					
15. I feel the flipped classroom has improved my ability to work in groups and pairs.	1	2	3	4	5
16. I am confident in my math abilities.	1	2	3	4	5
	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Flipped Classroom Versus a Traditional Classroom.					
17. I felt there was a clear connection between in-class activities and on-line activities.	1	2	3	4	5
18. In a flipped class I am more willing to discuss math concepts with my peers than in a traditional class.	1	2	3	4	5
19. The flipped class room is more interesting and likable than a traditional classroom.	1	2	3	4	5
20. I work on math problems during class time with other students in my class	1	2	3	4	5